LMS DESIGN INTERVENTIONS FORENHANCING THE INTENTION TO CONTINUE USE

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A thesis submitted in partial fulfilment of the
requirements of the University of Westminster
for the degree of Doctor of Philosophy

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May 2021

Acknowledgement

In the name of God, the most gracious, the most merciful. By completing this work, I am deeply grateful to my Director of Study Dr Li Jin for her continued support and wisdom advice and for always believing in me throughout this journey. Dr Li's innovative suggestions and thoughtful recommendations were always the anchors of this research. I am grateful to my second supervisor Dr Alan Porter for his valuable inputs and for enlightening the multi-disciplinary aspect of this research. Moreover, I would like to express my sincere gratitude to Dr Andrzej Tarczynski for the time, support, and mentoring he provided me during my entire research years.

I would like to recognise the unfailing support that I have received from my family; Alya, Haidar, and Abdullah. This work would not be completed without my loving husband (Hussam Hassan), my boys (Mohamad and Abdolrahamn), and dear Zainab Al-Rawi. Finally, for all those whom I passed by and captured some of their lights.

This work is dedicated to the purest and most precious love in my life, my mother (Malak), and my father's soul (Ibrahim).

Abstract

Learners, according to the literature, believe that the use of a Learning Management System increases self-regulated behaviour, but even so, a significant number of them have no positive intention to use one. The goal of this thesis is to investigate this mismatch and to propose and test the use of Perceived Learning Self-regulation and Perceived Cognitive Absorption as predictors of the intention to use an LMS and to design and test interventions that improve the Continued Intention to Use an LMS that enhances Perceived Learning Self-Regulation and Perceived Cognitive Absorption.

Three intervention tools were designed on a theoretical basis and then implemented: herd behaviour was the basis for Tracking Technology, goal setting was the basis for Visualised Competency, and social learning theory was the basis for Social Media. The intervention designs were based on data from interviews, focus group discussions and online collaboration with 10 teachers. They were implemented on a computer science module with 400 registered students. Two questionnaires were circulated to examine the effects of these interventions on the PLSR, PCA and CIU (151 students) and assess their opinions (149 students).

All three interventions increased students' perceived cognitive absorption and perceived learning self-regulation and increased their continued intention to use a learning management system. Moreover, perceived cognitive absorption was found to be a critical antecedent to perceived learning self-regulation, which plays a mediating role between perceived cognitive absorption and their continued intention to use a learning management system. The survey analysis reported a positive perception overall among the students of the proposed interventions and the LMS with the given technology. Interaction analysis showed the continuous and consistent use of the intervention by the learners.

The main contribution to knowledge here is a new framework for interventions that can improve students perceived cognitive absorption and thereby their continued intention to use an LMS. This research integrated the theories of experience flow, self-regulation, herd behaviour and goal setting to explain the potential effects of tracking technology, visualised competency, and social media on the perceived learning self-regulation and perceived cognitive absorption, which improved the continued intention to use a learning management system.

According to the Information System Success Model, positive attitudes and the perception of benefits can be significant predictors of the intention to use a certain technology. Thus, Perceived Learning Self-Regulation and Perceived Cognitive Absorption were used to propose predictors of students’

continued intention to use a learning management system, instead of their perception of and attitude to possible benefits. For this reason, the present research aimed to develop a framework that

introduced, evaluated, and examined the impact of interventions on improving learners perceived cognitive absorption and perceived learning self-regulation as well as affecting learners' continued intention to use in LMS. To fulfil this aim, the main research question was, "How to improve students' Continued Intention to Use (CIU) an LMS by improving their perceived learning self-regulation and perceived cognitive absorption?"

The results suggest that all interventions had a significant effect on the perceived cognitive absorption, perceived learning self-regulation and continue intention to use the LMS. perceived cognitive absorption was found to be a critical antecedent to the perceived learning self-regulation, which plays the mediating role between perceived cognitive absorption and continue intention to use LMS. The survey analysis also reported overall positive perceptions among students of the use of these interventions and the LMS with the technology. By using interaction analysis, the intervention showed continuous and consistent use among learners.

The main contribution to knowledge, as noted above, is a new framework to propose interventions that can improve the perceived cognitive absorption, and in turn, the continue intention to use can be improved. This research integrated experience flow, self-regulation, herd behaviour and goal-setting theories to explain the potential effects of the tracking tool, visualised competency, and social media on the perceived learning self-regulation and perceived cognitive absorption, which improved the learners continue intention to use learning management system.

Table of contents

Contents

Figures

Tables

Chapter 1: Introduction

1.1 Introduction

This chapter aims to introduce the motivations of this thesis. Section 1.2 gives background information on the Learning Management System (LMS) and justifies this technological application as the focal point of this research. In Section 1.3, the professional motivations behind this research are spotlighted and the main practical challenges facing LMS are defined. Section 1.4 consults the literature to find the knowns and unknowns concerning these practical issues to address the main knowledge gaps in this topic. Next, in Section 1.5 are the research questions, aims and objectives that address these knowledge gaps. The final section of this chapter, Section 1.6, describes the structure of this thesis as a kind of roadmap in tackling the questions, aims, and objectives of the present study.

1.2 Learning Management System

A Learning Management System (LMS) is a web-based innovative educational system that has revolutionised the educational environment. Its ultimate aim is to improve a student's ability to set educational goals and to organise the content and material under study and improve communication and collaboration between teachers and students (Cheng & Yuen, 2018). The cornerstone of its blended delivery is the Learning Management System (LMS).

The unprecedented emergence of Covid-19 pandemic has introduced new challenges and imposed new norms that integrate social distancing within the new education paradigm. Due to its current challenges, educational institutes are moving significantly to reduce face-to-face interaction, which is reserved for the direst necessities. The risk of infection has compelled universities all round the world to swiftly initiate plans to move to virtual learning, as a temporary measure, but one likely to become permanent (Lau, 2020). Many of them are even planning for online delivery throughout the next educational year, 2020-2021 (Razavi, 2020). This has quickly put LMSs as a new gene in the educational DNA. Universities in the U.S., including Harvard and the University of North Carolina, have announced that all their courses will be virtual or online from autumn 2020 (Razavi, 2020). The Department of Education in the UK is also working to develop a blended learning platform for schools (Russell & Provan, 2020). The Guardian (2020) reported that the London School of Economics, King's College London, the University of Durham and Manchester Metropolitan University declared they would completely switch to virtual learning for one year at least (Adams, 2020). This new norm of heavily switching to using LMS as a main learning platform over the

traditional face to face mode has revolutionised educational practices and forced institutes, learners, and teachers to adopt information and communications technologies at an unprecedented pace.

But even before the pandemic, the LMS was prevailing across the globe. It is used in virtually all universities in the UK and the USA to improve students' ability to organise materials and topics so as to improve their satisfaction and performance Boulton et al. (2018). This trend extends to the East and the Middle East Awad, Salameh, & Leiss (2019). According to Markets-and-markets (2019), "The LMS market size is expected to grow from USD 9.2 billion in 2018 to USD 22.4 billion by 2023, at a Compound Annual Growth Rate (CAGR) of 19.6% during the forecast period *(LMS Market Size by Solutions & Services - 2023* | Marketsandmarkets 2019). Today's market contains tens of LMS platforms with different designs, functionality, and price tags (E-learning-industry, 2020). Regardless of their differences, all of them claim to achieve the intended objectives of an LMS which is to improve learners' ability to manage their learning.

1.3 **Research Professional Motivation**

Although it confers clear benefits and has seen substantial market growth, LMS technology faces several challenges. The main challenge is the variations in the level of its use. Although it aims to improve learners' ability to plan and set education goals, more than 90% of learners use LMS only as a data repository technology (i.e., for data storage) and for taking online tests. No more than 10% of learners use LMS for online collaboration or forum discussion Awad et al., (2019). According to Capterra's research in 2015, unless it makes mandatory online testing requirements, the average use of LMS falls to a between 19% and 36% of the total number of learners enrolled in a course (Medved, 2017). According to Capterra's report, the retention rate of LMS as a supplement to face-to-face learning is 21%, indicating that about four-fifths of the students do not use LMS at all. It also shows that a significant number (more than 50%) of students are not satisfied with LMS; hence they are unlikely to continue using it in the future Capterra (2015). One of the main challenges facing LMS adoption is students' failure to use this platform for all its intended purposes, i.e., for organisation and planning Capterra (2020). Students' disengagement can negatively affect the chance that LMS will be widely used by learners and teachers.

The above discussion suggests that, despite the availability of advanced LMS platforms in the higher education sector, the use of it for the intended purpose and the commitment to using it is challenging. This may indeed influence the current use of the system and the intention to continue using it in the future.

1.4 **Academic Motivation for the Research**

Two main generic questions lead this research: "What models/framework could describe the interplay of the learner and the Learning Management System (LMS)?" and "How can technological interventions be adopted to improve the learning experience?" A review of the literature seeks to define the models and framework that would contribute to the adoption of this system.

The adoption and success of the LMS in e-learning have been widely studied in the current literature (Aparicio et al., 2017; Ashrafi et al., 2020; Cheng & Yuen, 2018). The dominant overarching theory explaining its adoption success is the Information System Success Model (ISS). One of the success factors defined by DeLone & McLean, (1992) is the "use", which can be assessed by the intention to use an information system. Unlike the intention to use a current system, this research focuses on the intention to continue using the LMS in the future (CIU). CIU is a more comprehensive definition of success because it offers a sustainable perspective that indicates sufficient satisfaction from current use to guarantee continued use in the future.

ISS (Information System Success) model scrutinises the role of system characteristics (e.g., information quality, system quality, and service quality) in the intention to use an application through improving the users' satisfaction and perceived benefits DeLone & McLean (1992). In the LMS literature, some modifications to this model have been made to fit the nature of this application (Cruz, Arriola, Tzot, & Hernandez, 2019; Ramírez-Correa et al., 2017). For instance, Hwee Ling and Kan (2020) extended the ISS to the LMS by adding pedagogical elements such as instructional quality, learning quality, interaction quality, and the impact of the perceived frequency of use on learners' perceptions of quality. Although the ISSM clarifies the impact of the perceived benefits, satisfaction, and system characteristics on the LMS as predictors of the intention to use it, Cruz, Arriola, Tzot, & Hernandez, (2019) were not successful in explaining the intention to continue to use it Ashrafi et al., (2020).

This research proposes the following: to strengthen students' continued intention to use LMS, they need a more vital sense of satisfaction and a stronger perception of the value of using the system purposefully. The traditional ISS focuses on "satisfaction" and "perception of benefits" as key predictors of the intention to use the system. This research proposes two new constructs to reflect these points. To replace "satisfaction", this research proposes "Cognitive absorption" and to replace "perceived benefits", this research proposes "Perceived Learning Self-regulation".

Cognitive absorption is defined as a level of endurance in using technology commensurate with the level of engagement Agarwal & Karahanna (2000). Thus, the valence of satisfaction is magnified by using cognitive absorption to provide this endurance in the use of the LMS (Leong, 2011). Perceived Learning Self-regulation (PSLR) is defined as the learners' perception of their ability to set goals and organise activities to achieve these goals Zimmerman (2002). Since the LMS is an organising technology Cheng & Yuen (2018) designed to improve the learner's ability to set goals and plan for them (i.e., self-regulation) Alkhasawnh & Alqahtani (2019), 'perceived benefits' will be replaced by the PLSR. These reflections have not been included in the literature that was reviewed and have not been tested on the CIU. This theoretical perspective for explaining the CIU is examined later in this research.

The second generic question concerns the adoption of technological interventions to improve LMS success. Based on the literature in the field, I propose interventions that can improve the PCA and PLSR so that LMS success can be improved. The two proposed interventions are the use of dashboard technology and social media. Although each of them has featured in the literature as a useful tool for improving engagement, use, and intentions, each of them has some weaknesses. This research compensates for the critical weaknesses and examines their potential for improving learners' intentions and perceptions.

Using dashboards can improve students' PCA. They can see other people's interactions and become competitive, thus increasing their engagement Jivet et al. (2017) but the negative effect of this on their self-esteem could easily cause unintended consequences (Jivet et al. 2017). To address this issue, this thesis proposes to build a new dashboard technology that does not compare one student's performance with another's; instead it reports interactions of others' but omits any benchmark for comparing performances. The theory underpinning this intervention is herd behaviour, which stipulates that people follow and imitate the herd (i.e. others' interactions), giving it power over perceivers' perceptions, beliefs, and behaviours Shiller (1995). No theoretical framework to explain the possible role of having a dashboard stimulates the impact of herd behaviour on learners' perceptions that would make them continue to use the LMS. Herd theory to explain the role of tracking technologies in learners' PCA and PLSR and improving the CIU has not been used before. Thus, it is expected this research will contribute to the knowledge by embedding herd theory in the educational technology literature for theorising the use of the tracking technology in educational context.

In addition to indicators of learners' interactions and performance, dashboards can support the required competencies in guiding learners as they learn. The visualised competencies are found to influence students' ability to self-regulate (Brooks et al., 2014) because the clarity and coherence of their goals can improve their focus and concentration (Seidel et al., 2005). Furthermore, Locke and Latham (2006) suggested that learning goals require clarity and task specifications if they are to improve learners' performance. Once the students feel they are in control of their learning and they are equipped with the tools that enable them to engage with and deepen their learning, they will perceive themselves to have better planning and managing skills to learn and complete their learning tasks (Nguyen et al., 2018).

Learning outcomes are usually presented at the beginning of the semester. The primary noted weakness here is the learners' ability to memorise and embed them in their weekly lessons. The rationale for this proposed intervention, based on goal-seeking theory, is that if the required weekly learning is structured and organised, it could improve learners' perceptions of their ability to organise it and set clear goals (i.e., PLSR). This reduces the distortion of being overwhelmed by the topic and sharpens learners' focus on it (i.e., PCA). There is no theoretical framework to explain the effect on PLSR and PCA of providing weekly competency goals in the dashboard.

Social Media (SM), as documented in the literature, can play two significant roles in improving learners' outcomes. They are to improve the learners' engagement (Bergdahl et al., 2020) and to improve the perception that they can get help whenever needed (Bartholomé et al., 2006). However, two serious weaknesses noted in the SM may obstruct these two outcomes. SM can be a distractor because learners can drift away from the Learning Outcomes of the course, which can negatively affect engagement (Smith, 2016); and traditional SM applications such as Facebook and Twitter also raise privacy concerns because students' personal information is shared on the system, affecting their perception of the safety of searching for help (Burtăverde et al., 2019).

Subject to overcoming those noted challenges (e.g., learners' distraction, and privacy issues), the literature suggests that using social media in LMS has apparent benefits (Chugh & Ruhi, 2018). This brings up knowledge gaps. First, if the distraction is eliminated, will the engagement be improved? No precise method has been developed in the literature to overcome the risk of distraction which could improve the PCA (as a reflection of the improved engagement) but if one existed, would it improve the PCA and PLSR so that the CIU could be improved? These possible relationships lack theorisation. Second, if the learners felt safe and unthreatened, their use of the system to seek help and advice would be improved; thus, the LMS would be more beneficial as an organising technology

and would be more beneficial. Learners' ability to get the required help is found in the literature to improve their ability to plan and improve their learning self-regulation (also called as 'learner-managed learning') (Gobert et al., 2015; Kizilcec et al., 2017). As applied to this thesis, if they got timely help from the social media attached to the LMS, would learners be able to organise and structure their study more effectively and efficiently? This could improve their focus and strengthen their engagement (i.e., PCA) and planning (i.e. PLSR).

To sum up, the Information System Model is a key theory to explain the intention to use LMS, but it fails to explain the intention to continue use. Thus, this research alters some critical constructs (i.e., perceived benefits and satisfaction) for indicating extended effects to show that learners will intend to use the system in the future (i.e., the PLSR and PCA). This theorisation is novel. Second, this research proposes two central interventions (i.e., dashboard (tracking technology and weekly visualised competences) and the social media) for improving the PLSR and PCA. These interventions, amended to combat their noted weaknesses in the literature, are still new and vague, and their effects on the PLSR and PCA have not been measured. According to the researcher best knowledge, no previous writer has there is a lack of research dedicated to develop a theoretical framework for explaining the impact of these amendments in the dashboards and social media on the PCA and PLSR so that CIU can be improved.

1.5 **Research Question, Aim and Objective**

1.5.1 Research Question:

The main motivation of this research is to develop interventions to improve the CIU. Thus, there is a need to identify the antecedents of the CIU and use them to propose positive interventions for influencing these antecedents.

Research Question: *What are the antecedents of the CIU and how interventions to improve them be developed?*

Research Aim: *To develop a framework that evaluates and examines the impact of interventions on learners perceived cognitive absorption and perceived learning self-regulation. And thereby affect learners' continued intention to use an LMS.*

1.5.2 Research Objectives

The research objectives are as follows:

1- To develop a model for explaining the role of the PLSR and PCA on the CIU.

2- To develop a herd-based model for designing a new dashboard to improve learners' PCA and PLSR.

3- To develop a model based on goal setting for the design of new weekly visualised competences to improve learners' PLSR and PCA.

4- To develop a model for incorporating the SM in the LMS to improve the PLSR and PCA. NOTE: 2.6 page 35 – you state that an objective of this study is to improve student learning. That is not stated here. I suggest you change the statement on section 2.6 (see comment on the page)

1.6 **Thesis Structure**

This thesis is organised as follows. In the literature review (Chapter 2), the key constructs of this research are defined and justified, and the research gaps in explaining the adoption of the LMS in general, and the CIU in the LMS, in particular, are identified. In this chapter, the theoretical framework, the theoretical basis is set to propose the relationships between the research constructs (i.e., PLSR, PCA, and CIU) and to set the theoretical basis for developing interventions to improve the CUI. The research methodology is presented in Chapter 3, where the ontological and epistemological stance was set for evaluating and examining the proposed framework. In Chapter 4, based on interviews, workshops, and the literature review, the design of the interventions (i.e., by Dashboard and Social Media) is reported and the design hypotheses of the effects of the interventions on the LMS CIU. The interventions are evaluated in Chapter 5 using data interaction analysis, a learners' survey, and data from interviews with teachers. Then, in Chapter 6, the theoretical framework and the interventions impacts are tested. Finally, Chapter 7 outlines the contributions of this research and its academic and professional implications and suggests the future direction of its research.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews the literature on the Learning Management System (LMS) in general, and the theories contributing to the understanding of its success. In section 2.2., LMS is defined along with its components, advantages and challenges and main service providers. Then in section 2.3 LMS success is defined to indicate the research direction. This success is defined in terms of the learners' intention to continue using the LMS (their CIU). With this definition in mind, the relevant factors defined in the literature to improve the CIU are defined in section 2.4. Since it is not easy to deliver this success in the CIU, the literature introduces many technological interventions, which are introduced and evaluated in section 2.5. Lastly, to fulfil the research aim of developing technological interventions for improving the CIU, the relevant theories that could explain the CIU are defined in section 2.6 so that they may be adopted in the research and the knowledge gaps in these theories may be identified.

2.2 Learning Management System

An LMS is a platform to support blended learning courses (Yueh & Hsu, 2008). It is used to complement face-to-face teaching and improve students' learning experience. LMS is different from e-learning. In the latter the whole curriculum and all interactions are delivered online, with no opportunity for students to meet their teachers face-to-face (Zanjani, Edwards, Nykvist, & Geva, 2017). LMS originated from management systems, as a technology for organising and managing learning materials to support learners, and further enable them to build knowledge through performing organisational tasks (Lonn & Teasley, 2009). LMS is a powerful education tool that can improve learners' ability to regulate themselves and be more structured and organised in their learning process (Zheng et al., 2018).

The next subsections will cover first the different major service providers of the LMS and define the focus of the research on one of them. The following section defines the challenges facing industry in general regarding greater "success" for the LMS.

2.2.1. Moodle and Blackboard

Moodle and Blackboard are the most often used LMS platforms. Both systems widely support in-class engagement as the traditional teaching method in higher education. Moodle was founded in 1999 and launched in 2002. The name is an acronym of "Modular Object-Oriented Dynamic

Learning Environment" (Aldiab et al., 2019). Blackboard was launched in 1997 (Aldiab et al., 2019) and is a closed source platform that requires a yearly subscription. Amendments to the system are also provided at an additional cost (Blackboard).

For academic scholars, Moodle has been the more attractive. Searching "Moodle" as a keyword in Google Scholar yields more than 16,500 articles published since 2019. Interestingly, searching "open-source learning management system" as a keyword in Google Scholar under the same criteria brings up only 254 results, many of which discuss Moodle as an example. According to (Trends.builtwith.com, 2020), Moodle is the most used and adopted LMS worldwide with 163000 registered websites hosting more than 27,530,298 courses in 241 countries (About Moodle).

Moodle is an open-source platform which enables the hosting academic institute to independently customise it and further study its inner implementation for research purposes. Moodle open source is aimed to encourage openness, creativity, knowledge sharing, control and value for money (About Moodle, 2020). The back-end system of Moodle can be retrieved either via the web or a mobile application. There is also a large online community of experienced Moodle users, developers, and academic members who actively participate in answering troubleshooting queries. In addition, the Moodle community organises regular scholarly meetings and conferences. Although a wide range of open-source LMSs is available (E-learning Industry), Moodle's support is essential for scholars aiming to research LMSs at minimum cost. Thus, this research will focus on the Moodle platform. A broader list of LMS can be found comparison online platforms such as Capterra. However, other LMS platforms such as Captivate Prime by Adobe can be found independently. Due to the research specific scope these LMS are not reviewed in this research.

2.2.2 LMS Challenges

Despite the evolving technical aspect of LMS, learners do not use it as much as they might (Rodrigues et al., 2019). The technical aspects of LMS become irrelevant if learners do not use them in their learning process (Tarhini et al., 2014) . It has recently been reported that HE learners are continuing to disengage and withdraw from LMS (Feild et al., 2018; Friðriksdóttir, 2017; Stocker, 2018). Therefore, it is essential to validate the parameters that determine learners' use of e-learning and LMS as beneficial means of learning (S. Sharma & Chandel, 2013)

LMS has been investigated by researchers from various perspectives and a wide range of new improvements have been proposed to enhance learners' cognitive, creative, self-motivation, and independent learning skills (Chen, Huang, Gribbins, & Swan, 2018; Zanjani et al., 2017). Different

practical and theoretical perspectives have been proposed from which to investigate and address the challenge of not getting all the benefits one requires from LMS. In order to address these challenges effectively, LMS success has to be defined. This is addressed in the section below.

2.3. LMS Success: Intention to Continue to Use (CIU)

LMS success is defined as the level of use of and engagement with the LMS (Alraimi et al., 2015). The level of use can be measured by actual use or through the intention to continue using the application in the future (Hong et al., 2017). Actual use can be affected by technological factors (e.g. the design, the interface and any technological intervention) or it can result from other, non-technological reasons such as family, personal or course-related reasons. Behavioural intention (BI) is further defined as the degree to which a user aims to perform a particular action on a system (Davis et al., 1989). The intention is a predictor of future behaviour that a person is aware of and interested in performing (Ouellette & Wood, 1998). Thus, considering the intention will sharpen the focus of this research on technological factors only. This research will focus on the intention to use rather than actual use, as a reflection of the success of the applications in terms of their technical features. Intention can refer to the intention to use the system only for a current course or to the intention to keep using it in the future. To avoid situational factors (e.g. aspects to do with teachers or the course itself), the focus will be on the future. Intention to continue to use has a more substantial effect on attitude as an influence on future intention. Therefore, the Continued Intention to Use (CIU), also called the intention to continue to use, is defined as the personal attitude and perceptions of the possibility of using a certain learning technology in the future after finishing the current course (Alraimi et al., 2015).

Several factors affect the intention to continue to use LMS. They may be psychological or technical interventions affecting psychological factors. From the psychological point of view, Hong et al. (2017), writing on 150 professional users of LMS in Taiwan, found that the students' psychological traits and Internet cognitive failures (i.e., distractions caused by the Internet) were closely related to their intentions to continue to use the LMS. This is because when they were distracted the learners perceived a lower utility value. Similar conclusions were drawn in another study that examined students' expectations, perceived enjoyment, perceived usefulness (PU), and CIU to use e-books in Korean high schools. The primary outcome relevant to this research is that the PU of e-books has a direct and positive impact on CIU (Joo et al., 2017). Chiu and Wang (2008) sampled 286 respondents and found that, besides personal attributes, computer self-efficacy, attainment value, utility value, and intrinsic value were strong predictors of students' CIU. Not only psychological factors, but also

technological factors that could influence the psychological factors have been studied in the literature. Yang et al. (2017), studying 294 respondents, revealed that the characteristics of the learning technology platform, such as system quality, course quality, and service quality play a significant role in determining the attitude to the LMS and thus the intention to continue to use it. Similarly, Tsai et al. (2018) conducted a study on 126 learners and concluded that liking, enjoyment, and engagement play a significant role in explaining the continued intention to use the learning technologies.

In conclusion, CIU is similar to the intention to use because they are both related to attitude. Nevertheless, affecting the CIU needs more valance in attitude. Therefore, since the key factors shaping attitude are perceptions, the focus of this research is on the psychological reasons that could explain the variations in intentions that are due to technological interventions. CIU is mainly affected by learners' experiences which may stem from the design of the interface. Accordingly, there are two perspectives on improving the CIU to investigate: the psychological factors in the learners and the technological interventions for dealing with the psychological ones. Therefore, the next two sections focus on the psychological factors and technological interventions in that order.

2.4. Psychological Factors affecting LMS success

The literature shows several aspects of the learning perspective to direct learners' intentions to use LMS. Based on extensive evidence on the ability of LMS to structure, organise, and improve collaborative learning, researchers checked whether it improves students' performance if properly used (Clark & Mayer, 2012). Here, "properly" is defined in terms of the level of engagement (Skinner & Pitzer, 2012), level of use (Islam, 2012), or level of exploitation (Al-sabawy, Cater-Steel, & Soar, 2016). It is, however, challenging to move from minimal use to a high level of deployment. For example, being aware of LMS and occasionally using it is different from changing one's learning behaviours into something more structured, organised, and up-to-date with the teachers' instructions and requirements (Revythi & Tselios, 2019). Thus, the antecedents of success in this context are engagement, cognitive absorption, and perceived self-regulation in learning. Each will be covered in more depth in the following sections.

2.4.1. Engagement

Engagement is a critical aspect for ensuring the successful use of LMS in terms of getting the expected benefits. Engagement is defined as "one's involvement, focus, participation, and persistence on a task, all of which have been implicated in learning" (Ben-Eliyahu et al., 2018, p.24).

Engagement can be an independent, dependent, or mediating factor. As a dependent factor, engagement can be manipulated by the research variables. For instance, as examined and verified by Grant-Smith et al. (2018), visual designs in LMS can improve learners' engagement, hence improving their academic performance. A similar conclusion was reached in Olivé et al (2018) study.

The attractiveness and creativity of the design could play a role in improving the intention to continue LMS. Attractiveness is studied by Cheng and Yuen (2018), who surveyed 448 undergraduate students using Moodle in Taiwan. The outcome reported was that the design of attractive and progressive problem-solving activities affects the attitude to self-reflection and self-assessment, which then improves engagement in further online learning tasks. Creativity is also perceived as a factor in improving learners' engagement (McDaniel et al., 2017). Interestingly, engagement with LMS not only relates to its features but is also affected by the support that it provides to users. (Baragash & Al-Samarraie, 2018) studied 196 questionnaires and found that learners' engagement with face-to-face learning activities had a significant impact on their engagement with LMS.

Learners need to be motivated, remain resilient on the tasks, and have excellent meta-cognitive skills to initiate the learning process and proceed to complete a learning task meaningfully. If these are present, the perceived benefits from the LMS are also enhanced (Ley & Young, 2001). Researchers further show that learners will have a positive e-learning experience if they are enabled to regulate their cognitive and meta-cognitive behaviour through their learning process and this also affects their intention to use LMS (Goulão & Menedez, 2015).

Learning engagement (LE) comprises four dimensions: behavioural, social, emotional, and cognitive engagement (Skinner & Pitzer, 2012). Behavioural engagement refers to the activities performed by students, whereas social engagement refers to interactions with peers in order to share knowledge. In addition, emotional engagement refers to the feeling of belonging and acceptance. Emotional engagement is excluded from the present research because it is a personal interaction, which traditional LMS does not offer. All of these kinds of engagement can build cognitive absorption for the user, as detailed in the next section.

2.4.2. Perceived Cognitive Absorption

Cognitive absorption (CA) is explained by the state of flow theory, first coined by Agarwal & Karahanna (2000). Getzels and Csikszentmihalyi (2017) define the flow as the absolute immersion that generates a sense of thorough engagement. State of flow means the inability to sense time or

place while using an application (i.e. LMS, in this case). According to Getzels and Csikszentmihalyi (2017), the state of flow is reflected by the realisation of each performed action, the focusing of attention, neglect of self-mindfulness, a complete sense of autonomy, consistency requirements, and knowing the purpose of each activity required and performed. In such situations, CA is useful and leads to positive outcomes; however, it must be subject to being directed to purposeful activities. For instance, Roca and Gagne (2008) studied 172 university learners and found that cognitive absorption significantly improves the continued intention to use LMS. Another paper, by Léger et al., (2014), studied 36 students, and concluded that cognitive absorption has a significant effect on the learning outcomes. Similarly, another study by Venter and Swart (2018) used two dimensions of PCA, i.e. focused immersion, and temporal dissociation, to predict students' CIU. Their study showed that focused immersion affects the CIU of LMS.

Nevertheless, the outcomes of bringing the learner to the state of flow are subject to several conditions, e.g., the usability of the system. Without a usable system, the learner cannot reach this state. A study conducted by Moreno et al., (2017) on 251 students enrolled in distance learning business programmes in Brazil concluded that usability mediated the relationship between CA and the effective intention to use. Another study conducted by Hsu and Lin (2017) investigated the intention to continue to use SM among 310 Facebook users in Taiwan. Their research suggested that, to improve the intention to continue to use a system, CA requires learners' social relationships and interactive capabilities. This suggests that adding social media could be one of the key determining factors of improving CA. The same conclusion was reached in another study by Guinaliu-Blasco et al. (2019) on Spanish students learning marketing using Pinterest as a collaborative learning technology. Their study corroborates the view that using SM improved cognitive absorption and the learning experience.

CA is perceived as both a negative and a positive factor affecting academic performance. Based on a study of 239 students in a University of Technology, Rouis, Limayem and Salehi-Sangari (2011) showed that CA on the social media makes students less connected to their studies. This made them unable to plan for their studies and negatively affected their ability to self-regulate. However, the CA can be perceived as a positive factor, if it is purposeful and leads to transformed educational behaviour in the learner, such as to derive benefits from the technology.

2.4.3. Learning Self-Regulation (LSR)

Self-regulation is critical for students' learning performance (Goulão & Menedez, 2015). In e-learning, LSR is a significant predictor of learners' success (Sun & Rueda, 2012). Previous research

reported that unsuccessful e-learners are those who were not equipped with LSR skills and could not practise its strategies (Liaw & Huang, 2013). Therefore, LSR is essential in the learning processes and is particularly applicable to e-learning since it is a self-driven learning platform (Liaw & Huang, 2013).

Learning self-regulation is the learners' ability to set their learning objectives and plans and to carry out these plans as expected (Goulão & Menedez, 2015). It is further defined as "learners' ability to independently and proactively engage in self-motivating and behavioural processes that increase goal achievement" (Zimmerman, 2002). LSR is identified through the behavioural activities that indicate cognition (Jeske et al., 2014). including active and self-derived participating, completing assignments or quizzes, peer-collaboration, seeking help, and managing resources.

Writers have debated whether self-regulation nurtures learning or is part of its nature. The first school of thought believes that it is part of the learners' competence (Davis et al., 2017) and ability. In contrast, the second believes it can be temporary (Hall & Fong, 2010) or can be learned through specific training or technologies (Kitsantas, 2013). The first school also perceives self-regulation as an aspect of personal competence that is gained over time. Learners direct their learning processes and attainments by setting challenging goals for themselves and devise appropriate strategies to achieve their goals, enlisting self-regulative influences that motivate and guide their efforts (Liaw & Huang, 2013).

Self-regulated learners are characterised by their ability to initiate meta-cognitive, cognitive, affective, motivational, and behavioural processes which function to achieve their learning goals,; in this they persevere until they achieve success (Kitsantas et al., 2019). LSR, as a personality trait is suggested in Kizilcec et al. (2017), where learners have the resilience to initiate, undertake, complete and adapt to the process or the task in hand. The second school of thought agrees that LSR is not a static skill. Instead, it evolves with practice and is a scaffolding that supports the learner through contingencies or uncertainties (Kizilcec et al., 2017). Indeed, learning self-regulation is highly dependent on a person's self-efficacy (Liaw & Huang, 2013), while the perception that one can be structured is contextual and based on the tools available. In other words, learning self-regulation is more of a personality trait while Perceived Learning Self-Regulation (PLSR) can be gained by technological interventions (Wu, Tennyson, & Hsia, 2010).

In the context of this research, PLSR is defined as an active, constructive ***process*** that is made possible by technology, in which learners can set their learning goals and are enabled to monitor, regulate, and control their cognition and behaviour (which are driven and constrained by their goals

and by the contextual features of the environment) (Liaw & Huang, 2013). Therefore, unlike LSR which is confined to personal attributes, PLSR is operationalised as the perception of the technology as a self-regulated individual learning tool and as an enabler in regulating the content of e-learning (Liaw & Huang, 2013). To explain; PLSR is an outcome or a benefit of using LMS effectively. According to their study of the perceived satisfaction of 196 university students, perceived usefulness, and interactive learning environments were shown to positively influence PLSR in an e-learning environment (Liaw & Huang, 2013).

In online learning, PLSR can be improved by an intervention in the practical interface design. For some learners, learning and forming a concept map through a digital environment may be challenging and a cognitive overload. This challenge is due to the nature of the layout and nonlinearity of the content, as well as the various methods of content presentation, e.g., multimedia, hypertext, and text (Al-Samarraie et al., 2017; Kalyuga & Liu, 2015). A sophisticated LMS that caters for a wide range of capabilities may create resistance in some users (Berking & Gallagher, 2015).

Thus, in this research, both the engagement elements of technological intervention and the factors that could improve PLSR for the learners are considered.

2.5. Technological Educational Interventions (TEIs) affecting LMS success

A variety of initiatives aim at improving the acceptance of LMS. Many of such interventions focus on the main interface and dashboards and incorporate social media elements. The main interface in LMS is often used to handle assignments, lecture presentations/slides, videos, and records (Almarashdeh, Sahari, & Zin, 2011).

The purpose of the main interface in LMS is to provide accessible, functional features for supporting students in their learning process. Designing an efficient main interface is one of the TEIs for improving the usability of the LMS. For instance, Conley et al. (2020) studied layout-block design in LMS. They showed that a layout which sticks to functional aspects of LMS is perceived to help students perform their tasks faster. They also show that the students perceive a chronological design based on searching by Alphabetics as an easier interface that requires less effort, thus improving the PLSR. A similar insightful study by Shao and Kwon (2019) focused on the use of an advanced organiser to improve the learners' confident ability to navigate LMS independently. Their study showed that the learners who used this organiser achieved the learning objectives significantly better than those who did not. Consequently, Lung-Guang (2019) concluded that as a way of empowering the users of a self-regulated interface, the design improves the students' experience, and motivates

them to continue using LMS in the future. Similarly, Ouadoud et al. (2020) improved an LMS by guidance in the educational structure of its LMS interface.

Despite the apparent benefits of amending the interfaces for improving the learners' interaction flow with LMS, such amendment often requires a deeper understanding of the nature of the learning process and can be seen as an expensive approach to improving the learners' commitment. In the present study research, the focus is on a design which is based on understanding the psychological aspects of learning. The following sub-sections cover the second and third technological areas of intervention, i.e., the dashboards, and the incorporation of social media elements.

2.5.1. LMS Dashboards

The LMS Dashboard, also called Learning Analytics Dashboard (LAD), is defined as an application that provides a comprehensible visualised summary of the learner's tracked interactions, and further analyses the progress of the learning (Park & Jo, 2015). The LAD composed of the following elements: data mining, visuals, visualisation techniques, recommendation system, the provision of feedback, class comparisons, and interactivity (Bodily & Verbert, 2017). In other words, LAD, in its simplest form, is a reporting system that provides a summary of students' personal history on the LMS (Bodily & Verbert, 2017). Visualising the learning analytic on learners' dashboards was suggested as a way of encouraging learners and educators to make major changes in their learning process (Jivet et al., 2017). The LAD is also concerned with representing learners' progress visually in order to facilitate their reflection on their own progress (Santos, Govaerts, Verbert, & Duval, 2012). In this context, Greller and Drachsler (2012) concluded that the visual presentation of LAD data should be implemented as an instructional tool driven by pedagogy.

The LMS dashboard is a reporting system incorporated in LMS to improve the learning experience by defining the required competencies. The dashboard enables learners to track their performance in a useful and timely manner to achieve their learning objectives (Park & Jo, 2015). Dashboards in LMS are perceived as necessary tools for gaining value from using the LMS (Jivet et al., 2017). There is convincing evidence that dashboards improve the learning performance (Beheshitha, Hatala, Gaševic, & Joksimovic, 2016) because dashboards provide the students with information that help them plan their learning more effectively and efficiently. Using dashboards in LMS is also shown to improve the learners' self-regulation capabilities (Schumacher & Ifenthaler, 2018). Empirical evidence in Hu, Hou, Lei, Yang and Ng (2017) also suggests that learners use the dashboard for self-checking, which enabled them to plan more effectively and to recognise their weaknesses. A similar observation was made in a study of 216 learners using dashboards by Schumacher and Ifenthaler

(2018), who concluded that students used the dashboard as a planning and organising tool for their learning activities.

The students also perceive the LAD as a self-assessment tool which provides adjustable recommendations and further generates a personalised and useful summary of the learning progress which it investigated (Kia et al., 2020). In the study by Kia et al. (2020), the students were provided with "actionable information'' to enhance their learning self-regulation in LMS. The analysis of 860 students' responses across ten different undergraduate courses concluded that the dashboard could effectively categorise learners through their various levels of academic achievement and LSR strategies. There is also evidence to show that the dashboard affects the learners' perceived competency, which then affects their perception of the value of using LMS (Sun, Abdourazakou, & Norman, 2017). Improvement in the development of the learners' self-regulation skills and their competencies facilitated by using the dashboard directly affect their learning achievement (Kim, Jo, & Park, 2015).

Although using dashboards seems beneficial, it has been shown that only 25% of students use dashboards regularly (Bodily, Ikahihifo, Mackley, & Graham, 2018). Dashboards can be either personalised or non-personalised (Santoso, Batuparan, Isal, & Goodridge, 2018). Non-personalised dashboards focus on reporting the learners' interactions using anonymised data to conceal information about individual performance. In a personalised dashboard, the learning achievement information of all the learners is made available; hence the students can compare theirs with others. A personalised dashboard also guides learners by *recommending* learning tasks or suggesting alternative activities, depending on the learners' interaction history with the system and their learning goals (Schumacher & Ifenthaler, 2018). A personalised dashboard could report students' activities and their interaction with the learning platform, such as their access time, time spent, peer interactions, quiz attempts, tasks completions, and evaluations (Bodily & Verbert, 2017; J. Kim, Jo, & Park 2016). Note that in a setting where all the students are supposed to cover the same content, e.g., every week, a personalised learning recommendation may be irrelevant.

2.5.2. Tracking tools

A tracking tool acts as a cybernetic system which collects information on specific indicators to regulate the decision-making process (Green & Welsh, 1988). Tracking tools track and report learners' interactions with the LMS (Jivet et al., 2017). Jivet et al. (2017) and Tan et al. (2016) presented their views of the importance of reporting outcomes in the design of a pedagogical approach using tracking tools. The approach was aimed to support the achievement of students' goals

based on promoting positive learning skills and perspectives. In an educational process, a tracking tool collects learners' interactions and feeds this information into their dashboards to be displayed and compared with similar information collected from other learners.

Despite the benefits of these tracking dashboards, evidence shows that the learners do not use them because of the tracking tool. Evidence shows that a determining factor in this process is self-comparison by the learners (Neugebauer, Ray, & Sassenberg, 2016) and may harm some learners' sense of self-esteem. Harvey and Keyes (2020) also reported lower self-esteem among those students who (from information provided by the dashboard) believed their academic performance to be lower than their class average. A similar observation was reported by Herodotou et al. (2020), who concluded that peer comparison demotivates some students. Probably, if the comparison is anonymised, this negative effects may demolish. Similarly, in the study by Kia et al. (2020), only 52% of the students used LAD, and among these, 19% had only a single interaction with the dashboard. Reimers and Neovesky (2015) also reported that more than half of the surveyed students did not want to be compared to their peers on LAD. This negative consequence is an adverse factor is using dashboards and could explain why many students did not want to access LAD, as reported by Bodily et al. (2018) and Kim, Jo & Park (2016). Moreover, Jivet et al. (2017) showed that peer comparison could shift the students' focus from mastering knowledge and skills to comparing themselves against others. Some researchers, e.g., Toohey et al. (2019) have suggested that the peer comparison component in LAD needs to be carefully designed to minimise its negative impact on students, which will formulate one of the objectives of this research.

Thus, this research set out to develop a tracking tool that did not compare learners with other with a view to avoiding the above negative consequences.

2.5.3. Visualised Competency

With a non-personalised dashboard, learners can be informed about the module's required competencies as well as through the LMS interface (Williams, 2018). Thus Competency Based Education (CBE) is proposed in the literature as a significant enhancer for improving learners' focus and self-regulation (B. Zheng et al. 2020; Gruppen et al. 2012). Similarly, Williams (2019) underlined the need to integrate CBE in LMS because this would help students to grow from narrow curriculum-focused learners to dynamic life-long ones. CBE focuses on equipping learners with the knowledge, skills, and attitudes to enable them to solve complex problems in their discipline of study or professional career, i.e., authentic tasks (Hoogveld, Paas & Jochems, 2005). A learner's repetitive application of a competency then forms a permanent set of transferable skills (Brown & Charlier,

2013). Therefore, to make this competency understandable and applicable by the learners, it needs to be interpreted as one of their learning goals.

Researchers have suggested further enhancement of the assessment aspect of the current CBE in Moodle; see (Rezgui, Mhiri & Ghédira, 2017). Competency, in general "refers to the individual's mental capacity to contend with a certain level of challenge in a knowledgeable and reflective approach" (Blomhøj, 2011). Competency is defined as a statement of a generic skill or knowledge required by the learners at a certain level of performance (Paquette, 2007). It is considered a measurement of the learning achieved. It can be presented as the general outline of a learning objective, or a narrow identification of learning outcomes and expected skills (Paquette, 2007). Accordingly, as summarised in **Error! Reference source not found.**, competencies are classified in a taxonomy of learning outcomes and transferable skills. In the following sections, the development of learning outcomes and transferable skills is discussed, to justify the use of the Revised Bloom Taxonomy and Cross-curriculum competencies in this research.

Figure 2-1 Proposed model of Learning outcomes and transferable skills forming module competencies

2.5.3.1. Learning outcomes

Learning outcomes form a set of clear objectives and skills that learners are expected to achieve in relation to a particular subject (Nusche, 2008). The development of learning outcomes requires a structured methodology since it is concerned with constructing knowledge and linking suitable concepts (Allan, 1996). The learning outcomes are the basis for setting the course material, the assessment format, and the course design. Blau et al. (2020) concluded that the pedagogical design and integration of the learning outcomes are predictors of the learners' performance. The approaches to developing the learning outcomes are varied.

One of the ubiquitous approaches is the Bloom Taxonomy (BT) (Rao, 2020). The Bloom taxonomy (Bloom, 1965) is commonly adopted to provide clearly defined learning outcomes that indicate students' knowledge level (Murtonen, Gruber, & Lehtinen, 2017; Rao, 2020). The BT is operationalised as a set of standards and indicators to guide and evaluate the design of modules. Because of its ability to structure the knowledge required by learners, Lumpkin (2020) suggested

that incorporating BT in taught content can improve students' learning self-regulation because they learn with it how to advance their learning to a higher level of understanding. For example, Gandomkar et al. (2020) used the synthesis level of thinking in BT as an indicator of the level of self-regulation among medical students.

The Bloom taxonomy starts with the knowledge level, which represents the lowest category where information is processed with minimal understanding. Then it progresses into Comprehension, Application, Analysis, and Synthesis. The highest level is Evaluation which involves critical judgement; this exhibits the cumulative inputs of the five proceeding levels (Murtonen et al., 2017). BT is also used to classify curricular objectives and to assess learning items by measuring the goals across a range of learning categories. For example, if learning objectives focus only on recognising or remembering information, they fall into the knowledge category, whereas if the objectives are associated with the understanding and use of knowledge, then they are part of the comprehension or the synthesis categories, which are the highest-weighted goals in education (Krathwohl, 2010).

BT was later revised by Krathwohl (2010), and further researchers produced a nuanced representation of the outcomes in a large number of subcategories which provide insights into the design of learning objectives, and how to plan the learning activities associated with them. In the Revised Bloom Taxonomy (RBT), the language of BT was improved with the effect of aligning the learning outcomes with the instructional activities. Accordingly, "Create", "Knowledge" and "Comprehension" in BT are respectively replaced by "Synthesis", "Remember", and "Understand" (Barari, RezaeiZadeh, Khorasani, & Alami, 2020). In RBT, the incorporated types of knowledge and learning processes are also integrated and optimised (Lumpkin, 2020). These amendments to the taxonomy are shown to improve teachers' ability to plan the teaching materials (Kalou, Solomou, Pierrakeas, & Kameas, 2012; Thambyah, 2011). This also helps teachers to set a clear strategy for all topics and their assessment. Choudhury et al., (2015) and Virranmäki et al., (2020) used BT in two separate studies as an assessment tool (spotter test) to respectively examine the practical knowledge in medical and geography courses. Similarly, Stack et al. (2020) used RBT's cognitive domain for curriculum mapping, planning learning outcomes, and assessing their relation to online tests.

Due to the above salient benefits, RBT is also extensively used in the e-learning context Barari et al. (2020). In a semantic study carried out by Barari et al. (2020), they explored and evaluated the educational standards and indicators of 171 e-learning platforms. This study proposed a framework based on the Bloom-Anderson Taxonomy which provides pedagogical standards for effective online

learning environments. Zainuddin et al. (2019) also designed a flipped learning instructional model based on RBT for teaching Islamic studies in Indonesia. Similarly, RBT was adopted by Thai et al. (2020) to enhance innovation in educational technologies. RBT was also used as a mechanism to develop auto-generated assessment levels to measure students' apprehension instead of their knowledge alone. BRT has also been used to reduce the time consumed in identifying the correct answers (Kusuma & Alhamri, 2018). Given the wide range of applications and significant benefits of RBT, it is used in this research for developing visualised competency.

2.5.3.2. Cross-Curriculum Competency

Cross-Curricular Competency (CCC) was brought to the attention of researchers in the education field as a valid benchmark for assessing students' learning (Peschar, 2004). CCC refers to learners' ability to merge the skills and knowledge from different disciplines to construct new knowledge (Iglesias-Pradas, Ruiz-De-Azcárate, & Agudo-Peregrina, 2015). It is selected as a basis for designing research competencies because it includes a set of transferable skills that can be applied across different cognitive domains or subject areas, and/or across a variety of social situations, e.g., employment (Bridges,, 1993). CCC is operationalised as the skills acquired in a known situation that can be reused in new situations (Iglesias-Pradas et al., 2015; Safta, 2015). In other words, CCC refers to learning measurements and presentations methods that are not subject-related.

Examples of CCC, such as study skills and soft skills, are widely investigated in the related literature. Learning to develop skills, for instance, is interpreted as a competency by Hoskins & Fredriksson (2008). Study skills were also defined as one of the preliminary CCCs that can be gained and transferred from module to module (Gettinger & Seibert, 2002). There are several soft skills in the literature; e.g., metacognition and problem-solving (Scherer & Teimann, 2012), learning self-regulation (Zimmerman, 2002), being a capable team player (Kauffeld, 2006), and creative and critical thinking (Paul & Elder, 2012). In summary, due to the importance of integrating CCC in defining the visualised competences and its capacity to help learners understand the expected module requirement, CCC is considered in designing the VCs.

2.5.4. LMS and the Social Media

The Social Media (SM) were initially developed for general social interaction (Cheung, Chiu, & Lee, 2011). The importance of SM in the context of higher education as a powerful enabler and a versatile tool for collaborative learning was investigated in (Balakrishnan, 2016; Kulakli & Mahony, 2014). The availability of open SM platforms such as Facebook, Twitter, Telegram, etc. facilitates

significant growth in learners' collaboration (Greenhow & Lewin, 2016; Veletsianos, 2017). Several pieces of research have recently reported evidence of positive outcomes achieved by using SM in HE. They concluded that the collaborative learning activities built upon SM platforms could significantly improve students' learning experience, e.g., (Philip, 2017).

SM have been described as a new form of a decentralised learning platform (Castro, 2012). According to Tess (2013), using SM alone has educational benefits because the recent generation of university students use SM every day as a primary tool for content creation and reflection. There is convincing evidence that incorporating SM elements in LMS leads to a higher level of in-depth cognitive involvement and thus improves learners' learning experience (Sobaih, Moustafa, Ghandforoush, & Khan, 2016). Indeed, using SM for learning is a strong predictor of influencing the perception of usefulness and ease of use in e-learning (which includes LMS) and collaborative learning in higher education among students (Tan, Ooi, Sim, & Phusavat, 2012; Elkaseh, Wong, & Fung, 2016). A complementary observation was made by Chugh and Ruhi (2017), who reported that using Facebook in education improves learners' engagement, academic performance, as well as teacher-student and student-student interactions. There are certain constant factors in predicting the possible use of SM in education.

Despite the apparent benefits of using the SM in education, fully embedding them in educational tools presents some challenges. Sobaih et al. (2016), collecting responses from 190 academics in eight Egyptian higher education institutes, found that using SM as a teaching and learning tool had a positive value; however, the actual use of SM by the academics was limited. Interview outcomes also identified the factors that hindered the use of SM in HE. These factors are privacy and security concerns, time and commitment issues, loss of control and monitoring, the digital divide (e.g. through age, or availability), variation in mobile services, grading and assessment issues, integration with LMS, institutional support, lack of infrastructure, ethical issues; such as personal data protection, and awareness issues.

Besides, SM platforms do not support learning pedagogically, according to Liu et al. (2010). Although they can help in creating and sharing content, one of the repeatedly reported barriers that negatively influence learners' perspective on using SM is content overload (Bright et al., 2015; M. F. G. Lin et al., 2013; Ri et al., 2016). Content overload also has negative effects in terms of hindering students' ability to be self-regulated. (Whelan et al., 2020) and cause students' to be distracted (Abe and Jordan, 2013). For instance; using Twitter to support learners' collaboration has been shown to be ineffective in improving students' engagement (Tur & Marín, 2014), which is mainly attributed

to an excessive number of irrelevant feeds. One of the main concerns in using SM is the lack of trust that can affect learners' concentration. Other studies showed that the root of this issue is the learners' perception of content overload. Bergdahl et al. (2020) also supported this conclusion: they found the level of students' engagement is directly correlated with the level of purposeful use of learning technologies. Their study showed that the high-achieving learners used the ancillary learning application purposefully, whereas the lower achievers believed that LMS was wasting their time because it involved unnecessary applications.

One of the critical suggestions for reducing the distracting effects of the SM is to avoid cognitive conflict in the discussion. Noise can be reduced by categorising the SM posts into smaller groups based on learners' shared interests (Topping, 2005). Several studies also proposed personalising the SM content into a set of streams based on the learning topics and learners' preferences (Yin, Cui, Lu, Huang, & Yao, 2013; Yin Zhang, Tu, & Wang, 2017; Zhu, Ming, Hao, Zhu, & Chua, 2014). In addition to the potential distraction issues caused by using SM along with LMS, the concern over privacy is a critical impediment in using the SM in learning technologies (Chugh & Ruhi, 2017). In the UK, the general data protection regulation, GDPR, are embraced in this research when dealing with personal information and privacy.

With the above discussions in mind, the SM were adopted in this research because of the ability of their extensive features to support the learning process. Most importantly, it should be noted that using the social media in learning to establish a pedagogical approach has not been tested in a solid theoretical framework. This assertion is supported in Al-Qaysi et al, (2018) on the basis of a systematic literature review on the use of SM in learning.

2.6. Learning

The experiential learning theory suggested by Kolb (1984) is designed to guide learners in identifying how they learn from experience. Kolb's learning cycle is divided into four stages; concrete experience (where the learners need to do the task and in this way permit learning to take place; reflective observation (where the learners reflect on and review their experience to learn from it and discover how to amend it in the future); abstract conceptualisation (where the learners fit what they have learned to their previous knowledge in order to amend and extend it).

Although all learning is founded biologically and neurologically (Säljö, 2009), researchers have defined the process of learning in various ways; some define it simply as the process of acquiring knowledge, while others define it as "an increase, through experience, of problem solving ability" (Washburne, 1936). One kind of learning, e-learning, is defined as the "delivery of learning, training

or educational program by electronic means" (Lim, 2012). Alternatively, it is "the delivery, over the internet, of concise and dynamic educational content and instructional methods which aims to build knowledge and skills for quality learning" (Pange & Pange, 2011). Building knowledge requires specific understanding of concepts and being able to relate them to on another. Concept mapping is an example of knowledge building strategy. According to Schwendimann, (2014), concept mapping is "a node-link diagram showing the semantic relationships among concepts". Visualising the concept can be a powerful graphic tool in teaching and learning that may unlock learners' abilities (Zhao et al., 2014).

2.6.1. **Behaviourism**

One of the first learning theories was Behaviourism. Behaviourists started by describing the learning process as an automatic, involuntary, permanent change in a person's behaviour which is a reaction to an environmental stimulus (Collins et al., 2001; Andrews & Haythornthwaite, 2014). The learning process can be kinaesthetic or symbolic. Therefore, Behaviourist-led teaching strategies involved individuals learning within conditioned environments and performing correctly on the basis of external feedback (Andrews & Haythornthwaite, 2014). In response to behaviourist theory. To learn more, researchers have extended the description of the behaviourist's process; for example, Collins et al., (2001) discussed Pavlov's theory of classical conditioning and proposed that learning is an involuntary response or reflex, and brings about a change in behaviour based on environmental stimulus. Moreover, Collins discussed Skinner's theory of operant conditioning to find a method of managing this type of learning. The theory states that positive and negative consequences (like punishment and reward) change specific behaviour permanently and can be used as strategies which, if implemented consistently, can result in effective learning (Collins et al., 2001; Scott, 2013).

2.6.2. Cognitivism

The behaviourists were challenged by cognitivists who suggested that human beings are active learners who select, filter and evaluate according to their needs and goals (Collins et al., 2001), and that these processes are enacted within their social interactions and not only inside the learner's mind (Scott, 2013). Cognitive learning theory has had a vast influence in modern learning, particularly its two concepts of assimilation and accommodation. Assimilation suggests that knowledge is acquired through relating new information to prior existing knowledge, whereas accommodation suggests that learners adjust, amend or add to their prior knowledge in order to fit in the new information (Andrews & Haythornthwaite, 2014) . However, it is worth mentioning that individual differences and mind-readiness have an impact on the process of acquiring knowledge (Cassidy, 2004). Hence, to accommodate these differences, it may be essential to implement a variety of styles of material

representation and effective personalisation as features that may allow us to widely support individual learners and their needs (Pange & Pange, 2011).

2.6.3. **Constructivism and other learning theories**

Constructivism is based on the premise that learners acquire and build their knowledge through their interactions, both socially and with the environment (Rovai, 2004). Constructivism defines learning as mental work (Andrews & Haythornthwaite, 2014). Ideally, Constructivism is initiated through an external stimulus. This is why Rovai (2004) suggested that learning materials must enable learners to construct knowledge rather than merely reproducing it. (Weegar & Pacis, 2012) observe that although online learning environments are behaviourist-driven, there has been a shift to providing constructivist support platforms. According to Weegar & Pacis, (2012), the aim seems to be to develop an environment that blends the two theories (behaviourism and constructivism) in light of other factors, such as assessment and resources.

2.7. Proposed Theoretical Framework

This research will develop a theoretical framework for examining the effects of new interventions on the CIU of the LMS. In brief, which will be detailed in the following sub-sections, the scope of the proposed framework involves three main theories, integrating the information success model with the technology acceptance model, herd behaviour theory, and goal-setting theory, as in **Error! R eference source not found.**. The Technology Acceptance Model (TAM) has been extensively used to measure learners' behavioural intention to use educational technologies. Thus, the perceived ease of use and perceived usefulness are strong predictors of the use of a technological intervention. Accordingly, the Information Success (IS) model was adopted to address the issues identified by TAM and to set a theoretical connection between the usability of a technological intervention and the CIU of LMS. TAM is successful in predicting intentions to use but not the intention to continue use. Thus, the TAM model will not be used to explain the CIU for the LMS; it will be used only to measure the use of the technological interventions.

In the Information Success Model, the predictors of use are the perceived benefits and satisfaction. The theoretical distinction between the intention to use and the intention to continue to use LMS is the valence of the satisfaction. Therefore, in this research, 'satisfaction' is replaced by 'cognitive absorption' because cognitive absorption indicates a high level of valence in engagement and provides a higher predictive power in explaining the change in learners' behaviours in receiving the benefits (i.e., PLSR), and being kept motivated to use LMS in the future (i.e., CIU). Similarly, the

perceived benefit is replaced by the PLSR, to indicate the original purpose of LMS as an education organiser technology.

In order to portray the relationship between the interventions and the CIU of LMS, two theories were adopted: herd theory and goal-setting theory. While herd theory focuses on the impact of exposing learners to the interactions of others (i.e., through TT), the goal-setting theory underlines the role of clear goals (by using VC intervention) in improving the acceptance of LMS. The goal-setting theory further highlights the ease of getting help to achieve these goals, without feeling unsafe or threatened, through directed and guided social media intervention.

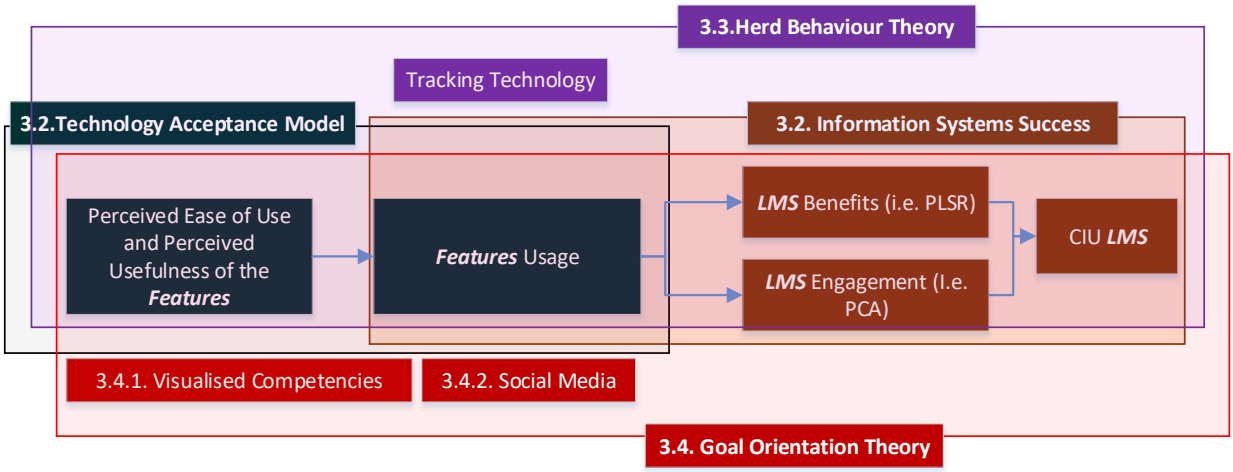

Figure 2-2 Proposed Theoretical framework

2.7.1. Herd Behaviour Theory

The first theoretical basis for introducing and defining technological intervention is the Herd Behavioural Theory. Herd Behaviour theory (HBT) is different in nature from self-regulation theory. HBT focuses on the mainly irrational imitation of others' behaviours while self-regulation theory focuses on a person's determination in his/her goal setting and the behaviours required to achieve these goals(Reeve, 2004) (Zimmerman 2002; Reeve, 2004). Herd Behaviour Theory (Banerjee, 1992) is based on the premise that individuals tend to follow an exhibited behaviour which seems to be legitimised and followed by others. Herd behaviour theory (Banerjee, 1992) is based on a natural human reaction to observing peers, which leads to imitating their behaviour to achieve a similar success level. In other words, an individual's decision is more likely to be influenced by the way that people around them choose, prefer, and behave. The concept of herd behaviour explains people's tendency to follow explicit behaviour when they see that others in the same group are applying it (Banerjee, 1992). This theory reflects the power of social pressure, as discussed by Shiller (1995) who explained the irrational aspects of herd behaviour as 'people follow the actions of others'.

Setting the relationship between herd behaviour and technology adoption involves several features. Herd behaviour theory is used to explain the adoption of technology by discounting users' internal beliefs and embracing the beliefs of others about the usefulness of an application, and the further adjustment of their behaviour to reflect changes in the level of use by others (Peng et al., 2009). Similarly, it was shown that, depending on the perception among technology adopters of the behaviours of others, a new adopter would then follow their interaction and behaviours (Darban & Amirkhiz, 2015). Similar evidence in Wang et al. (2019) also suggests a possible theoretical relationship between herd behaviour and the use of technology. Investigating the students' participation in an MOOC in China, Wang et al. (2019) observed irrational and rational herding behaviours among the learners. The term 'irrational behaviours' refers to passively following other learners' behaviour. Engaging in active observational learning to fulfil the learning needs a rational herding behaviour. Rational herding is the feature of most online learners and correlates with the difficulty of the course. The difference of this theory for face to face and online, "the media is the message" McLunhan (1967). Thus, technological intervention that could increase herding behaviour may contribute to improving the use of LMS and the intention to keep using it in the future.

2.7.2. Goal-Setting Theory

The second theoretical basis for improving the learners' CIU by defining a technological intervention is goal setting. According to goal-setting theory, the existence of a learning goal (i.e., the setting of a goal) and the characteristics of the goal (e.g., its clarity, contribution to ultimate goals, and relevance) affect the level of engagement with the conducting (Elliott & Dweck, 1988). According to Seidel (2005), the clarity and coherence of goals lead to enhancing students' competence in performing the learning tasks. Furthermore, Locke and Latham (2006) have suggested that learning goals require clarity and task specifications if they are to improve learners' performance.

Thus, this thesis argues that the factors defined in the goal-setting theory could contribute to learners' engagement and to influence their ability to plan effectively (i.e., PLSR). From this perspective, this thesis proposes that visual competence and social media as technological interventions could help learners to identify their expected learning outcomes and ways of communicating in order to better understand these outcomes, and further set plans for achieving these outcomes.

2.7.3. Technology Acceptance Model

The Technology Acceptance Model (TAM) developed by Davis et al., (1989) predicts users' acceptance and use of information technology by focusing on the system features that affect users'

acceptance. In general, acceptance is defined as "antagonism to the term refusal and means the positive decision to use an innovation" (Taherdoost, 2018, p. 86). TAM has been extensively studied in the literature as an efficient model for understanding and predicting learners' adoption of LMS (Harrati et al., 2016; Persico et al., 2014). Davis further suggested TAM (Davis et al., 1989) for understanding the use of information management systems. Furthermore, TAM has proved to be a fundamental model for understanding the human behaviour that predicts potential acceptance or rejection of technology (Marangunić & Granić, 2015). As reported by (Venkatesh & Bala, 2008), TAM is capable of persistently elucidating 40% of the variance in users' intention (Venkatesh & Bala, 2008).

Several studies empirically identified the factors that directly affect system use (Liu et al., 2010). These factors are the perceived usefulness (PU) and the Perceived Ease of Use (PEOU) of the system. The user's perception of usefulness and of ease of use are the main influencing factors of system use (Marangunić & Granić, 2015). PU is described as the level to which an individual believes that using a specific system would improve their task performance, while PEOU is defined as "the level to which an individual believes that using a specific system would be effortless" (Davis,1989, p.125). Based on a study of 252 Chinese learners, Wu and Chen (2017) also found that PEOU and PU affect the continued use of MOOCs. In this thesis, PEOU and PU are collectively referred to aspects of usability, as detailed in the design framework in Chapter 4.

Forty-two academic papers on using TAM in LMS have been analysed (Dinçer & Sahinkayasi, 2011) and it was concluded that TAM is significantly effective in predicting learners' actual use of LMS. A study considering 543 professionals who taught in Malaysian public schools was conducted by (Hamid, Razak, Bakar, & Abdullah, 2016). Hamid et al. (2016) investigated the relationships between predicting factors (perceived usefulness and perceived ease of use) and the intention to continue to use an online learning platform. It confirmed the positive effect of improved PU and PEOU on CIU. Similarly, Farhan et al., (2019) studied the perception of 102 undergraduates and 10 instructors in a Canadian university and concluded that learners' perceptions of usefulness and ease of use predict their attitude to the intention to continue to use LMS. Similarly, regarding the use of the social media, perceived ease of use and usefulness are essential factors in determining the intention to use. As evidenced in a study conducted by Dumpit and Fernandez (2017) of 500 responses from students in HE in the Philippines, it was found that the perceived playfulness, PEOU, and subjective norms significantly affect learners' use behaviour and intention to use. The actual use of the social media has a significant effect on acceptance and assimilating educational technologies.

2.7.4. Challenges with TAM to predict LMS CIU

Although TAM is shown to be effective in predicting learners' intention to use educational technologies, this model involves some issues, such as a lack of learning perspectives in the model, returning different results in different contexts, and inaccurate predictions.

The first challenge is concerned with the limited learning construct in the model. Therefore, the concept of 'learning' and 'learners' needs to be fundamentally included in the TAM extension for the field of education, as will be detailed in Chapter 4. This is due to the nature of LMS, whose users are, in fact, learners (Liu, Liao, & Pratt, 2009). In most of the published TAM research in the education field, the learning angle has been ignored. Methods for improving TAM were solely based on its system usability factors, e.g., PEOU, and PU (Chang, Hajiyev, & Su, 2017; Revythi & Tselios, 2019; Shroff, Deneen, & Ng, 2011).

To address this issue, Tarhini et al. (2016) collected a sample of 604 university students to investigate their perspectives on an extended TAM at Brunel University in the UK. Due to the TAM limitations in terms of its learning perspective, they extended the framework to include social, institutional, and learner factors. Their study concluded that PEOU and PU, along with social norms (SN), quality of the work-life balance, computer self-efficacy, and facilitating conditions of using LMS, have strongly affected the acceptance and use of LMS. Similar observations were made by Revythi & Tselios, (2019). They studied 345 university learners using an e-class platform and concluded that in an extended TAM framework, social norms, system accessibility, and self-efficacy significantly affected behavioural intention. They further showed that these factors might downplay the importance of PEOU and PU. Other learning-related factors were also included in the extended TAM. Abdullah and Ward (2016) identified the most often used external factors of TAM using a quantitative meta-analysis of 107 papers. These factors were Self-Efficacy, Subjective Norm, Enjoyment, Computer Anxiety, and Experience.

The second challenge with TAM is that it may return different results in different contexts, i.e., the TAM findings may be contradictory. Although Roca et al. (2006) found that PEOU and PU are critical predictors of CIU in LMS, Revythi and Tselios (2019), in contrast, concluded that while PEOU affects the behavioural intention, it does not affect the PU and the attitude to using the system. Nevertheless, Larmuseau et al. (2018) and Akman and Turhan (2015) reached different conclusions. Based on the data collected from 191 students using Moodle, they found that the PU affects the intention to use, but the PU fully mediates the impact of PEOU on the intention to use. A different observation was made by Akman & Turhan, (2017) while analysing the data collected

from 142 learners; it did not support the impact of PEOU on PU and the intention to use.

Cheng & Yuen, (2018) studied CIU based on TAM and the Expectation Confirmation Model to analyse the data collected from 1182 junior secondary learners in Hong Kong. Their results showed that, although the importance of PEOU as a predictor for CIU was increased throughout system use, the importance of PU diminished, which may indicate that the relative importance of these two metrics in predicting CIU varies over time. This study, however, did not consider the likely effect of the TEIs that can improve CIU. The differences could also be based on the nature of the technologies, as shown in Larmuseau et al.(2018), Akman and Turhan (2017), where conclusions were reached on results unlike those of Roca et al. (2006b) in terms of the effect of PEOU on the intention. Despite the effect of PEOU on the intention, a study on the benefits of perceptions revealed interesting findings; a group of 249 university students using Moodle showed that PEOU and PU both affect the perception of the benefits from the system, which then affects students' use of the system and their academic performance (Islam, 2013). Such dissimilarity in results, however, is unable to provide enough practical insight into learners' perspectives in the educational field.

Therefore, a carefully investigated extension is required to develop an efficient TAM for learners' uses of LMS. Note that the inclusion of learning constructs and understanding of the relationship between the perceived cognitive absorption and the perceived learning self-regulation have not been investigated in the current literature. Moreover, there are differences in the outcomes of earlier researchers who incorporated various external factors in their TAM extension model. Hence, a generalised TAM that can be directly transferred from one learning environment to another seems to be impractical (Sánchez-Franco et al., 2009).

Because of these challenges, the TAM will be used for assessing the technological interventions in use now but not will be used for assessing the CIU of the LMS, which needs to integrate a more psychologically based factor. Thus, for the LMS, the Information System Success Model will be used, as in the next section.

2.7.5. LMS Success Model

The critical challenge facing the TAM is the inconsistency of the findings, which can be attributed to the nature of the technology and/or how learners use LMS might undermine the value of PU or PEOU "PEOU" indicates the importance of using the technology; however, it may not be the key driver for using technology in the long term. Regardless of the importance of these two factors, learners will lack the clear motivation to use technology unless they can perceive the benefit of doing

so. There are other comparable concepts for reflecting the level of usefulness, e.g., the "perceived benefit". The benefit can be defined as the advantage perceived by the users in changing their behaviour to get new outcomes. The perceived usefulness and the perceived benefits are, however, philosophically different because technology can be useful but not necessarily something that changes the users' behaviour (Badewi & Shehab, 2016). Therefore, technology that leads to benefits needs a more substantial effect on behaviour rather than merely on the users' perceptions.

In this context, LMS is an application that is developed to regulate students' learning behaviours. If it cannot do this, then it is a "failed" initiative. Thus, in this research, the perceived benefit is attributed to the LMS platform, and the perceived usability is used for assessing the use of the tools added to LMS (i.e., the TEIs). In other words, for new tools to be added, they have to be perceived as useful and easy to use. Meanwhile, the perceived benefit predicts the intention to continue to use LMS in the future, i.e., the perceived learning self-regulation (PLSR) as a fundamental learning construct.

In this research, the IS success model was adopted to bridge the gap between the benefits and the intention to use LMS. The traditional IS model consists of service quality, system quality, information quality, perceived benefits, satisfaction, and intention to use (Petter et al., 2008). The relationship between the IS success model and LMS has been studied in the literature. For instance, a study by Dalle et al. (2020) was carried out to assess DeLone and McLean's information system success models in the LMS. The results of 98 survey responses revealed that system quality, information quality, and service quality are related to user satisfaction.

Furthermore, system quality and information quality predict the success of the LMS. Another study conducted by Ramírez-Correa et al. (2017) used DeLone and McLean's model to evaluate the moderating effects of the learning styles on the success of LMS from the learners' perspectives. The analysis of 258 responses showed that the IS success model was able to adequately explain students' satisfaction and the perceived benefit of LMS. Like TAM, the IS success model needed TEIs before it could be used in the learning context. The learning styles also affect the impacts and relationships among the variables of the success model. A study conducted by Cruz et al. (2019) also used the DeLone & McLean Information Success Model to measure the success of Moodle among college students. The model constructs were information quality, system quality, service quality, use, user satisfaction, and perceived net benefits. They further added a computer self-efficacy measure and complementary technology to the model. The proposed model explained the learners' satisfaction level with Moodle, which was mainly positive.

The information, system and service quality have been studied extensively in the related literature; hence there is no reason to replicate these factors any longer.

2.7.6. Integrating TAM and IS Success Model

The integration of the TAM and the IS success model was proposed in several papers to overcome the weaknesses of each, as detailed in Sections 2.5.2 and 2.5.3 neither of these models is sufficient on its own to predict CIU in LMS consistently. Thus, the research initiatives were to combine them into a single theoretical framework. For instance, Binyamin et al. (2019) conducted a study of 833 Saudi learners using LMS in higher education and found that content quality, system interactivity, and instructional assessment were the main predictors of perceived usability and usefulness. They further concluded that learning support is an essential factor in perceived usefulness. System learnability was also found to be an essential factor in the perceived ease of use. Their research further concluded that the perceived ease of use can predict perceived usefulness.

Another attempt to address the weakness of TAM was made by Mohammadi (2015), who integrated the TAM and the ISS model to explore the effects of quality features, perceived ease of use, and perceived usefulness, on users' intentions and satisfaction, alongside the mediating effect of usability on the use of e-learning. Based on a study on 420 Iranian students, he further found that "system quality" and "information quality" are the primary factors driving users' intentions, and PEOU and PU are the weakest factors. Similarly, (Koh & Kan, 2020) showed that LMS information and service quality increased students' satisfaction and predicted their intention to continue to use LMS.

CIU was also predicted by integrating self-determination theory into TAM (Roca, 2008). In their study of 172 university learners, they considered PEOU, PU, information quality, confirmation, service quality, system quality, and cognitive absorption, and showed that these factors affected CIU. This research adopted the theoretical integration of TAM and LMS because it can improve the predictive power of the LMS CIU as illustrated in **Error! Reference source not found.**.

2.7.7. Proposed Design Framework

In the present study, the proposed framework is based on integrating the TAM and ISS success models that are capable of predicting learners' Continuation Intention to Use (CIU) in Learning Management System (LMS), as clarified in Chapter 2. TAM is used to operationalise the use of the intervention in terms of Perceived Ease of Use (PEOU) and Perceived Usefulness (PU), while the Information System Success Model (ISSM) is used to assess the effect of these interventions on the CIU of the LMS. The modified ISSM replaces the "satisfaction" by "Perceived Cognitive

Absorption" and the "PLSR" by "perceived benefits" to reflect the nature of the CIU, instead of using 'intention to use' and the nature of the application is that of an organising tool for learners. Each of the proposed interventions is measured by the PU and PEOU. As detailed in Chapter 4, the significance of the intervention can be evaluated by the change in the Perceived Cognitive Absorption (PCA) and Perceived Learning Self-Regulation (PLSR) of the LMS, in turn strengthening the CIU as visualised in **Error! Reference source not found.**.

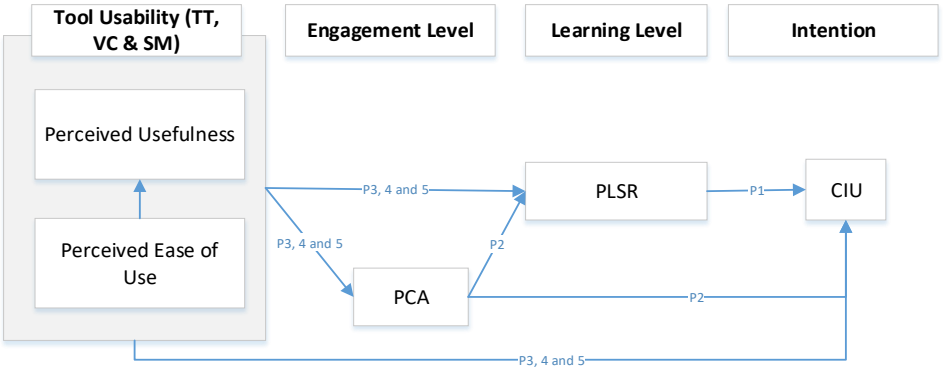

Figure 2-3 Design Framework

2.7.7.1. Proposition 1: The Effects of PLSR on the CIU of LMS

The ultimate purpose of LMS is to improve learners' ability to self-regulate. To be meaningful, the first criteria for a meaningful intervention is to improve the PLSR. I.e., the new intervention must improve the PLSR so that the CIU can be strengthened. The ISSM, as theorised in Chapter 2), suggests that if the purpose of the LMS is perceived to have been met (i.e. if it becomes a perceived benefit and operationalised in this research PLSR), CIU will be improved. There are two main theoretical perspectives explaining the proposed effect of the PLSR on CIU, those of perception theory and expectation theory.

First, according to perception theory, perception is subjective and based on contextual factors, i.e. people's perceptions and their interpretations are based on their experience, knowledge, background, and self-rating (Yammarino & Atwater, 1993). People's perception of themselves may also have a significant effect on their intentions (Maselli & Altrocchi, 1969). In other words, if a system improves one's perception of one's capabilities and performance, it will strengthen one's intention to keep using the system. There is academic evidence that PLSR and CIU are associated ~~positively~~. The relationship between PLSR and CIU was studied in Concannon et al. (2018). In their phenomenological study, Concannon et al. (2018) found that the courses that are designed to improve learners' perceived self-regulation strengthen their persistence on their course and their intention to take similar courses in the future. Self-regulation is formed not only from competence but also from

perception and experience, built up by the design of the course and the interfaces and characteristics of the LMS.

Second, according to expectation theory, if a system's users receive the expected benefits from the system, their intention to continue using the system is accordingly strengthened (Lee, 2010). Therefore, if the system can deliver the targeted objectives, the users are expected to use it in the future. PLSR is about the belief that one can set goals, plan accordingly, and then follow the plan. LMS is a system designed and implemented to improve learners' ability to set goals, plan accordingly, and follow the plan. Therefore, if LMS improves the PLSR, the CIU is expected to become stronger.

H1: PSRL positively affects CIU

2.7.7.2. Proposition 2: The Effects of PCA of CIU

The second criterion to ensure the meaningfulness of the intervention is the ability to improve the PCA. It is proposed in this section that the PCA can improve the CIU. Based on the ISSM, user satisfaction affects the perceived benefits and the intention to use the system. Using the same analogy, in the present study the PCA of LMS, was used as a stronger form of satisfaction. In design perspective, the new intervention could improve the PCAs which is theorised to have three positive effects on students' PLSR and the CIU the LMS.

First, by enhancing the learners PCA, it is proposed to improve the CIU because it can change the attitude to the system (Moreno et al., 2016), which can then affect the CIU. PCA is found to influence the continued use of social media in different contexts; for instance, a recent study by (Hsu & Lin, 2017) of 310 Facebook users shows that the CIU is affected by PCA. Using the same analogy in LMS, if students are fully engaged by the use of a learning technology, their engagement improves their attitude to the application of LMS, hence strengthening their intention to use it effectively. This is also shown by Moreno et al. (2017) in their examination of 251 students in Brazil. Venter and Swart (2018) further found that PCA directly affects the CIU in their study of an MS Office simulation of an interactive learning application. On the same lines, the present study proposes that improving the learner's PCA may accordingly intensify the CIU.

H2: PCA positively affects the CIU

Second, it is proposed that by improving the learners' PCA, the perception of the benefits from the LMS (i.e. PLSR) will be improved. A LMS is an application that aims to improve the learners'

perception of their personal ability to organise, structure and achieve learning objectives. It is shown in Basol and Balgalmis (2016); Karlinsky-Shichor and Zviran (2015) that the effective use of a software application improves its perceived benefits, i.e. the PLSR. Since the PCA can improve the effective use of applications (Moreno et al., 2017), the present study argues that PCA positively affects the PLSR.

H3: PCA positively affects PLSR

Third, it is proposed that the technological intervention that can improve the learners' PCA will influence CIU positively mediated by improving the perception of benefits from the LMS (i.e. PLSR). PCA does not, however, always affect the CIU because it can sometimes be perceived negatively. For instance, learners who had higher PCA in using Facebook were found to have a lower level of academic achievement (Rouis et al., 2011). Therefore, PCA needs to be directed to the purposeful use of applications. Otherwise, it could lead to poor results. Since the ultimate purpose of the application is to regulate one's learning activities, the present study proposes PLSR as a mediator between PCA and CIU.

H4: PCA affects the CIU mediated by PLSR

2.8. Chapter Summary

This chapter covers two main areas. They are the LMS perspective that focuses on a critical analysis of LMSs and success models and the learners' perspective that examines the factors of learning experience such as motivation, engagement and PLSR.

The objective of LMS is to enable learners to organise and navigate through learning content in ways that improve their learning experience. Researchers have proposed several integrations of new technologies. However, integrating such technologies in LMS is not always possible due to their costs. Hence, learning analysis, LA, was proposed to support learners' perceived experience as they progressed to self-regulation, LSR, and their competence in using LMS. LA dashboards can be either non-personalised or personalised. The former anonymously track peers' interactions while the latter compare a learner's performance with those of their peers. Although personalised LA provides tailored learning guidance, it might not be fit for academic learning since all learners in the same class need to progress at much the same pace. Besides, methods the compare students might distract them, lower their self-esteem, or hinder their learning self-regulation. Evidence presented in previous works also shows that the learners do not often like to use personalised dashboards.

Hence, this research focuses on non-personalised dashboards which track learners' activities and visualise their learning competence, while comparison aspects are excluded. The visual representation of learning competence displays the required competencies (i.e., learning goals) in the LMS interface or dashboard. In this research, Competencies are interpreted as learning outcomes and transferable skills, based on Bloom's Taxonomy. At the same time, the transferable skills were extracted from the literature.

In order to ensure a reasonable level of system use, the students need to engage and get their expected benefits from LMS. Cognitive absorption is a state of deep engagement and the immersion into interaction with a system, and it can be perceived as a negative or positive factor in academic performance. CA could be a negative factor in cases where it concerns immersive playfulness while learning. In contrast, positive CA results in cases where it is purposeful and leads to a transformation in learners' educational behaviour to reap the benefits of the technology. CA further requires social and interactive capabilities to improve learners CIU SM for learning.

Self-regulation, in contrast, has been clearly demonstrated to be a crucial predictor of students' success in academic learning in both online and conventional learning environments. Perceived LSR, as an indicator of self-regulation, is improved if learners receive benefits from a specific feature that is perceived to help them regulate their learning skills. Accordingly, a purposeful LMS design should fundamentally involve constructs that support learners' perception leading to the intention to continue to use the system in the future. These perceived elements are system usability, cognitive absorption, and learning self-regulation.

Due to the TAM's capacity to explain the intention to use, this research uses TAM in assessing the level of use of the new proposed LMS features. The use of these features is reflected in an improved perception of LMS benefits. The IS success model is also used to examine the CIU of LMS. Moreover, this research replaced satisfaction by PCA as a more robust indicator of future intentions. In other words, this research sets a theoretical connection between TAM on the feature level, and the IS Success model in LMS, while taking into consideration the nature of LMS as a self-regulating tool.

Last, but not the least to note, the new proposed features are built on theoretical perspectives. Herd theory and goal theory are used as guiding tools for introducing, developing and implementing the new features of the LMS. This means that if the proposed features are used successfully (as measured by the TAM), they can improve the PCA and PLSR of LMS, which in turn affects the CIU of LMS. Thus, the research question. "What are the antecedents of the CIU?" is partially answered here; they

are the PLSR and PCA which can be affected by the Dashboard and Social media. The next chapter aims to develop the research methodology to answer this research question, aim and objectives in which to theorise these effects and to set the theoretical basis for the effects of interventions in the PLSR and PCA that consequently affect the CIU.

Chapter 3: Research Methodology

3.1. Introduction

This chapter sets out the methodological paradigm, approach, and strategy for fulfilling the research objectives. It demonstrates the research paradigm and strategies that link computer science with pedagogy, and psychology as this research proceeds from design and implementation to evaluation. It also reports the selection, justification and application of the methods, techniques and tools used to tackle the aim and objectives of the present study. The rationale in this chapter is to justify the methods that were chosen.

Thus, this chapter starts with the research paradigm see Section (3.2) to discuss the ontological, epistemological, and axiological positions that underpin this research paradigm. On this basis, the research model relied upon a case study design that borrows from scientific research, as discussed in Section (3.3). The section after this details the research strategy. The study takes a multi-phased approach, as detailed in Section (3.4), to cover the several objectives of the present study (i.e., developing a theoretical framework, developing interventions, evaluating them, and examining the theoretical framework). Because the research phases cover different objectives, the methods are numerous and varied in nature. These are covered in Section (3.5) and are detailed in those chapters where the analyses are presented. Like the research methods, the analytical methods were many; the definition and the use of them are defended in Section (3.6) of this chapter. However, a detailed description of their use is reserved for the chapters that show the findings. The penultimate section assesses the research quality. The present study adopted rigorous measures to ensure the quality of the evidence supporting these research arguments. These quality measures are described in Section (3.7). The earlier discussion is illustrated in Figure 3-1.

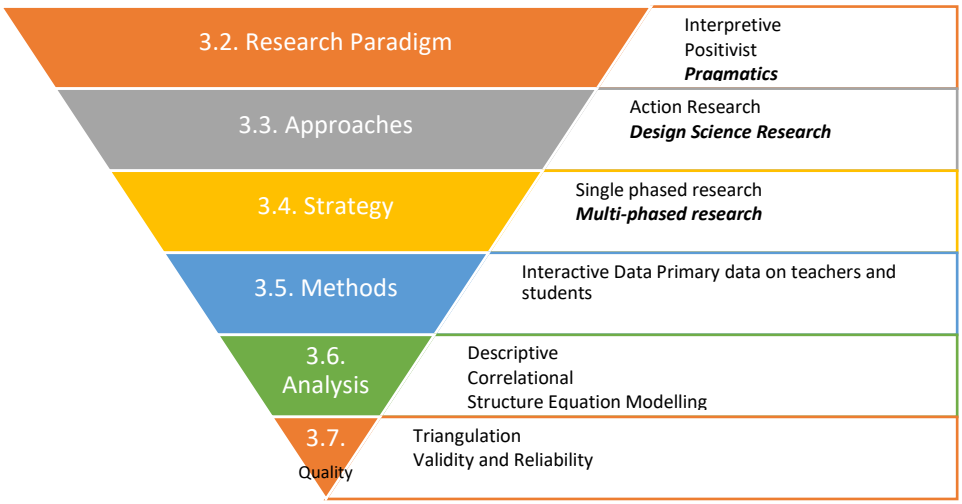

Figure 3-1 Research methodology and methods

3.2. Research Paradigm

The research paradigm embodies the researcher's worldview – what 'reality' means - and what contributes to it. The ultimate contribution of the present study is to the theory predicting the CIU and to setting theoretical foundations for developing and evaluating new interventions for improving it. A research paradigm has its own ontology (the nature of existing knowledge, whether it is single and universal, or multiple and varied by context); epistemology (which concerns how knowledge may be produced, for instance, by means of deductive reasoning, as a positivist sees it or, by induction, as an interpretivist sees it); and axiology (i.e., dealing with researchers' values) (Kanellis & Papadopoulos, 2011). In the following paragraphs, each of these aspects will be detailed.

Positivism and interpretivism are the two possible ontological stances. Positivist researchers argue that knowledge is universal and objectively measurable Singleton et al. (1988) whereas interpretive researchers believe that reality is varied and a phenomena which requires an investigative contextualization to be understood (Walsham, 2006). This research embraces the naturalism and accepts that reality is contingent on the context (i.e., the case of application) because countries may have different cultures and values influencing the research findings. The epistemological stance is in itself two-fold. The positivist epistemological approach is deductive in character because it presumes that a hypothesis can be objectively extrapolated from the literature and applied on a certain context (Stahl, 2014). Meanwhile, the interpretive approach is more concerned with the subjective basis on which knowledge is said to be built (Cavaye, 1996). The present study relies on both approaches. A positivist approach is necessary for reviewing the literature and analysing the constructs. However, an interpretive approach is essential for assessing the users' experiences (Kumar et al., 2017). In other words, the present study used an interpretive inductive approach to

develop and evaluate the technological interventions proposed, namely a tracking tool, visualised competency, and the social media in LMS. Elsewhere, the positivist deductive approach was used for theorising and testing the theoretical framework that was developed.

The last aspect of defining this research paradigm was the axiological stance. This standpoint underlined the levels of objectivity/subjectivity in collecting, understanding, presenting, and concluding. Positivist researchers claim to use objective quantitative tools such as questionnaire. In contrast, interpretive researchers believe that objectivity is impossible and consider the context of their own words and perceptions, accepting the inability to see except through the individual lens. The present study accommodates both views: it quantitatively and objectively test the theoretical framework using questionnaire (as detailed in section 3.5.4) but developed the interventions on the basis of the researcher's experience and knowledge and used contributions from the participant teachers that were based on each one's worldview. Thus, this research is using pragmatic approach in which the positivism and interpretivism are embraced. Moreover, the validation of the amendments and assessment of their effectiveness were based on the students' and teachers' interpretations, as detailed in Chapter 6.

To sum up, from an ontological, epistemological, and axiological perspective, the present study combined a positivist with an interpretive approach to provide coherence in the account of the object of study and the evaluation of the interventions. The study adopted a pragmatic theoretical position (Mackenzie, 2006) whereby the ontological, epistemological, and axiological stances were not inherited from any single classical school of thought (i.e., paradigm). Pragmatic research was consistent with the literature Venkatesh, et al. (2013) initiated from both positivist approaches using quantitative methods and movement towards an interpretive approach, and vice versa (Onwuegbuzie & Leech, 2005). Thus, the present study relied upon a deductive, theoretical framework which was tested objectively using quantitative techniques while the interventions were developed and evaluated interpretively, as illustrated in Figure 3-2.

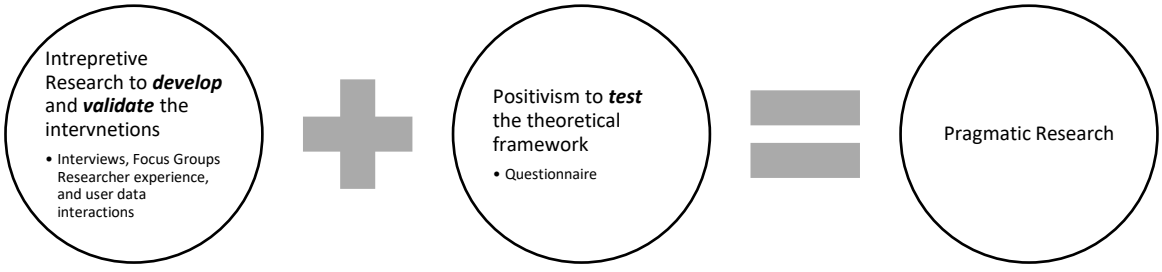

Figure 3-2 Research Paradigm

3.3. Research Approach

Each research paradigm has its own set of methods. For instance, the positivist approach relies upon surveys, experiments, and quasi-experiments (Huitema, 2011). Interpretivism has come to rely upon grounded theory borrowed from ethnography (Palmer, 2001) and phenomenological studies (Finlay, 1999). In contrast, pragmatic research combines positivism and interpretivism as a method for delivering the research objectives. Unlike the monolithic paradigms (i.e., positivist and interpretive), pragmatic research offers something more dynamic in this multi-phased context. Multi-phased research has taken various forms, but because the present study aimed to develop solutions, it favoured a scientific research design (Peffers al., 2007). Nevertheless, because the study needed to consider contextual factors, it also embraced a case study approach to help define the scope of the work (Yin, 2013).

3.3.1. Design Science Research (DSR)

The design science model is a multi-phased research approach often adopted in the fields of information systems and computer science for building industrial solutions (Peffers et al., 2007). Because one of the research objectives here was to develop amendments to the LMS that would enhance its future capacity, the design science approach was taken. As the present research is intensively concerned with learners' acceptance of LMS, design science was required to develop its methodology (MAGUIRE, 2001). Design science provided a framework for designing a research methodology which had three objectives, namely, to logically and rationally represent how the present research related to the literature; to articulate the researcher's methodological approach and to present and evaluate the findings of the research process (Peffers et al., 2007).

DSR has often been used in case study settings because they allow the improvements and impacts to be readily perceived, documented and evaluated (Gregor & Hevner, 2013). In brief, the design science methodology follows specific steps. They comprise understanding As-IS, setting the theoretical foundations for a new design, developing the new design, implementing, and evaluating, and then validating it through the participants' feedback. Accordingly, the present study used this similar approach. An understanding of As-Is was mainly drawn from the literature which set out the theoretical foundations in the form of an evaluation framework for possible amendments. The parameters of the new design were based on this evaluation framework, the design and implementation of new amendments; the feedback from the relevant stakeholders (i.e. teachers and students) was also a key factor. Finally, the effects of the intervention were examined.

Design science research, in general, can be pursued from two different standpoints: the research participants can be either passive collaborators or active observers. If they are passive, the researcher develops a solution without any direct intervention with the subject under study. For example, the research could provide solutions for teachers to follow unquestioningly. If they are active, the researcher works with participating teachers to redesign their modules and plans them to fit with the intervention needs (Lee & Hubona, 2017). Thus, the present researcher held workshops to guide the teachers, who lacked the required knowledge and skills, in defining their learning outcomes in terms of a revised Bloom's taxonomy. In addition, the researcher took a teaching position in designing a database of the transferable skills because it demanded work, time and effort unavailable to the teachers.

Moreover, teachers may also have a lack of time and opportunity to ensure the intended use of the SM according to a set of rules and policies. Accordingly, the researcher took an active role in moderating the chat and developing the rules and policies, supporting, and collaborating with the teacher participants. Thus, the present study borrows also from participatory action research(Kemmis et al., 2019) in recognition of the reciprocal relationship between the researcher and the participants as they sought a joint solution. According to the participatory action research, the research role is to design the solution based on understanding of AS-IS and its challenges then the design the solution. After the solution or interventions are defined, the researcher put them into action and assess and evaluate the effects of the interventions (Bradbury & Reason, 2001).

3.3.2. Case Study Research

As stated above, the present study also favoured the case study research because it could be used to investigate and understand a context in depth (Yin, 2013). This approach developed and examined new tools in general (Mcphee, 1997; Rowley, 2002) as well as new e-learning tools (Su, Bonk, Magjuka, Liu, & Lee, 2005). Researchers have also observed, noted, and studied an actor's behaviours in a given case (Johnson & Stake, 2006). The case study under investigation concerned Westminster International University in Tashkent (WIUT) which was established in 2002. Uzbekistan University was the first international university located in Central Asia to offer a Western-style education with UK qualifications.

This university had a clear strategy for enabling learners to study from home and on campus. According to the university website citation, an integral part of their teaching delivery is to integrate technology whenever possible. There were several reasons for selecting this case. The first was that the teachers and students agreed to take part in this study. Second, the selected course was in the computer science

department, unlike courses on technology literacy. Moreover, this course had one of the highest enrolments (400) in the WIUT and this number increased the reliability of the results.

3.4. Research Strategy

This multi-phased research four main sections, are shown in the diagram below. The literature review was used to develop the research framework and as a theoretical basis for developing the interventions (i.e., TT, VC, and SM). The development of the interventions used workshops, collaboration learning and interviews. The suitability of each intervention was evaluated using questionnaires, interviews with teacher participants and data from interaction analysis and social media data interaction analysis. The last phase tested the theoretical framework developed in the literature review. Figure 3-3 illustrates the research strategies.

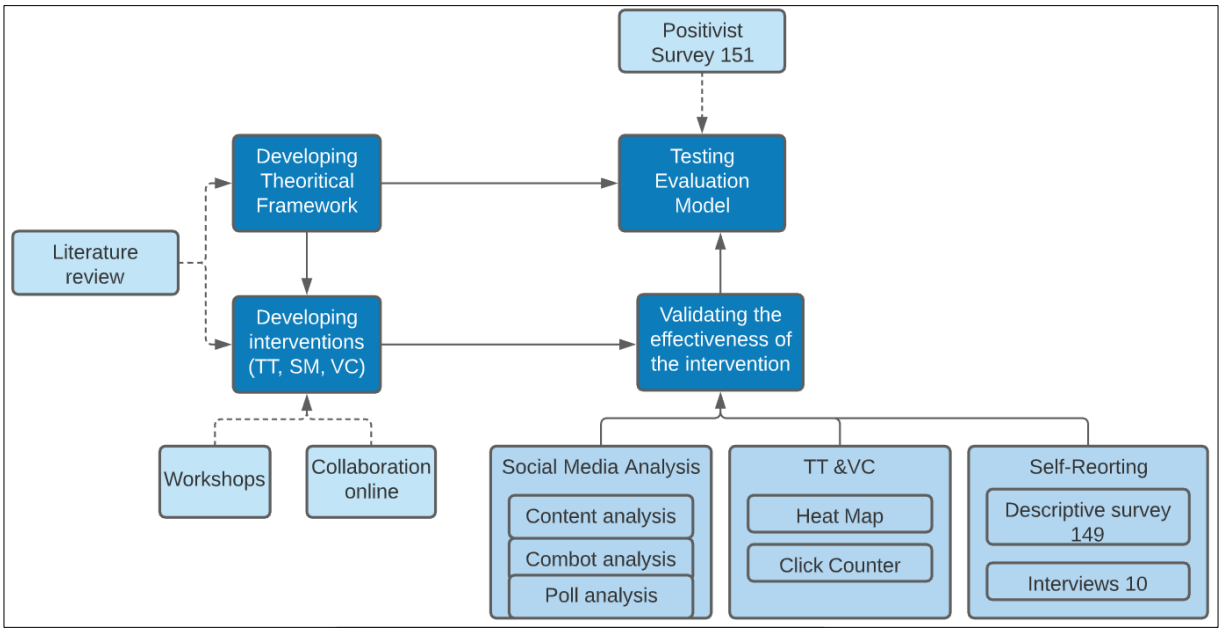

Figure 3-3 Research methods

3.5. Research Methods

This section aims to define and justify the use of the methods in the present study. Each of these methods is detailed in its appropriate chapter to avoid duplication. The methods used in the present study are data interaction analysis and self-reported data analysis. The data interaction analysis was meant for tracking the behaviour with the system and generated data automatically without the user's intervention that it reflects (Johnston, 2014). The data came from either the main LMS system or the social media platform. Self-reported data analysis captured respondents' feedback and opinions based on their subjective experience. In the study, the primary data collection methods were interviews, workshops, online collaboration, and questionnaires.

3.5.1. Interaction Analysis

Interaction analysis is a method for tracking a user's behaviour and activities on an interface. This method enables educational data mining to understand a learner's behaviour (Romero & Ventura, 2007). A wide range of researchers prefer this method because it automatically collects information in the background but does not disturb the learner's natural functioning (Belk et al., 2013). The present study used a heat map, click counter to capture users' interactions and student activity logging data.

3.5.1.1. Heat Map

The heat map is a data analysis technique which is used to portray the behaviour of recurrent user's slopes on a website as they interact within a particular area or with the content on a specified page of the website. The heat map can show intensified colours, reflecting the magnitude of the activity on specific content on a page (Wilkinson & Friendly, 2009). The darker the colour on the heat map, the more intense the activity. For example, heavier dots show more recurring activity. The cluster heat map is an original presentation that synchronically reveals clusters constructed in a data matrix in a row and column grid. It contains rectangular tiling, every tile being especially colour coded. Each colour symbolises the significance of the equivalent element of the grid. The rows (columns) of the tiling are structured such that analogous rows (columns) are alongside each other. On the vertical and horizontal limits of the tiling is an organised group of trees. This group heat map is a mixture of several diverse graphic displays that were established and developed by statisticians more than a century ago (Wilkinson & Friendly, 2009).

Heat-maps have been used in recent studies to deepen the understanding of students' behaviour on LMS. For example, in Kinnebrew et al. (2014), the researchers used a heat-map to analyse students' behaviour on a specific open-ended LMS which exposed them to meta-cognitive improvement strategies. The heat-map tool in the study data analysis helped the researchers to monitor behaviour in detail (Kinnebrew et al., 2014). The heat-map was used in large classes interacting with LMS to identify the behaviour of "at-risk" students, who were less likely to complete their course or risked failing it (Haig et al., 2013). Heat-maps were developed based on eye-tracking and cursor movement technology, where the more extended the gaze on particular content or area on the page, the darker the heat map colour appeared on the analysis presentation (Ramakrisnan et al., 2012; K. Sharma et al., 2014). This helped investigate students' behaviour in evaluating an LMS user interface through eye-tracking technology, but the present study could not synchronise the heat-map with eye-tracking

technology because of the cost involved. Instead, the heat-map adopted in the present study was based on the movement of the cursor on the interface.

3.5.1.2. Click Counter

Users' click behaviour is suggested in the early literature as a way of analysing user bias and satisfaction with content (Dupret & Liao, 2010). It is also used to predict user interest in content (White et al., 2010). The term 'click-stream' refers to the user's clicking behaviour as a collective sequence of analysis for the following sequence of queries posed by the user after clicking on content, including the time spent on each page, the sequence of pages and other parameters (Aalbert et al., 2010). However, users' click behaviour is accounted for by the need of system users to express their information needs in a task incrementally; thus, they click more often as their needs become clearer (Yuchen Zhang et al., 2011). The click counter will be used in the present study to capture by analysis the students' Moodle activity in log-inand social media.

3.5.1.3. Moodle student's activity logging

To define and count completed activities, Moodle activity logging is used. Analysis of students' logged files captured the students' behaviour and interaction on the LMS. In detail, the log file is accessed or downloaded content on the web that is automatically logged as a text file with an identical format to the background database (Poon et al., 2017). Explicit information gathering, like survey self-reporting, is still often used due to the direct information that it provided about users (Khribi et al., 2009). The implicit information-gathering approach is favoured sometimes because it collected data on the system background but did not disturb users' natural functioning (Belk et al., 2013). The present study is using both methods (questionnaire and students' login data in Moodle activity).

3.5.2. Social Media Analysis

Social media analysis is aimed at tracking and reporting the learners' behaviours and interactions with the proposed platform. These tracked behaviours indicated the levels of acceptance and possible retention (Peacock & Khan, 2019). Three main methods are adopted here. They are interaction analysis, voting and content analysis (Lee & Chun, 2016; Yoo, Song, & Jeong, 2018). While interaction analysis focuses on the user's actual behaviour over the SM, the voting and content analysis are used to collect standardised (i.e. voting) and unstandardised information (i.e. narratives in the chat).

3.5.2.1. Interaction Analysis

"Combot" is used as a free Telegram analysis (www.combot.org) . Combot is a tool which provides rich information on interaction and gives administrative options for regulating the chat and content exchanged over this platform. It is a third party free analytical online tool that gives group administrators insight into their group collaboration from different perspectives. It defines, counts, tracks and regulates messages, active users, new users, and converted users. In this research it gave information on many topics, such as active users (i.e., existing users who sent at least one message), users who had newly joined the group and sent at least one message, the number of messages exchanged during the period and the conversion rate (i.e. the ratio of students who had newly joined the group and sent at least one message to the whole). In addition, it summarises the group users' average activity, total of messages sent, and activity patterns at different times of day or during a complete day.

As hard evidence for the use of the SM in the learning process, the interaction data is a more reliable indicator for measuring user behaviour than for self-reported data. Conversely, self-reported data (i.e., from the questionnaires) helped to build a correlational analysis between perceptions, intentions and engagement. Thus, in the present study, the interaction analysis is used to validate the mechanism giving an aggregate measure for the use of SM among learners. Due to privacy concerns, it was not used to track interaction between identified learners, which limited the ability to consolidate these data with the results of the questionnaire.

Besides being a source of data, as in Figure 3-4 and Figure 3-5, it provided administrative and moderation features for the researcher as an active element for teachers. Combot allows master users to apply group rules for violations and other restrictions. This includes the prevention of repeated texts, inappropriate content, and the sending of a welcome message to new group users. Combot helped in the present study to implement the group policy in creating a group which collaborated over the social media to avoid possible topic distortions (i.e., discussing non-purposeful topics) when using the platform.

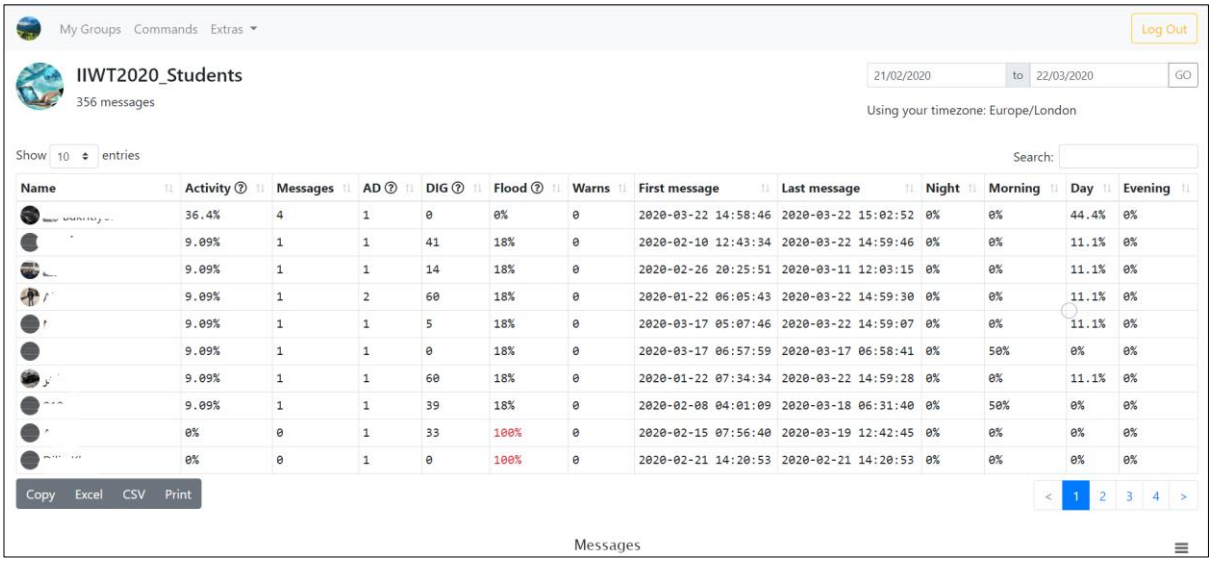

Figure 3-4 Message flood statistics on Telegram Combot

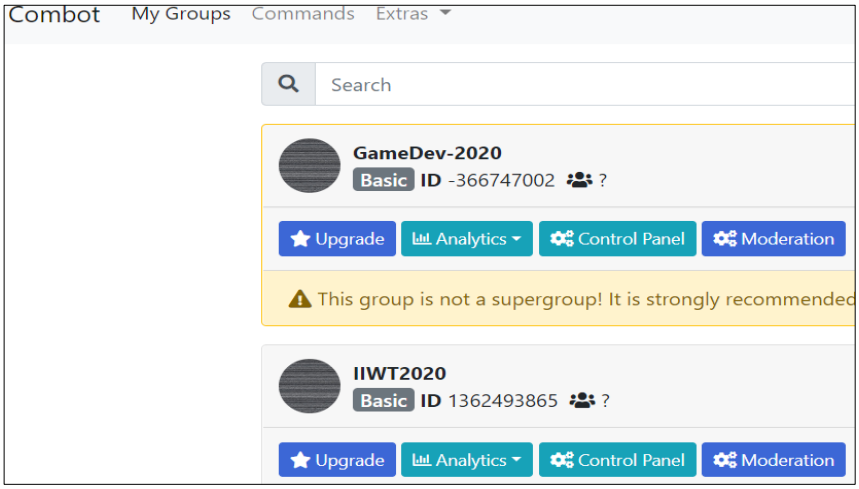

Figure 3-5 Combot group dashboard

3.5.2.2. Voting and Content Analysis

Content analysis is a method to classify the topics discussed on the platform (Riffe et al. 2014). In the present study, a text narrative analysis was conducted in which the researcher and the course leader searched with keywords using the keyword search bar on the Telegram group to retrieve the total number of messages sent using these keywords. The aim here was mainly to understand and identify the topics discussed by the students. Voting was another type of data analysis in the group discussion. The students were asked about their primary motive for using the discussion group. On another occasion, a poll was used for the weekly quizzes.

3.5.3. Teachers' Data Collections

This section discusses the data collected about from teachers and students. For example, the present research population was defined as the teachers and undergraduate students (male and female) at the International University of Westminster in Tashkent WIUT on the computer science course. In this case study, the 400 students enrolled on this course had 10 teachers altogether. Because there were only 10 teachers, the present study did not provide them with questionnaires because 10 were not considered a large enough sample to be reliable. Face-to-face interaction was required to develop the module LOs and transferable skills to develop the TT and select the social media platform. In addition, a discussion was convened so that the teachers could pool their experiences and knowledge in the designing process and to validate the usefulness of the intervention in improving the LMS CIU. The two used methods, in short, were focus groups and one-to-one interviews.

3.5.3.1. Focus Group

A focus group is a collaborative method for gaining knowledge from well-informed participants. It also helps researchers to understand better the context of their study (Smit & Cillers, 2006). In this way, the richness of the participants' beliefs, values, desires, concerns and aspirations is revealed for more extensive analysis. This corresponds with the design of the module's learning outcomes based on a revised version of Bloom's taxonomy and the technological interventions of the present research. Focus groups out-perform traditional interviews in terms of the internal validity of the knowledge gained. This is due to their responsiveness to recommendations made or to the proposals put forward by the participants. Thus, focus groups were used collaboratively to design the new amendments (such as their visualised competencies). The researcher did propose certain amendments based on the literature and from the researcher's perspective. As noted above, the teachers used their own experiences and subject knowledge of the topic to make recommendations.

Research with the focus group was longitudinal, not cross-sectional. 'Longitudinal' indicates that the same set of people met periodically. If it had been cross-sectional, the focus group would have described members at a single point in time. Longitudinal research was chosen because the number of teachers was fixed, and their inputs were necessary for the development of solutions. This process took 4 consecutive meetings over 4 weeks. During this period, the preferred online collaboration platform was Telegram, the teachers' own traditional social media platform (Hashemi & Chahooki, 2019) . The researcher's role was mainly asking questions and guiding according to the literature. In their role, the teachers gave answers, asked questions, drew up, improved, and accepted the new designs.

3.5.3.2. Interviews

Interviewing is one of the primary data collection methods for gaining the opinions, beliefs and experiences directly from the participants who took part in the present study (Kajornboon, 2005). Interviews serves a range of purposes from gaining knowledge to validating research constructs (i.e. concepts, arguments, models, designs or solutions). The present study used interviews for validating purposes to ensure that the design was deemed fit for purpose, took account of the teachers' background, and validated the implementation of the technological interventions, as well as triangulating with other methods, as will be detailed in section 3.7.1. Interviews can be classified as structured, semi-structured and unstructured. The structured approach is similar to a questionnaire where respondents are invited to pick one out of several options. The unstructured approach asked open questions, where the researcher having asked an opening question, follows the respondents without a clear pre-defined path for the interview. Between these extremes is the semi structured interview, on which the present study focused.

In the semi-structured approach, the researcher offers pre-defined questions and expects semi-predefined answers (Kajornboon, 2005).The present study adopted a semi-structured interview approach because validation, one of the main purposes of the interviews, covered aspects of fitness for use, usefulness, and ease of use, challenges and positive points. Nevertheless, the present study was open to accepting new answers and new questions, because sufficient flexibility for this was built in.

The semi-structured interviews assume that the respondents know and have experience of the subject. In the present case, the focus was on the teachers, who were relatively low in number and had greater experience of this field. The students were not interviewed because there would have been no way of generalising the perceptions of 400 students if only a small proportion of them had been interviewed and it was impracticable to interview them all. Accordingly, the present study targeted all the teachers who were involved in course preparation, teaching, and assessing students' feedback. Each of the interviews took around 30 to 60 minutes. Because the teachers did not have much time, the interviews were designed to be short. They set only five questions: on fitness for use, usefulness, and ease of use, on challenges and on positive points. The respondents were allowed to speak at their own pace for as long as they wanted.

3.5.4. Students Data collection

The interviews are helpful, considering the small number of participants. A questionnaire was preferred when the population was too large to be interviewed singly. In this research, 400 students, all from Uzbekistan, who had finished their first year in the Computer Science department, were using the LMS. This high number made questionnaires (also known as surveys) the most appropriate tool for collecting quantitative data. The questionnaires contained a list of structured questions that were prepared in advance (Rugg & Petre, 2007). According to Walliman (2016), a questionnaire as a research tool enables the questions and answers to be organised for rapid statistical analysis. A questionnaire instrument should be concise, simple, and straightforward, avoiding ambiguity or a lack of clarity. Academic courses at WIUT lasted eleven weeks. Accordingly, to avoid end-of-term stress, the surveys were distributed four weeks before the exam period.

The questionnaires are of two types, for the positivist and interpretive dimensions of the research (Lin, 1998; Mingers, 2001). The positivist questionnaire assumed that the respondents do not know very much, so the questions were short and concise. Data from this type of questionnaire were used for correlational and causal analysis. This approach helped in testing theories and hypotheses without any subjective discussion, enabling knowledge to be deduced from the literature and verified by experiment. This type of questionnaire was used to test the theoretical framework of the present study because its development was based on theoretical linkages and connections that had to be tested objectively.

The second type of questionnaire was interpretively used. The respondents were believed to be well-informed and able to comprehend and reflect upon the questions being asked. In this type of questionnaire, respondents were able to answer from their experience, beliefs, and knowledge and to confirm or refute relevant arguments. This approach is popular for validating arguments, as distinct from testing relationships. Using these two types of questionnaire was helpful for the present study because the first contributed to examining theories and the second confirmed that the users accepted these arguments (the perceived ease of use, usefulness, PLSR, PCA, and satisfaction from the technological interventions). Having two perspectives offered a multi-dimensional notion of reality by explaining the relationships on a theoretical basis and from the practitioners' perspectives.

Scales can be even (i.e. 2, 4 or 6 items) or odd (i.e. 3, 5, or 7 items). In even scales, the participants have to be either accept or reject, while in the odd, there is a space to select the middle point (i.e., neither agree nor disagree). This research preferred the odd scales because it gives space to the respondents to give a neutral response. Thus, participants have the freedom to select the right

reflections without pushing him/her to be negative or positive. Scales used in this research are five Likert items to assess the learners' acceptance towards different statements, regardless of being positive or interpretive questionnaires.

With all types of questionnaire, a pilot study is essential to try out the research method. A pilot study mimics the data collection process to detect and adjust potential pitfalls in preparation for the survey and the actual data collection phase of the research (Bryman, 2018). The last stage of developing the questionnaire involves a process pre-testing for validity, reliability, and mistakes (Presser & Blair, 1994; Presser et al., 2004; Reynolds et al., 1993).

The evolution of the questionnaire went through the following pre-testing phases: first, the supervisory team (two senior lecturers from the Psychology and Computer Science department) examined the preliminary version of the survey. In the present study, the pre-testing included recruiting a postgraduate student in psychology from the University of Westminster in the UK. 16 responses were collected, of which 7 had no missing data. Feedback on the questionnaire design, layout, using more straightforward language was given. The questionnaire was revised according to the recommendations received.

3.6. Analytical Methods

The analytical method can be chosen to suit the need from descriptive (i.e., mean, mode, standard deviation and skewness of the data) to multi-variant analysis (i.e. regression, and structural equation modelling). Descriptive analysis addresses and establishes the nature of the data and its current characteristic status and classification (Ertürk & Önaçan, 2016; Nassaji, 2015). Multivariate analysis (MVA) is the statistical analysis method for data collected on more than one dependent variable (Field, 2013). These variables can be correlated with each other, and the significance of their statistical dependence is taken into account when analysing such data. Thus, they can be used to assess the magnitude and the importance of the effects they cause.

While the first, interpretive, questionnaire aimed to measure the level of acceptance of different constructs (i.e. evaluation criteria), the descriptive analysis was optimal. The second, positivist, questionnaire was circulated to examine the relationships between different constructs; thus, multi-variant analysis was fit for this purpose since the level of sophistication of the review went from descriptive analysis to a multi-variant study. The following sections starts with descriptive analysis, then covered different multivariate methods to underline the justification for the use of this model in the research.

3.6.1. Descriptive Analysis

Descriptive analysis was useful for visualising and measuring parameters. It can be used to describe the characteristics of a sample and to indicate the degree of acceptance of a statement. Descriptive analysis in the present study presented and reflected the current stage of a student's perception of the three proposed LMS features. The main statistical methods applied were the mean and standard deviation. The mean identifies the current status of the sample without revealing the level of confidence or variance in this status. Thus, standard deviation measures the level of dispersion or the magnitude of variation of a set of values. The level of the variation can indicate the level of acceptance of a certain measure, i.e. a large standard deviation would indicate by the mean value a dispute and no widespread acceptance of the indicated figure.

3.6.2. Structure Equation Modelling

The examination of the theoretical framework required a suitable analytical model to measure the effects of the different proposed operationalised constructs on the CIU LMS. In order to examine this the research, the regression-based analytical models will be used. Regression analysis is the statistical model used to investigate the causal relationships between a dependent variable (known as the 'outcome variable') and one or more independent variables (known as 'predictors' or 'covariates') (Jolliffe, 1986). The aim in doing this is to confirm or challenge the hypotheses proposed for building the research evaluation model. This type of analysis computes the probability value (for instance, the significance level) and standardised coefficient (for instance, the predication value) for each hypothesis in one statistical operation. The evaluation presented two significant values for each hypothesis, the probability value (i.e. the significance level) and the standardised coefficient (i.e. the prediction value).

In addition, the hypothesis confirmed when its p-value (probability value) was lower than 0.05. Otherwise, the hypothesis was declined. The analysis covered the standardised coefficient for each hypothesis of the research despite their probability values since the significance of the relations had to be described for the confirmed and rejected hypotheses. There were several regression-based analytical models, which differed in the assumptions that they relied on. The regression models were unstructured regression-based models (i.e., simple and multiple) and structured based models (i.e. Covariance Based and Partial Least Square). The unstructured models gave flexibility but were less efficient and effective in testing. The unstructured analysis faced many challenges, such as multi-collinearity. Multicollinearity is defined as the significant interrelationships between the independent constructs which inflates the effects on the dependent variable. Thus, in case of significant

relationship between the independent variables, there is a need to treat this issue, as using structure equation modelling, to have unbiased and appropriate results (Hair et al., 2011).

The difficulty in building complex models lies in having many independent factors to consider at the same time, and the difficulty of addressing the model's significance. For these reasons, structural equation modelling (SEM) was adopted (Hair et al., 2011). Structural equation modelling is a regression-based model which involves a set of statistical methods that suits constructed networks. SEM simultaneously analyses a sequence of associated dependence relationships between the observed variables and the latent constructs and within a group of latent constructs. SEM is effective for weighting developed theories that consist of dependent relationships (Schreiber et al., 2016).

3.6.2.1. SEM Model Selection

The SEM essentially consists of two methods (Hair et al. 2016); Covariance Based (CB) SEM and Partial Least Square (PSL) SEM. Following (Ringle et al, 2014) and (Richter et al., 2016), CB SEM is applied in the following situation. First, the aim of the model is to examine a theory or to weigh different theories against each other. Second, error expressions such as covariation entail further description to enhance the model fitness. Third, the structural model has orbital relationships within the constructs. Fourth, the research requires a global goodness-of-fit measure. The present research did not use the CB SEM because no contrast between theories was required. The model fitness was confirmed, as in the PLS model. Fifth, no spherical relationships existed in the present research model.

Therefore, according to Hair et al (2014), PLS was applied as follows. First, the aim was to determine specific constructs or to classify key "driver" constructs, since it provides a comparison of different effects. Second, it was used in a complicated structural model that contained various constructs and indicators. Researchers suggest that PLS-SEM is ideal for the CB SEM because it caters for a wider range and greater flexibility of presumptions and practice, since the path model evolves throughout a discourse between the researcher and the computer (Wold, 2006). Above all, the researcher can allocate uncertain model improvements such as introducing a latent variable, an indicator, and an internal relation of a model which can easily provide a test with effective technique for predictive links.

Thus, the present research used PLS. The model was complex, having five interdependent constructs to evaluate LMS features and (PEOU, PU, PCA, PLSR, CIU); this created several direct and indirect effects. Accordingly, PLS was deemed more functional for producing significant outcomes, since it

considers non-parametric data and small sample sizes. In addition, the PLS works better than the CB method in certain areas. For example, in SEM, PLS-PM does not fit a common factor model to the data; instead, it fits a composite model (Hair et al., 2019). To be precise, SEM in PLS-PM enabled the present study model to enhance the total variance described and hence to validate the maximum feasible validity of the construct attained (Hair et al., 2017).

In the SEM for Path Analysis (PLS), bootstrapping was applied to measure the significance of the effects (Hair et al., 2016). Bootstrapping is a metric that utilises random sampling technique for replacing data events by mimicking the sampling process. The data were presumed to be not normally distributed, which does not comply with the use of parametric significance tests (Hair etl al, 2016). Hence, PLS-SEM depends on a non-parametric bootstrap method (Davison & Hinkley, 1997) to weight the significance of the measured path coefficients. In bootstrapping, partial samples are produced with randomly performed observations from the original set of data (with replacements). The partial sample is then tested to evaluate the PLS path model. This method is repeated until a significant number of random partial samples is generated, in this case 5,000. With these results, the t-values are computed to examine the significance of each estimate. In summary, the present research adopted the PLS-SEM statistical method which used bootstrapping to measure the significance of the direct and indirect effects of the proposed features of PEOU and PU on the outcome variables (PCA, PLSR, CIU).

3.6.2.2. Sample Specifications based on SEM

Statisticians have agreed that a sample size of 20-50 to measure each independent variable is a sufficient range in any research where SEM is applied, such as the multiple regression analysis and confirmatory factor analysis found in the present study. However, a ratio of 30:1 is a preferable way of making the measurements reliable (Kline, 2015). The developed model of the present research was structured of the following independent variables: PEOU, PU, PCA, PLSR, and CIU. The ratio of 30:1 suggests that the minimum sample size for the present research was 150 responses. The total number of participating students in the present study survey for the experiment in the case study was 149 (for the descriptive questionnaire) and151 (for testing the hypotheses), and these numbers became, on average, adequate for the research sampling requirements by satisfying the minimum range of 150 students.

3.7. Research Quality

Among the quality issues addressed in the present study to ensure the robustness of the results, the first was the use of methodological triangulation to ensure the validity and reliability of the research findings. The second concerned the quality of the instruments used in the present study. The main instrument used in the present study for examining and validating purposes was the questionnaire. Hence, the questionnaire was tested in many ways to ensure its validity and reliability. Moreover, the analytical models used to generate the research findings were tested to ensure their robustness and the adequacy of their margin of error.

Thus, the next section covers triangulation, discussing the rationale for this technique in the present study. The questionnaire quality and the model quality are considered in turn.

3.7.1. Triangulation

Triangulation "aims to reveal complementarity, convergence and dissonance among the findings" (Hussein, 2009). Triangulation was identified as the group of empirical measures that entailed a range of methods support and validate each other (Erzberger & Prein, 1997). It was considered useful for validating certain hypotheses or assumptions (Olsen, 2004). The present study combined two triangulation models, data, and methodological triangulation (Seamus, 2009). Data triangulation applies to the many techniques, sources, and situations in data collection. Here this was approached from two perspectives; the first was that the qualitative data should be substantially evaluated and discussed. It assessed the research case in depth, extracting information from another perspective than that taken to the quantitative data (Ammenwerth et al., 2003). Nonetheless, this approach had limited objectivity, which may have been an obstacle in grasping the overall situation (Tashakkori & Creswell, 2007). Hence, a quantitative evaluation was also needed to reduce the subjectivity of the researcher (Bergman, 2014).

3.7.2. Questionnaire Quality

The two qualitative characteristics of the questionnaire are its validity and reliability.

3.7.2.1. Validity

Validity measures assess whether the instrument can function as it required. A questionnaire's validity is concerned with the accurate presentation of the data that have to be measured, for which

the researcher is responsible. Nonetheless, a valid questionnaire should elicit accurate responses, and for these the respondent is responsible.

Thus, the questionnaire should have three different types of validity. The first is face validity, in which the researcher confirms with a sample of experts that the questionnaire will function as required, and ensures that the targeted sample understands the questions, without misinterpretation, as the researcher intended. The approval of three academics is advised to ensure that a questionnaire has face validity and confirm that the survey will perform its intended function (i.e. its descriptive purpose, for the use of the evaluation model, and its examination purposes for testing the relationships between the constructs in the model). Eight students were also interviewed to confirm the comprehensibility of the researcher's intended meaning in the constructs of the questionnaire.

The second type of validity is construct validity. A positivist survey needs to ensure discriminated construct validity, i.e. that the constructs measure different things so that multivariate analysis can be conducted. Construct validity aims to ensure that the items constituting the constructs are significantly connected. Thus, factor loading is used to examine whether the pre-defined items are well-loaded on their relevant constructs. This method examines the variance level of the indicators that have to be explained by the relevant latent variables (Urbach Frederik, 2010). All of the constructs in the present study had factor loadings of more than 0.6. This indicates the validity of the constructs in the three models.

The third validity measure is convergent validity, which compares the level of association of the items in the constructs with each other and with its composite constructs in order to associate these items with other constructs. It is measured by the average variance extracted (AVE) in which the magnitude of the variance in the indicators is compared. This magnitude is captured by a construct to show the level of variance due to measurement error. More than 0.5 is considered acceptable (Henseler et al., 2014). All AVEs are above 0.5, as indicated in Table 3-1.

Table 3-1: Factor Loadings and AVE

	TT	**VC**	**SM**	**References**
Perceived Usefulness (PU)	.62[1]	.65	.67	(Sánchez & Hueros, 2010; Davis, 1989; Ahmed & Ward, 2016; Mohammadi, 2015)
1. It is useful for my learning	0.72	0.78	0.77	
2. It improves my productivity in studying	0.83	0.85	0.85	
3. It enhances my effectiveness in studying	0.82	0.80	0.83	
4. It is advantageous for my learning	0.80	0.80	0.86	
5. It is practical to use in learning	0.77	0.79	0.78	
Perceived Ease of Use (PEOU)	.66[1]	0.76	0.71	(Roca et al., 2006;Davis, 1989;Ahmed & Ward, 2016; Mohammadi, 2015)
6. It is easy to follow	0.81	0.89	0.77	
7. It is clear and understandable	0.78	0.85	0.87	
8. It is easy to use	0.84	0.89	0.89	
9. It is effortless to use	0.80	0.87	0.84	

10. It is simple to follow	0.82	0.89	0.84	
Perceived Cognitive Absorption (PCA)	0.62[1]	0.62	0.62	(Roca et al., 2006)
31. I am fully absorbed by my study	0.75	0.74	0.74	
32. I can block all distraction from outside	0.80	0.79	0.78	
33. Time flies when I study	0.77	0.77	0.77	
34. I don't feel the time when I study it	0.82	0.82	0.83	
35. I get fully occupied with it	0.80	0.80	0.80	
Perceived Learning Self-Regulation (PLSR)	0.70[1]	0.70	0.70	(Wong et al., 2020)
36. I can manage my study time	0.82	0.82	0.82	
37. I can plan my learning tasks independently	0.85	0.85	0.85	
38. I know where to search for missing information	0.86	0.86	0.86	
39. I can track my learning progress independently	0.85	0.85	0.85	
40. I can evaluate my achievements	0.80	0.80	0.80	
Continuation Intention to Use (CIU)	0.78[1]	0.78	0.78	(Ifinedo, 2017; Mohammadi, 2015)
46.I am intending to use it in the future	0.87	0.87	0.86	
47. I will use the Moodle for learning in another module	0.84	0.84	0.84	
48. I would like to use the Moodle for learning again	0.92	0.92	0.92	
49. I am going to use the Moodle in the future	0.89	0.89	0.89	
50. I have in mind to use the Moodle again for learning	0.90	0.90	0.90	

[1] Average Variance Extraction (AVE)

3.7.2.2. Reliability

Reliability measures ensure the internal consistency of the constructs. "Internal consistency" describes the extent to which all the items in a test measure the same concept or construct and hence it is connected to the inter-relatedness of the items within the test (Henseler et al., 2014). (Tavakol & Dennick, 2011)There are three main measures for assessing construct reliability, namely, Rho_A, Composite Reliability and Cronbach's Alpha. Composite Reliability assesses the total of a latent variable's factor loadings depending on the total of factor loadings and taking account of error variance (Urbach & Ahlemann, 2010, p.19). An acceptable score of composite reliability is 0.6. The RhO_A uses the same concept as the CR, but has unstandardised loadings instead of standardised ones. The last measure is the Cronbach's Alpha model. Cronbach's alpha measures the average correlation of items in a survey instrument to judge its reliability (Santos et al., 2012). All of these indicators require a score higher than 0.6 to confirm the reliability of the scales that enables them to be used in the analytical models, as tabulated in table 3-2. All constructs have Cronbach's Alpha, Rho_A, and Composite reliability of more than 0.6 which indicates that the constructs of all the models are all reliable. Table 3shows the numeric data of the earlier discussion.

Table 3-2 Cronbach's Alpha, Rho_A, and Composite reliability

	Cronbach's Alpha			rho_A			Composite Reliability		
	TT	VC	SM	TT	VC	SM	TT	VC	SM
CIU	0.93	0.93	0.93	0.93	0.93	0.93	0.95	0.95	0.95
PCA	0.84	0.84	0.84	0.85	0.85	0.85	0.89	0.89	0.89
PLSR	0.89	0.89	0.89	0.89	0.89	0.89	0.92	0.92	0.92
PEOU	0.87	0.90	0.90	0.87	0.90	0.91	0.91	0.93	0.92
PU	0.85	0.86	0.88	0.86	0.87	0.88	0.89	0.90	0.91

3.7.3. Ethical Considerations

All of the students in the present study were involved in the data collection process, which included their engagement in activities and participation in the online survey, received an enrolment email to notify them that the process would be anonymous. The students, who were between 16 and 19 years old, could choose to withdraw from the voluntary data collection process at any time. None of them did so.

The current research followed the security policy guidelines for data protection and information required by the University of Westminster, London and required by the Westminster International University in Tashkent. This claim has been validated by obtaining ethical approval from both institutions. The present research was conducted in the UK, and employed undergraduate students on an open-source learning management system, Moodle. , To protect the data, the University of Westminster IT Management required that the Moodle should be installed on a server that was physically located in the UK or Europe since both followed the same data protection policy. This requirement was met, as evidenced in the pdf file Ethics-ETH1819-0409, pages 12,13 and 15.

The current research followed throughout the British Educational Research Association guidelines for educational research (https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018-online) and the General Data Protection Regulation (https://gdpr-info.eu/art-2-gdpr/) in terms of researcher responsibility, participants' consent, transparency, participants' right to withdraw, participants' privacy, and data storage. The evidence can be found on the Ethics-ETH1819-0409 file pages 4-6 and 22-26. The Telegram privacy policy (Telegram, 2020), Telegram stores UK ad EEA users' data are stored in a data centre in the Netherlands; however, the data remained owned by Telegram, which means that it has the same privacy protection and is not accessible locally. Telegram does not employ its users' personal information to personalise its streamed ads. Moreover, it does not use cookies for profiling or advertising. Furthermore, Telegram does not require any user's real name, gender, or date of birth. However, since it requires each user's mobile number, a user's contacts may still see him/her in their Telegram application despite the profile nickname chosen by the user. Telegram also provides a message self-destruction technique. This function works by permanently deleting the message once it has been read.

The Telegram messages, videos, and photos are stored on a "heavily encrypted" cloud service. The contents are encrypted before they reach the server with a key known to the sender and the recipient, with an end-to-end encryption service. The encryption keys are stored in several different data centres where each can be revealed under specific terms and conditions. Each item uploaded in

Telegram is encrypted with a key that is not known to the server. Moreover, another security layer is applied to encrypt the item key, its location, and the secret chat key that is sent to the recipient. In addition, Telegram follows the "secret chat" technique, which uses end-to-end encryption. This type of encryption requires a key that cannot interrupt the messages between two devices or users' accounts. In other words, the secret chat is not stored on the Telegram cloud and can be accessed only from a user's device. Therefore, Telegram provides more personal data protection for young learners. The complete ethical approval information (together with all the relevant documents) can be viewed in the appendix attached to this research.

3.8. Summary

This chapter discusses six methodological aspects of the present research: the research paradigm, approach, strategy, research methods, analytic methods and quality of the research. There are three main paradigms to choose from: positivist, interpretivist, and pragmatic (i.e. mixed). Each of these paradigms is detailed in terms of its ontological, epistemological, and axiological stance. The pragmatic paradigm was adopted in the present study due to the nature of the research (developing, evaluating, and examining interventions). The pragmatic paradigm mixes the three stances of the positivist and interpretivist research. In the present study the theoretical framework was deduced from the literature and was tested objectively using quantitative techniques while the interventions were developed and evaluated interpretively.

The present study adopted the design science research (DSR) strategy with a case study orientation. The DSR is a multi-phased research approach often adopted when a scientific approach is needed in the computer science field. One of the research objectives was to improve learners' CIU LMS; hence the DS approach was adopted to frame the present study. A case study model was required because it could be used to investigate and understand the context in depth. The present research case study took place at Westminster International University in Tashkent (WIUT). The course selected for study was in the Computer Science department, which ensured ICT literacy. It also ensured that sufficient numbers of students could be surveyed, in this case 400 of them.

The strategies adopted on this multi-phased research were applied in four main phases. First was the literature review which laid the research framework and was the theoretical basis for developing the interventions (i.e. TT, VC, and SM). The development of the interventions used workshops, collaborative learning and interviews. Then, the suitability, usability and importance of the interventions were evaluated via questionnaires, interviews with teachers, data interaction analysis

and social media analysis. Finally, the theoretical framework was tested to confirm or reject the proposed hypotheses behind it.

One of the main objectives of the present study was to consider students' behaviour on the LMS; three methods – a heat map, a click counter, and analysing the relevant students' logs on Moodle – were applied to extract behavioural data. Data interaction on the social media in question was also analysed by a plugging tool (Combot) which analyses students' behaviour in collaborative groups. Content analysis and polls (voting) were also used in the social media survey.

Students' perspectives were the main data that the present research aimed to evaluate. Accordingly, two types of self-reporting were elicited: questionnaires and interviews. Two questionnaires were used in the present study. A positivist survey was used for testing the theoretical framework (i.e. testing the effects on the perceptions of the LMS caused by the perceptions of the intervention), while an interpretive survey was used for evaluating the framework (i.e. the number or percentage of students who acknowledged the effect of the interventions on aspects of the LMS). The teachers' perspective was also required in the present study to develop and evaluate the interventions. Accordingly, the involved teachers took part in focus group meetings and interviews.

The analytical methods in the present study involved descriptive analysis, correlation analysis, and structural equation modelling (SEM). Descriptive analysis was derived from the interpretive questionnaire data to capture the level of acceptance of the statements of opinion (e.g. 'The TT improved my cognitive absorption in the LMS'). Inferential analysis was used for examining the effects of the usability of the interventions on the CIU.

Three aspects of quality were considered in the present study. The first was triangulation which aimed to reveal complementarity, convergence and dissonance among the findings. Two kinds of triangulation were used in the present study, the triangulation of findings and methodological triangulation which combined qualitative and quantitative approaches for a deeper and more accurate explanation of the accumulated data. The second aspect was questionnaire quality, which tackled the study's validity and reliability. Finally, ethical considerations were thoroughly implemented in the present study. The relevant document for the ethical approval of this research can be viewed on Appendix-Ethical approval.

Chapter 4: Solution Development

4.1. Introduction

This chapter proposes a new design framework for the LMS interventions to improve students' Continued Intention to Use an LMS. Following the design science methodology presented in the research methodology chapter, the first step is to design the solution by understanding and critiquing the current situation As-Is. Thus, the first section, Section (4.2), underlines the issues and challenges of the current design that could influence the learner's CIU and puts forward the motivation for new inventions and their specifications. Section 4.3 is dedicated to presenting a design framework for the development and setting the aims of the new interventions (i.e. PCA and PLSR). Sections (4.4), (4.5) and (4.6) detail the theoretical basis and development process for each of the proposed interventions (i.e., the tracking technology, competency-based technology, and social media). Hereafter, the final new proposed LMS interface and architecture is presented in Section (4.7) and (4.8).

4.2. The Current Design

This section lays a foundation for the new design by first discussing the current elements of the actual interface of the Moodle used in the present case study. This is examined on two levels, the LMS process and the design architecture.

4.2.1. Learning Management Process

To accomplish the learning objectives of the course, the students follow a specific sequence of activities. They begin with the registration process for enrolling on the LMS course. Students start their weekly interaction with the learning content by reading the material and watching videos, interacting in a forum, and sending emails to their course leader. The students complete their course by taking a final exam or completing an assignment. Apart from these, certain other features to support the learners, such as the use of forums, emails, and evidence-based competencies, as well as dashboards. The next table (Table 4-1) summarises the educational technologies available and their associated activities. The next subsection describes each element in detail.

Table 4-1 The Current As-Is: the LMS technologies used in the learning process.

Aspect	Activities	Evaluation
Registration	Recording students' demographics	No useful data here because they involve no applications to analyse students' interactions in a meaningful way for either students or teachers
	Tracking their activities	
	Assignment and examination	These are part of the course requirements for an undergraduate degree
Materials	Uploading and downloading course materials and videos	Different types of content can be uploaded to Moodle, such as videos, quizzes, articles and lessons. The distribution of the material varies with the course. For example, some instructors may distribute slides and articles every week while others may do so in every lesson. There are no visual or textual tools to guide students' solo learning
Forum	For interactive learning, where students share ideas and knowledge in a discursive and constructive way	Most undergraduate learners access Moodle only to download or to complete the required activities. Moodle forums are not accessible to mobiles. There is no privacy control over students' names on Moodle
Emails	For one-to-one conversations with the module leaders and students	Time-consuming for communication between students and instructors and even in peer collaboration. This has been replaced mainly by SM group communication for short queries that require formal writing protocols
Exam/final project	Assessing the students' achievements in the Learning Outcomes	There is no clear connection between students' engagement and their interactions, learning outcome achievement, and exam design. This is because teachers cannot correlate the students' content interactions with their examination scores.
Evidence-Based Competency (EBB)	This tool enables students to exhibit the skills that they have learned.	Course instructors do not use this, feeling that it is vague and not useful for them because it is too abstract and advanced. According to the interviewees,

		the Moodle EBB is not believed to be easy to use and can make students feel confused.
Dashboard	Moodle provides its evidence of students' progress via a series of reports that teachers can use	The course instructors do not use or investigate these reports. Some instructors are not even aware of their existence.

4.2.1.1. Registration

First, the registration process is done through students' self-enrolment, which requires every student's full name, university ID, and email address, in addition to some demographic data. After the successful registration, students receive a confirmation email to verify to access Moodle. User registration is the first requirement to complete before the student can gain access to their course page. Usually, this is followed by course enrolment (since Moodle gives access to an unlimited number of courses).

4.2.1.2. Material and Exam the

The second element is the learning content. It is distributed weekly in the form of videos, quizzes, lessons, and PowerPoint slides, in addition to other reading matter. Learning content can be organised as a weekly selection or based on folders named by the course instructor. Students access Moodle only to perform the required learning activities. Although the exams and assignments can be submitted and uploaded through Moodle, there is currently another platform for exams and assignments distinct from Moodle. In fact, exams are completed separately, usually on campus.

4.2.1.3. Forum

The third element is the discussion forum. It is supposed to be used for student collaborations but is only occasionally used for this. The current platform has a mailing system for sending questions or enquiries directly via a tutor, but in the current case the forums are not used for tutorial interviews. During the research period, Moodle forums were accessible only through the LMS itself and had no mobile facility.

4.2.1.4. Emails

The fourth element is the e-mailing system. This was intended to allow tutors to support students as required. But the data from interviews with tutors suggested that they believed students avoided using emails when they experienced minor challenges in their learning. Additionally, the tutors

believed the mailing system to waste their time because large groups of students often produced the same inquiry several times over. Direct conversation to groups was considered more effective, in view of the delays before email responses were received. Thus, this research worked on developing a structured and organised social media system to improve the flow of information among teachers and students.

4.2.1.5. Evidence-based competency

The fifth element is evidence-based competency, as described in Moodle: "Competencies describe the level of understanding or proficiency of a learner in certain subject-related skills. Competency-based education (CBE), also known as Competency-based learning or Skills-based learning, refers to systems of assessment and grading, where students demonstrate these competencies" (Moodl.org, 2019). The Moodle system adopts evidence- based competencies as its method of assessment.

An evidence-based competency tool is provided in Moodle: students can upload an assignment, essay, or some other required resource to the assigned competency to show that they have reached a milestone in their learning progress. One of the Moodle features asks students to reflect upon their achievements in a personalised plan provided by the instructor. Students receive the assigned competency on their dashboard, and as they complete the required tasks, they can upload their evidence to the course instructor, who marks it. Competencies are structured and connected to other Moodle tools (i.e., lesson plans) which provide learning plans for individual students. Although competencies offer rich potential in Moodle, they are rarely used because they require a degree of knowledge and skill to manage effectively. Moodle-competency settings require time and effort before the beginning of every academic term. Lastly, according to the interview data from tutors, the concept of competency is not understood by new academic staff, nor by instructors with a non-technical background. Although this facility should be of benefit to the tutors, they are, as they state, unfamiliar with the relevant technology and usually ignore it. Thus, this research aims to build a dynamic and useful weekly visualised competences as a remedy to this issue.

4.2.1.6. Dashboards and activity reports

As a sixth element, Moodle is rich in data about learners' interactions and behaviours. Moodle collects the students' essential primary data such as their name, ID, enrolled course, and email address. It provides the students with an automatic ID above which to log their completed activities on the platform and allows users to authenticate their access to higher ranks (i.e., to the course leader and administrator) and to search, retrieve and manage student logs instantly. This offers rich data

analytics, but the present research data suggests that, from the standpoint of the interviewees, there is no "useful" data analytic system in place for using these records.

Moodle provides sophisticated course administration tools and reports. For educational staff, exploring, managing, and using the data provided in these tools are perceived by teachers to be time-consuming, especially when added to an already heavy teaching load. Accordingly, a weekly system of briefing that required no navigation or manipulation might be more beneficial to the academic staff than fully detailed analytical reports which could benefit those who are specialised on studying student engagement with learning contents. Despite the analytical reports provided by Moodle, the data on students' activities during their academic term are not seen as the best way of conveying a clear view of their learning process. Moodle provides evidence of students' progress via several reports that teachers can use, but the course instructors tend not to use or explore these reports and some know nothing about them.

4.2.2. The Current Design Architecture

This section investigates the design architecture to propose areas for improvement and to ensure that the new interventions address weaknesses in the current design. Moreover, analysing the design architecture helped to ensure that new interventions were consistent with the current layout without impairing the functionality of the application by too many complications. Thus, a detailed service blueprint diagram is generated for the case study in Figure 4-1. Technically, the research developed requirements on Moodle are in four interacting layers. The first of these is physical evidence, which illustrates the separated interacting elements and processes containing the student email address, Forum, assignment and exams, and the students signing up and the materials. The second layer is the students' actions. It illustrates the research-relevant actions that the students perform while working on Moodle. The student action layer is the data generator for the data analysis phase of the research. The new interventions are operationalised on this level to ensure that students' behaviour will be consistent in the learning process and not over-engineered or over-complicated. The simplicity of the design is essential for ensuring the effective use of the LMS(Chen et al., 2018).

The third layer relates to the Moodle action. This layer exhibits the elements and processes which operate on Moodle to link the student action layer with the backstage action of the data collection. This layer was used in the present study for setting the interactive and dynamic data collection methods that fed into new elements of the design. The fourth layer is the backstage action which provides customised data for the visualisation phase on the Moodle course page but is not used in a meaningful way, though it could be used in the new design. These operational layers are illustrated

in the following diagram. The main teachrs' concern in the current design is that there is a weak feedback loop for informing students about their peers and for ensuring that students are fully aware of the possible learning outcomes through their interactions with these peers. These challenges set the foundation for the proposed design framework in the next section to address these points.

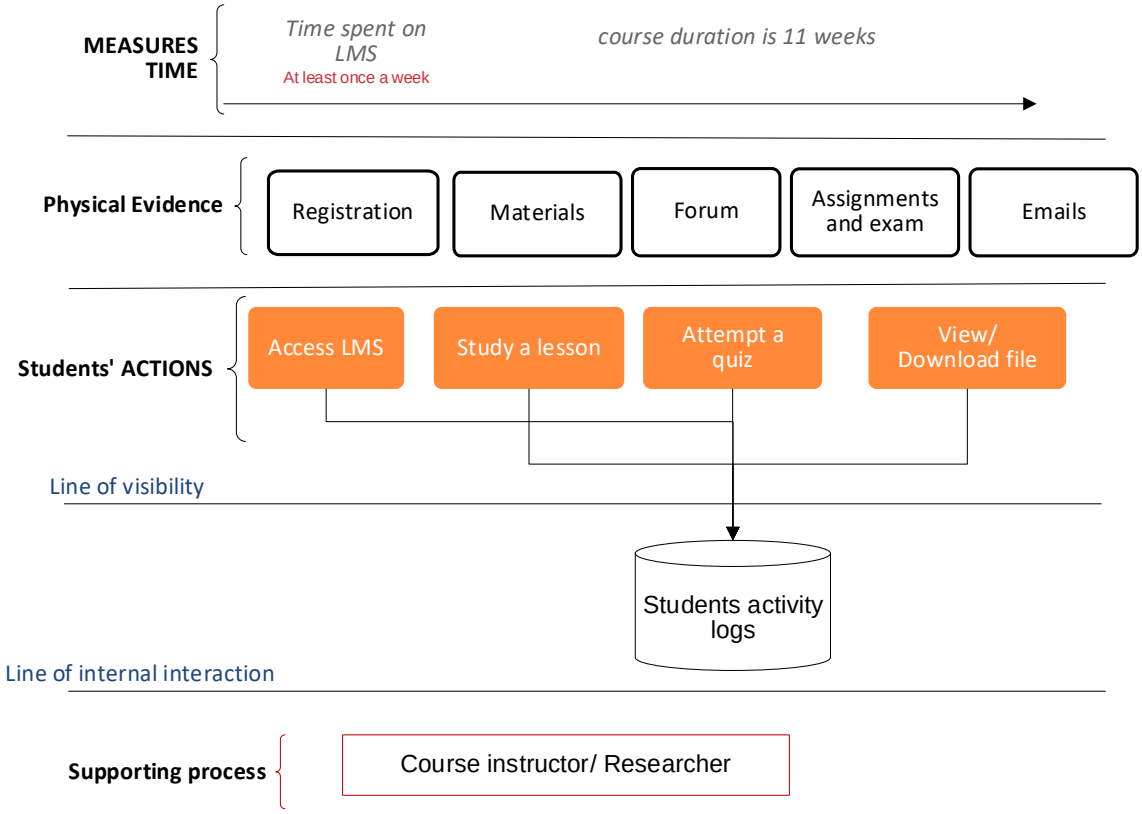

Figure 4-1 Default Moodle operational layers

4.3. Proposed Design framework

Based on the theoretical bases of this research in defining the success in Chapter 2, to have a meaningful technological intervention, they have to be easy to use, useful, and have an effect on the learners' PCA and PLSR from the LMS. The next sections will define these criteria to propose the technological interventions in the following section.

4.3.1. Criteria of the new interventions

The new interventions have to pass four quality criteria, PEOU, PU, PLSR, and PCA. The usability of the interface design is a key factor in predicting the learners' experience and system use (Al Mahdi et al., 2019). In other words, the most critical goal for instructional designers and educators is to develop productive learning environments that support learners in becoming engaged, self-directed, and self-regulated (i.e. autonomous learners) (Liaw & Huang, 2013). The critical factor for consolidating these points is the usability of the system, for without usability, the experience, use

and perceptions of the usefulness and benefits will be undermined. Usability reflects the *perceived ease of navigating the site* (Flavián et al. 2006). In the present study, usability is a criterion in designing solutions, and it is evaluated through PEOU and PU. Also, in the design, the interventions in themselves shall improve the learners' PCA and PLSR from the technology which in turn could influence their perceptions of the PCA and PLSR towards the LMS. I.e., the design criteria are PEOU, PU, PLSR and PCA. By having these criteria, the interventions are argued in this research to affect the LMS PLSR, PCA and CIU. The evaluation of the interventions as PEOU, PU, PLSR and PCA are done in chapter 5 while the examination of the effect of the PEOU and PU of the technological intervention on the LMS PCA and PLSR are in chapter 6.

To sum up, the success of the technological interventions will be assessed on two levels: first, the level of use, which is operationalised by the perception of ease of use and usefulness. The second, the effectiveness of the interventions, will be measured by the impact of these perceptions on the PCA and PLSR of the LMS so that CIU can be improved.

4.3.2. Proposed Technological Interventions

Due to the challenges in the current As-Is, the present study proposed three main interventions and activation of the Moodle features to improve the learners' perceptions of LMS benefits (i.e., PSRL) to be more engaged and satisfied (i.e. PCA) which could improve the CIU LMS. The interventions are Tracking Technology (TT), Visualised Competency (VC), Click Counter (CC), and Social Media (SM) integration. Table 4-2 summarises the status and nature of the interventions. Each of these interventions will be detailed in terms of theoretical bases and design characteristics in the following sections.

Table 4-2: Interventions and Justification

Intervention	Current Status	FUTURE STATUS	Justification
Activity reports	Not activated and not used	Activating and improving them for every activity and on the main interface	Students will be engaged because they will know what others are doing
Competency reports	Not activated and not used	Activating but customizing them to for weekly adoption and revising Bloom's Taxonomy for defining them.	Students will know the LO per week
Forums and emails	Not activated and the email not seen as useful	Telegram to be used because it protects students' privacy and has grouping technology for filtering and organising information in a meaningful way.	Students will use the SM platform that they are used to. Besides, they prefer the one which gives them control over their personal information, including their names. All students prefer applicable mobile platforms to those

			which are accessible only through certain websites such as their LMS.
Click counter	Non-existent	Developed to be a tracking tool for reporting in different interventions (TT and VC).	In order to report users' interaction, a tracking technology was needed to mine log files and to report these data meaningfully and purposefully.

4.4. Tracking Technology

The first proposed intervention is the tracking technology. First, the following section will set the theoretical basis to propose the possible effects on the PLSR and PCA of the LMS so that CIU can be improved. This theoretical base will be translated into design elements in the following section.

4.4.1. Theoretical Basis

Herd behaviour theory, as proposed in Chapter 2, was adopted in the present study to theorise the potential impact of TT on improving learners' PCA and PLSR. This TT could improve their PCA and their perception of an improved LSR. Improved perception of PLSR and PCA suggested by herd theory might further improve learners' LMS CIU. According to herd theory, users who are exposed to certain behaviours performed by others follow a similar pattern.

People's decisions and behaviours are biased towards imitating and following the herd (Banerjee, 1992; Duffy & Azevedo, 2015). Herd behaviour theory suggests that exposing learners to a technology that displays the behaviours of others (e.g., as shown by tracking tools (TTs)), is assumed to enhance their intention to follow and imitate the perceived learning practices of those others. The rationale for herd behaviour lies in people's belief that others may have access to some critical information that is unavailable to themselves. According to the arguments of Banerjee (1992), decision rules are characterised by a need to follow rather than lead.

The concept of TT is borrowed not from comparison theory as found in the classic literature, but rather from the leading fundamental theory here, that of herd behaviour. This operates by eliminating the self from the comparison and letting the learner see the pattern of the herd's behaviour. This research adopted the Herd Behaviour theory to develop the TT intervention.

The learners will follow the herd because learners feel safe and legitimate when they follow the herd as deduced from Banerjee (1992) research on the herd effect of information of early voting figures on the public behaviour in their consequent voting. Banerjee found a sequential decision model in which every decision-maker looked at the decisions made by previous decision-makers before taking her own decision. This approach in designing the tracking technology is different from the others

developed based on the competition theory. The adoption of the competition theory, the current format used in the literature shows student performance compared to others in the class. This, as found in the literature (Jivet et al., 2017), could lead to an increase in unhealthy competition and shift the focus from learning new skills and competences. Thus, when adapted in the present study, it will be customised to show up the performance of others yet without comparing the learner behaviour with that of others.

TT is a motivational learning method which has proved its effectiveness in traditional learning sets, as previous research suggests. The present study considers usability and usefulness as confirmation that the tracking tool is used. In other words, since students express their perceptions of its usefulness and its ease of use, their perceived benefits and proposed affects on the learners' cognitive absorption can be improved so that the CIU of the LMS can be enhanced. Thus, it is proposed that the more the TT is used, which is operationalised in the PEOU and PU, the learners will have higher tendency to keep using the LMS in the future.

H5: Perceived usability of TT affects CIU positively
H5a: PEOU of TT affects CIU positively
H5b: PU of TT affects CIU positively

4.4.1.1. TT & PCA

The use of tracking technology is proposed to influence learners' PCA in LMS. According to herd behaviour theory, learners will be motivated and engaged by following the steps of others. In the literature, Zhao et al. (2020) concluded that, because of the herding effect, the tracked software applications that form the largest group of downloads are the most likely ones to be discontinued. This indicates a level of engagement in buying the application without sufficient reason. Viewing and copying the completed activities could develop learners' engagement to a deeper level because the learning content is meaningful and not a mere set of random tasks (Jivet et al., 2017). Wang et al. (2019) also reported that a higher level of difficulty in the online course is correlated with more rational herd behaviour. This means that, when learning is concerned, the students tend to become intensely focused on the content as they follow the herd.

Similarly, information about others on the dashboard could affect learners' engagement with the system. This is because displaying the information could initiate their self-evaluation compared with their peers (since it makes them feel connected). This then improves their perception of their cognitive engagement (Jivet et al., 2017). Therefore, tracking technology will affect the learners' perceived cognitive absorption. Thus, it is proposed in this research that the more the use of the TT,

which is operationalised in the level of PEOU and PU, will affect the learners' perception of cognitive absorption from the use of the LMS.

H6: Perceived usability of TT affects PCA positively
H6a: PEOU of TT affects PCA positively
H6b: PU of TT affects PCA positively

In the ISSM, satisfaction is a mediator between the system features and the intention to use the system. The present study uses this analogy in LMS: if using TT improves the level of perceived cognitive absorption, the usability of the tracking technology can affect the CIU. In this research, satisfaction is replaced by PCA because it preserves a stronger and deeper valence which would lead to an increased intention to use, and an increased intention to continue to use LMS. Accordingly, the following hypotheses were developed.

H7: Perceived usability of TT affects CIU positively mediated by the positive effects of PCA
H7a: PEOU of TT affects CIU positively mediated by the positive effects of PCA
H7b: PU of TT affects CIU positively mediated by the positive effects of PCA

4.4.1.2. TT & PLSR

Learning analytics was found to enhance learners' awareness and regulation of their learning processes (Schumacher & Ifenthaler, 2018). The tracking tool is proposed to improve the learners' perceived self-regulation skills by exposing them to others' learning practices. According to social comparison theory (Festinger, 1954), when students can observe other students' performance, they can set goals and plan more effectively and efficiently (Venkatesh; Viaswanath & Davis; Fred D., 2000). This is unlike a calibrated self-comparison of a learning self-regulation LA, which could negatively affect learners' self-esteem. Instead, the present study uses the power of learners perceived self-regulation in learning to retain their focus on their perception of their learning while using the tracking tools. Learners will be able to know more about the relative weights of each topic based on the number of clicks by others. As Hager et al., (2013) found that the user of web based learning in the form of a learning journal, can improve the use of the technology, This research proposes that the tracking technology can influence their perception of self-regulation. The evidence here can be strengthened and magnified by research (Wang et al., 2019) which concluded that rational herd behaviour is a persistent pattern demonstrated by learners to alleviate the complexity of a module by planning based on the efforts of others and the time they spend on the learning activities.

H8: The usability of tracking technology affects PLSR positively.
H8a: PEOU of TT affects PLSR positively
H8b: PU of TT affects PLSR positively

The TT as an organisational tool could also improve the sense of a task being structured and being in control of it; this map improves the learners' perception of the value of an application as a self-regulating tool (i.e. PLSR). This positive perception could then affect the positive attitude to continuing to use an LMS in the future. The TT could affect the PLSR, which has been proposed to influence the CIU. Therefore, the present study proposes that the TT affects the CIU mediated by the PLSR.

H9: Perceived usability affects CIU mediated by PLS
H9a: PEOU of TT affects CIU positively mediated by the positive effects of PLSR
H9b: PU of TT affects CIU positively mediated by the positive effects of PLSR

The students are presumed to become immersed and focused on completing the learning activities in order to follow the herd. This could establish their perceived cognitive absorption. Only then could the students perceived self-regulation be improved. This could be explained as follows: the students will be focused and deeply engaged with viewing and completing the learning activities on time (since the weekly topic of the module is represented graphically). They will need to perceive themselves as they interact, reason, search for content, set goals, and plan to complete the activities. These skills are the critical dimensions of the PLSR

H10: TT usability affects PLSR mediated by PCA
H10a: PEOU of TT affects PLSR mediated by the positive effects of PCA
H10b: PU of TT affects PLSR mediated by the positive effects of PCA

The level of cognitive absorption in the use of the dashboard can be a determining factor in the CIU (Arnold & Pistilli, 2012). In other words, for purposeful behavioural engagement (i.e. PLSR) resulting from the motivational context (i.e. PCA), the cognitive behavioural engagement could be improved, which could then lead to the improvement of the intention to continue using an LMS.

H11: TT usability affects CIU mediated by PCA & PLSR
H11a: PEOU of TT affects CIU positively mediated by the positive effects of PCA & PLSR
H11b: PU of TT affects CIU positively mediated by the positive effects of PCA & PLSR

4.4.2. Design of the TT

The tracking tool is designed to have an effect on the users consistent with herd behaviour theory, and it correspondingly affects their CIU. The herd behaviour is encapsulated in the present study by a non-personalised tracking tool that is updated weekly via the module tutor. TT is featured operationally, by displaying students' completed activities on the Moodle user interface where other students can view them. In other words, it is expected that the exposed learners will follow other learners' steps and imitate them by increasing use of LMS. This could make become a habit which then improves the learners' acceptance of the technology and their intention to use LMS in the future.

Thus, activity reports are customised to include new indicators reflecting others' behaviour. In order to develop this activity report, the click counter is customised for this purpose. The technological intervention of the TT requires two new processes: data collection and data presentation. Thus, the researcher tailored the current click counter and tracking technology to fit this research purpose, as detailed in the next sections.

4.4.2.1. Click Counters

To collect information on learners' interactions, a click counter is used and customised to fit the purpose of this research. Tracking learners' is a well-established practice that involves following their navigational behaviour by logging their interaction with hyperlinks (Belk et al., 2013; Goulão & Menedez, 2015). The click counter indicates the behavioural intention to use the system (Toohey et al., 2019), and is considered a primary mechanism for collecting interaction data to feed the instructor's dashboard. The data on the click counters are reported to the students through the TT system.

Thus, the present study's click counter is developed to provide further insight into students' perspectives on the proposed features from a different angle. All clicks are recorded even when repeated by the same student. A re-clicked item could reflect the importance of the topic or the feature being revisited. In other words, non-unique clicks are also recorded. The "Like" counter collected only unique clicks. i.e. the student could click once only on the "Like" button. The like-counter captured the student's instant perception of the TT and the competency guidance visualisation. The deeper level click counter of competency sub-guidance is shown on Figure 4-4 and Figure 4-5. These data tended to show the students' interest in the competency being illustrated. There was a more in-depth investigation of the impact of the tracking tool panel on students' behaviour. This was implemented by adding a counter to each activity link to measure the number of times that students accessed it.

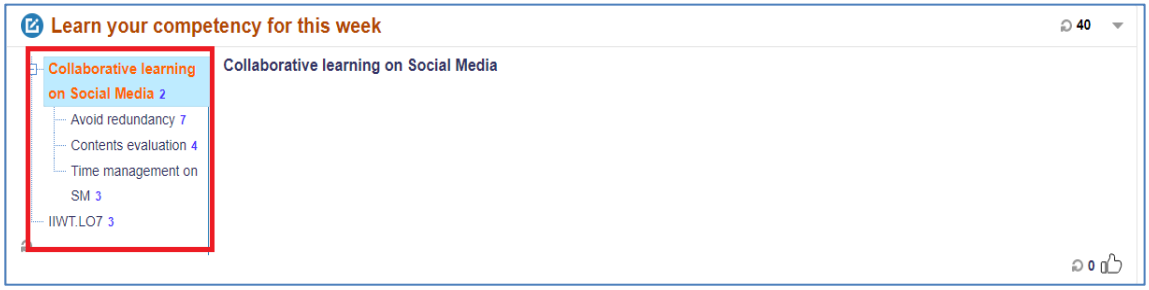

Figure 4-2 Click counter on the Visualised Competency

Figure 4-3:Click counter on the Visualised Competency

Based on the click and Like counters implemented on the features developed in the present study, the following weekly counters log is provided in Table 4-3 and figure 4-6, to record the students' interaction with the proposed features on a weekly basis. The full weekly log of the case study is presented in Chapter 7 where the data are analysed.

Table 4-3: Visualised Competency click counter log

Week	Visualised competency	Click counts to expand the table	Click counts on the sub-skills	Number of Likes
13th- 17th Jan	Learning self-regulation	378	500	260
20th – 24th Jan	Effective team worker	480		

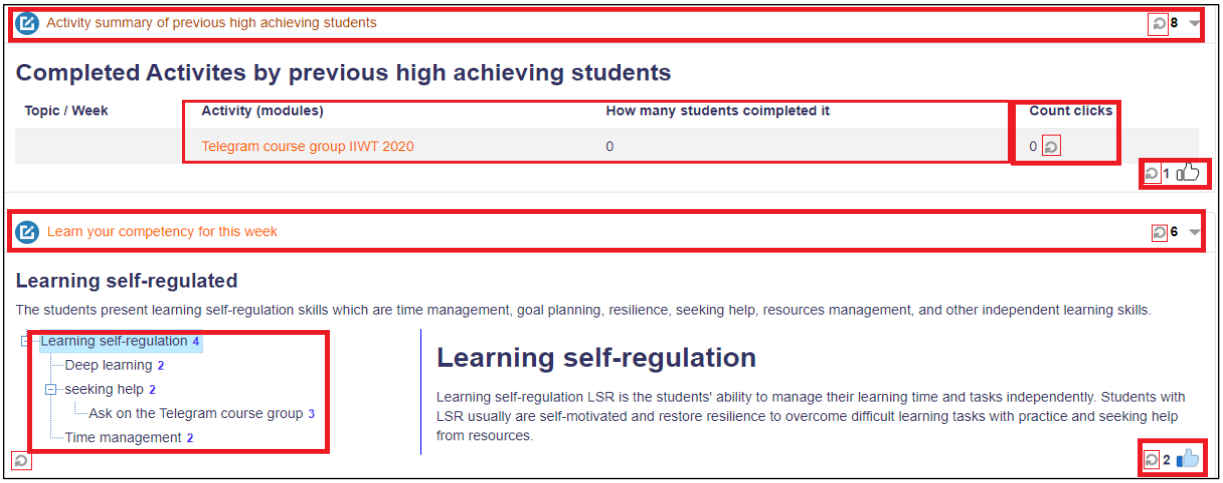

Figure 4-3 Click and Like counter

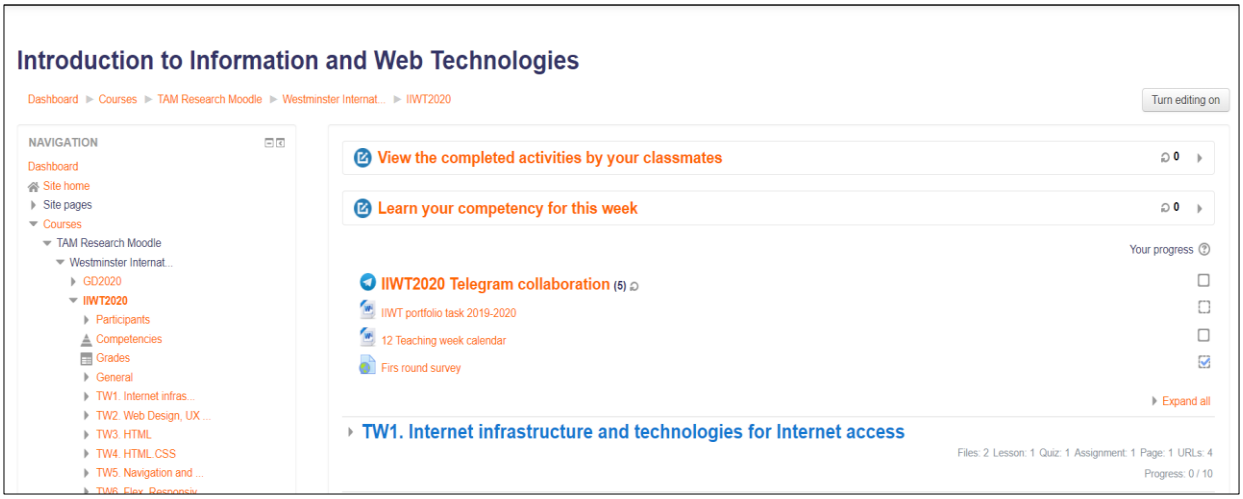

Figure 4-4 Design interface on the Moodle course page – shrinked mode

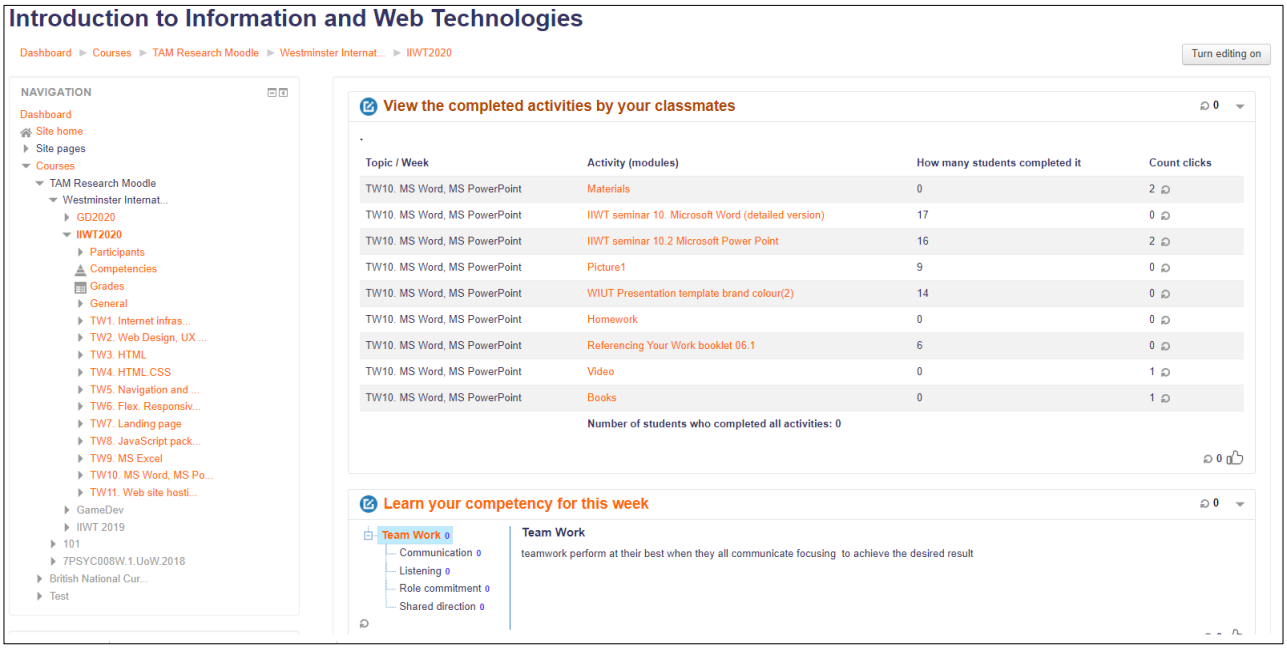

Figure 4-5 TT and VC on the Moodle interface – expanded mode

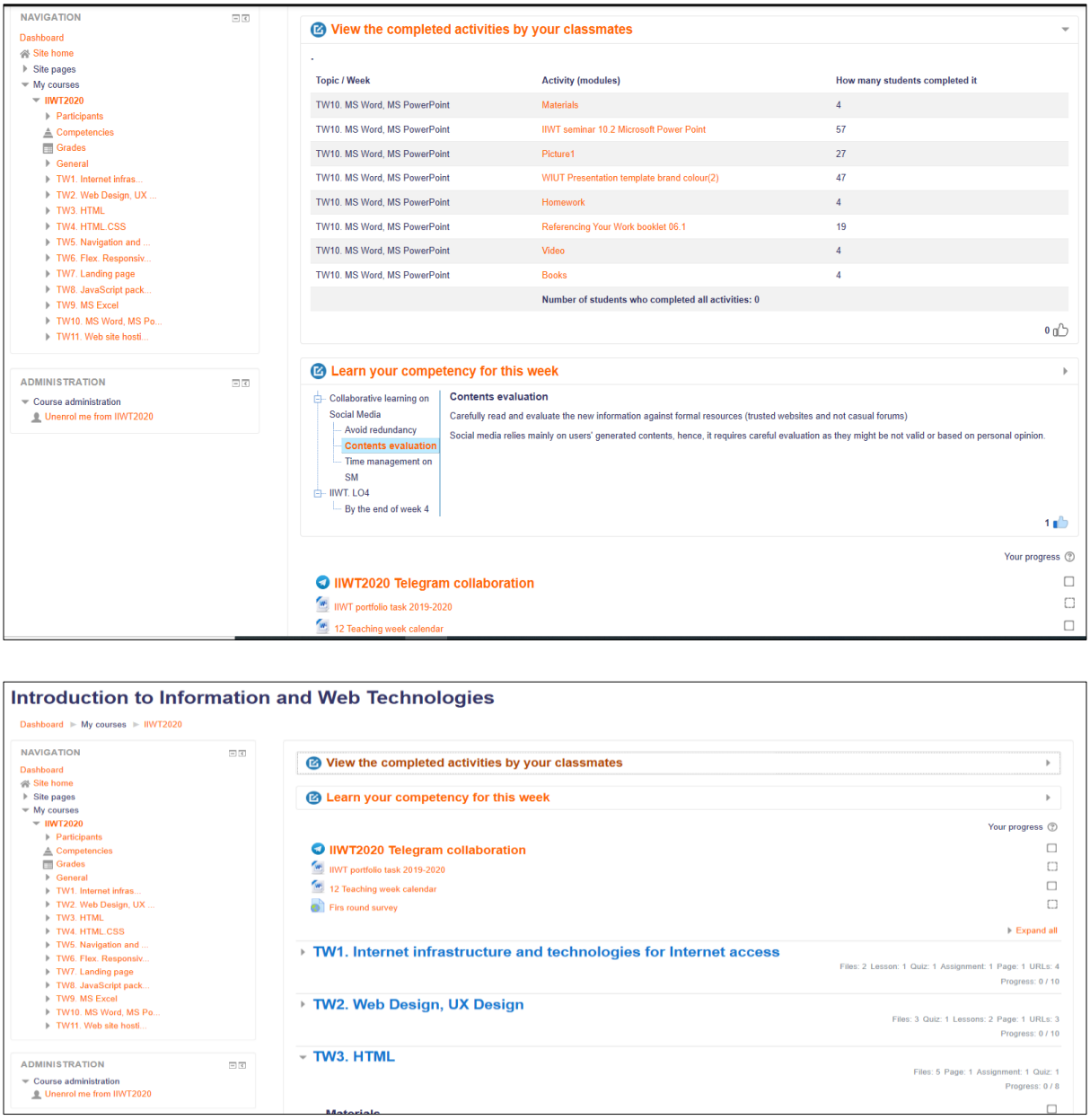

Figure 4-6 New interface Admin view - Expanded completed activities (TT) and Visualised Competency

4.4.2.2. Tracking Technology Solution

In the present study, TT is implemented by illustrating the summary of completed activities on the Moodle course page. The completed activities are the course learning content tasks (i.e. reading, attempting or completing a quiz, completing a lesson and downloading slides). Each pictured item connects to a hyperlink for the actual learning content. For example, see Figure 4-7, the second item was completed by 17 students; if students check on this and decide to complete the activity, they need only click on it to access it. This increases the click counter by one.

The click counter statistics were collected weekly on a separate database for data analysis purposes. A similar counter was added to the TT table to collect another aspect of students' satisfaction with the visualised data. All counters were reset every week to start totalling the collection of data for the

following week. The instructor and researcher collaborated weekly to administer the process of updating the illustration of the activity. Figure 5-3 shows the click counters on the TT.

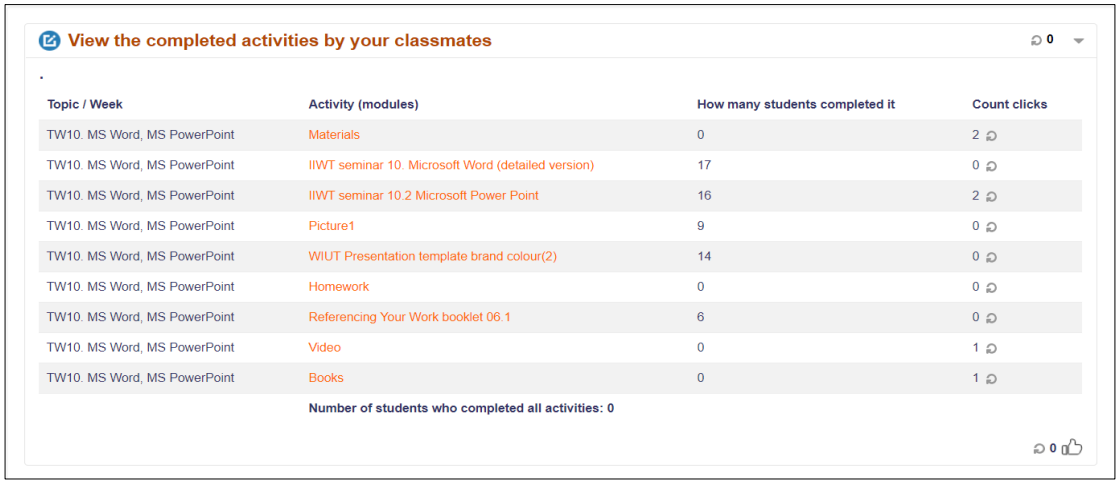

Figure 4-7 Tracking tool interface

The technical interpretation of TT in the present study was designed by visualising the students' completed activities on the LMS course page. Since Moodle provides sufficient log file reports ("Moodle documents"), it is used to extract the required student's activities (Activity completion report) to illustrate the TT feature on the module page every week. The retrieval report provides an administrative tool that filters which data to portray and when. The process of extracting and reporting the data covers three main stages. The first stage involves grouping the completed activity logs from the LMS database. This process includes creating a report/completion table. A sample of the main attributes of the table is provided below in Table 4-4.

The second stage filters, saves and collects the completed activity to illustrate on the course page. The third stage involves illustrating the saved report data on the LMS course page. The report in question was a folder of code under /report in Moodle. Reports can be created as needed based on each Moodle requirement. In the report, the main requirement was for the index.php file. It contained primary HTML forms to control the report and the code that managed the report display. A language file might also be required if, for example, it could be found as a lang/en/report_myreport.php. Other PHP code can be added to allow the user to deal with the report from the index.php file.

Table 4-4: Tracking tool table - back end view

Field name on DB	The data that it stores or processes	Process type	Relevant field	Technology/ tool used
Id	ID of the record, description and data type	Report access and data accumulation	A set of other tables in the database, based on the structure. The default Moodle structure can be retrieved from phpMyAdmin via a related report to retrieve it	SQL, PHP, phpMyAdmin, Debian Linux, Byobu

4.5. Visualised Competencies

Some students might not be able to assimilate the numeric representation of the TT, because it needs quantitative skills to understand what these numeric values mean. Therefore, visualised competency is proposed as an alternative to providing more structured textual guidance. Visualised competency is designed as set of instructions and guidelines that, once practised, it may help learners to acquire transferable skills, such as problem-solving and learning self-regulation (Hoogveld et al., 2005; Keen, 1992). The illustration of weekly targeted competencies was designed in this research as a competency-based educational proposal to enforce learners' LSR and CA in LMS. Learning a competency requires structured guidance for developing learning as well as measuring its outcomes independently. This section is structured as follows. After the theoretical basis is developed, the development of the competency process is detailed, and the final design can be found set at the end of the section.

4.5.1. Theoretical Basis

The second theory proposed in Chapter 2 is goal-setting theory (GST). Based on the extensive literature on the impacts of goal setting theory, it is proposed that goal setting increases learners' PCA and PLSR. This then leads to improved LMS CIU. GST is incorporated in the present study via two intervention tools, namely, visualised competency and embedded social media.

In this study, exposing students to detailed learning outcomes every week is presumed to have a strong effect on their focus and determination, which in turn could improve their attitude to LMS. The theoretical basis of this argument is developed on the lines of the research by Labarrete (2019) that found a relationship between exposing students to LOs and their self-perceptions and engagement levels. Labarrete (2019) used action research on a set of Philippine learners who used an LMS and found that exposing the learners to the required study skills before the course improved their educational outcomes. In support of this evidence, Foshee et al., (2015) further reported that in 75% of 2880 samples, the perceived competency for a college math subject was improved when students were provided with the study skills required from an online learning platform for a college maths course. Accordingly, the present study proposes that greater usability of the VC could improve the CIU because of the improvement in the learners' perceptions of the clarity of the study goals, and their attitudes to themselves as high achievers and competent learners.

H12: Usability of visualised competency directly affects CIU positively.
H12a: PEOU of VC affects CIU positively.
H12b: PU of VC affects CIU positively.

4.5.1.1. VC & PCA

Cognitive absorption is a state of deep engagement with an application. According to goal theory, the clarity of the requirements and objectives is a significant motivator of performance (Seijts et al., 2004). In other words, clear objectives can stimulate students' interest and engagement via a structured roadmap of competency. Such a roadmap would show the ways to acquire engagement as a skill or as a learning outcome Kizilcec et al. (2017). Graphic representations of competency are a form of goal setting. The primary underlying justification here is that when students know what is required and feel that they are being guided, distortions are reduced; thus, their deep engagement can be improved, i.e., they are in a state of cognitive absorption. Seeing these representations of the competencies every week positively affects PCA.

H13 Usability of visualised competency affects PCA positively.
H13a: PEOU of VC affects PCA positively.
H13b: PU of VC affects PCA positively.

According to the IS Success model, the factors that can raise the satisfaction level are also critical drivers of the intention to use a technology. On the same lines, if the VC can improve the PCA, as proposed in the previous paragraph, it is expected to be a driver of the CIU mediated by the PCA.

H14: VC usability affects CIU mediated by the positive effects of PCA
H14a: PEOU of VC affects CIU positively mediated by the positive effects of PCA
H14b: PU of VC affects CIU positively mediated by the positive effects of PCA

4.5.1.2. VC & PLSR

VC is proposed to support learners' core PLSR by providing structured instructions based on their weekly LOs and topic-relevant cross-curricular skills. In LMS, learners might not be regularly aware of the best strategies to adopt, or the right steps to take next to achieve their set goals. Therefore, they need external guidance and information (Hassan et al., 2020; Lupton, 2016). Once the students feel they are in control of their learning and they are equipped with the tools that enable them to engage and develop deeper learning, they will perceive that they have better planning and managing skills for learning and completing their learning tasks (Nguyen et al., 2018).

The central concept of VC is to present the learning goals for the students visually in the most accessible and actionable way. Visualizing a competency can improve students' ability to set goals (Santoso et al., 2018). Goal-setting competence is a preliminary requirement for learning self-regulation (Blackburn & Hakel, 2006). VC is proposed to improve students perceived self-regulation because it could improve the goal determination, which then improves the perception of having control over their goal-seeking behaviour.

Goal determination means that the teachers' communicated goals are time bounded and well-fitted to the topics covered each week. The revised Bloom's Taxonomy and transferable skills were developed to meet the requirements of the weekly learning outcomes. In the present study, an approach based on the work of Lee et al. (2016) is developed; these writers found that exposing LOs in MOOC raised the level of learners' metacognition of their self-regulated learning. Thus, VC is presumed to be a possible critical factor in explaining the perceived learning self-regulation in LMS. It follows that if the weekly required competencies are presented to the students, they will perceive their ability to control and plan their learning process effectively.

H15: VC usability affects PLSR positively.
H15a: PEOU of VC affects PLSR positively.
H15b: PU of VC affects PLSR positively.

Visualised competency aims to expose learners to the learning outcomes and related competency every week. This could consistently enhance students' perception of straightforward and achievable learning goals. Being aware of and consistently exposed to the steps needed to reach their objectives and goals may also enhance learners' perceived learning self-regulation. This could further mediate their CIU of LMS. Accordingly, the following hypothesis was formulated:

H16: Perceived usability of VC affect CIU positively mediated by the positive effects of PLSR
H16a: PEOU of TT affects CIU positively mediated by the positive effects of PLSR
H16b: PU of TT affects CIU positively mediated by the positive effects of PLSR

According to self-regulation theory, the learners could feel that they were organised and well-prepared if they knew their learning goals. Since these are updated every week to reflect what the students are primarily looking for, this presentation of competency could offer primary guidance to students. This guidance drives the sense of control (i.e. the student can master the visualised skills), and flow (i.e. the students will follow the instructions in order because they promise to culminate in acquiring the desired skills). Therefore, it is proposed here that the usability of the VC could improve users' perception of the benefits of using LMS (i.e. PLSR) which in turn could improve the intention to keep using it in the future. Since the VC's usability is proposed to affect the PLSR, and PLSR was also proposed to affect the CIU, the present study proposes that the usability of the VC affects the CIU mediated by PLSR.

H17: VC usability affects PLSR mediated by PCA
H17a: PEOU of VC affects PLSR positively mediated by the positive effects of PCA
H17b: PU of VC affects PLSR positively mediated by the positive effects of PCA

Following the line of argument used for the TT, adopting the IS Success Model suggests that the path between the intervention and the CIU is mediated by satisfaction (i.e. PCA), and the benefits (i.e. PLSR), which are proposed to interact between the PCA and PLSR.

H18: VC usability affects CIU mediated by PCA & PLSR
H18a: PEOU of VC affects CIU positively mediated by the positive effects of PCA & PLSR
H18b: PU of VC affects CIU positively mediated by the positive effects of PCA & PLSR

4.5.2. Development of the competency-based model

The main challenges for the use of competencies in Moodle were the tutors' lack of awareness of it and offered one time in the beginning of the module. Thus, competency reports will be activated but the reporting the visualised competencies will be weekly instead of once per semester and will be presented graphically instead of being in text format. The visualised competency maintains students' exposure to their weekly LOs and their relevant cross-curricular competencies. This encourages the students to engage deeply with their learning since their LOs are available using VC. The clear breakdown and simple step wise goals are also presumed to improve the students' PCA.

Thus, in this section research methods are used to detail the workshops and activities that were held to develop the weekly learning outcomes for enhancing the LOs of this research. The cross-curriculum competency (CCC) plan was developed by the researcher using the literature related to the course. The process involved the following steps. First, she reviewed the literature related to CCC, which was extracted then shared with the instructors on Google drive. Second, in a discussion with the instructors using Telegram she introduced the cross-curriculum concepts and their potential impact on the students. Third, this group decided collectively the most relevant content extracted from the CCC. It had a three-fold validation, presenting, reviewing and the finalising the CCC planner. The following figure, Figure 4-8, illustrates this discussion process.

The relevant literature was consulted to find the transferable skills in the computer teaching literature, using the following keywords: transferable skills, skills, learning outcomes, and cross-curriculum. The initial list had 42 items, reduced later to 24. The final list was mapped over the two courses and per topic following a collaborative discussion and feedback from the participating course instructors which showed how the accumulated transferable skills could be distributed over the weeks of the academic term.

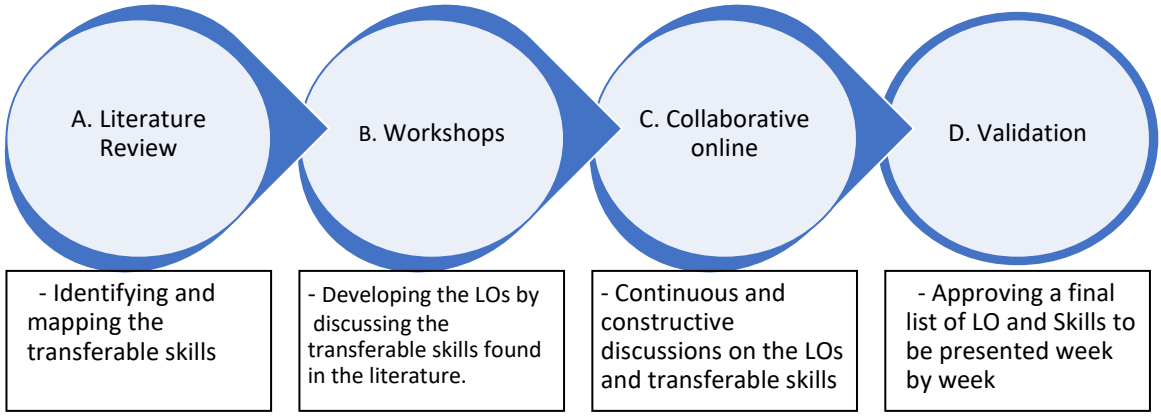

Figure 4-8 Stages in the development of Cross Curriculum Competency

4.5.2.1. Workshops

Several remote workshops were held, involving 3 instructors from 2 modules. The course instructors were required to design a practical approach to the LOs of their module, for the students' benefit. To support them in this task, a template was drawn up for them to complete. This was followed up by remote guidance on completing the template, using the researcher-instructor Telegram platform. The template contained a table of the revised Bloom's Taxonomy (RBT) developed for the instructor to use as a measurement tool for the decomposition of their LOs. Each course had its own LO competency-based table. Accordingly, this revised Bloom's Taxonomy was suggested as a curriculum map to guide the instructors. The RBT was used in the LO mapping process as a tool.

4.5.2.2. Collaborative Environment

Competency requires collaborative work between the LMS administrator, the course instructors, and the students. Each competency shall have the instructors' understanding of the competency concepts, and the methods of conveying them to the students, what the required skills are and what the expected evidence is. The researcher used a shared Google drive to establish a collaborative environment where she and the WIUT team could add their inputs, share their knowledge, and provide advice where needed. The three workshops extended over three weeks. In each, the researcher discussed different aspects of the use of the RBT in defining the LOs.

Next, the researcher asked them to discuss their ideas on Telegram[1]. The Telegram group was created for discussion and instant collaboration on the more important updates. Each of the developed competency frameworks was presented in visual form for a week of the academic term on the Moodle

[1] https://telegram.org/

course page. If any of the LOs did not require a structured competency (for example, students' practice on a spreadsheet or MS Word), then one of the cross-curricular competencies was illustrated.

4.5.2.3. Validation

The purpose of the validation stage was to justify the final list of LO each week and the transferable skills identified by the researcher from the literature. A workshop with teachers was held to confirm the list and in this final meeting they agreed and confirmed the final list.

4.5.3. VC design

The technical implementation of Visualised Competency was in three stages. The first stage was to construct the VC framework builder. The outcomes of this stage were the learning outcomes and cross-curriculum competencies that were agreed for the courses under review. This form allowed the researcher to lay out each parent competency along with its sub-rooted skills in preparation for being visualised according to their agreed time frame and matching learning content. The competency builder was used in the selector form to allow choice of which competency to illustrate. The second stage developed the illustrated competency selector form. This form allowed the competencies that were chose for visual presentation on the course page to be managed. The third stage implemented the illustration of the selected competency on the course page.

The outcome of this stage displayed the expandable hyperlink tree of the selected competency framework, which allowed students to navigate through it and read the content of each sub root of the illustrated competency tree. The image below shows an example of the competencies as illustrated. The students can navigate through the branched text-structure as shown on the left-hand side of the image. When a student clicks on any node (such as a title or subtitle of the competency), the description of the clicked node (on the right-hand side) is displayed.

The figures below, 4-9 and 4-10, shows the view available to the administrator, and instructor; hence, the click counters are viewable.

Figure 4-9 VC interface 1

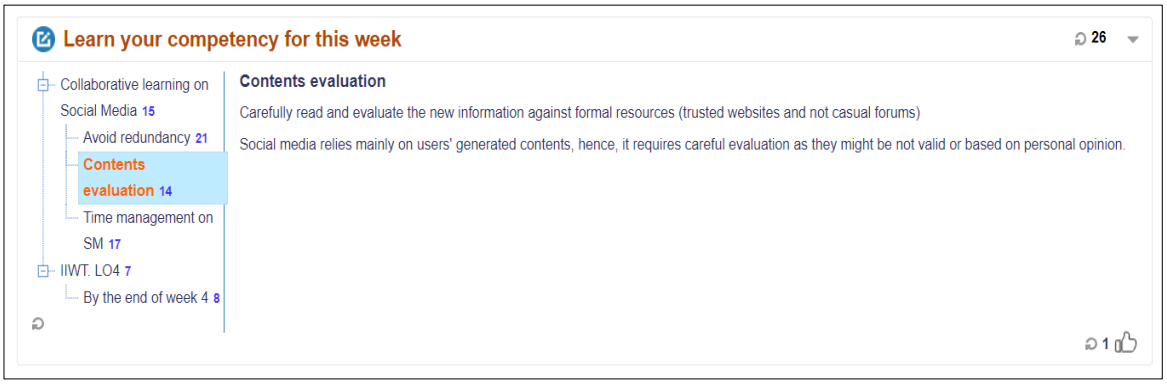

Figure 4-10 VC interface 2

4.5.3.1. List of Learning Outcomes

The weekly LOs, competency measurement, and visualised competency on the Moodle columns were added to allow the LO to be decomposed into visual applicable steps for the students to take; this offered a more precise process for the instructor to advise. The table below presents an example of the module's LO laid out according to the suggested table. The full learning outcomes – guided by the Revised Bloom's Taxonomy – is outlined in Table 4-5.

4.5.3.2. Cross Curriculum Competency (CCC)

The CCC represents the broad skills which learners can acquire and implement in different situations. The aim of providing competency guidance in the present study is to visualise it in its most straightforward form using tree/branch visualisation. Hence, the definition of competency had to be decomposed into shorter sentences to ensure its clarity and simplicity for the students. Table 4-6 was used as a competency break-down structure to simplify its transference to the visualization phase on the Moodle course page.

The CCC table was developed from a review of the literature discussing transferable skills in computer education. Initially, primary keywords were used to filter the scholarly findings, for

example, those on cross-curriculum competency, transferable skills, and key skills. Sixteen skills relevant to undergraduate computer education were extracted. The extracted list was shared with the participating course instructors and was based on their feedback and experience. Nine transferable skills were selected for use among the CCC in the present study. The CCC definitions were kept as they were; however, collaborative efforts were made to deconstruct each skill into smaller units in the instructions for visualising them. Table 4-6 sets out these competencies and shows how they were deconstructed in order to be incorporated in the visualization tool.

Table 4-5: Competency planner for learning outcomes

Weekly LO	Bloom's Taxonomy structure	Definition	Measuring tool	Competency measurement	Visualised competency on Moodle
1. Have a theoretical foundation for game development cores and trends	1. Remember	Retrieve relevant knowledge from long-term memory	1.1.Recognising		
			1.2. Recalling		
	2.Understand	Determining the meaning of instructional messages, including oral, written, and graphic communication	2.1. Interpreting	1. Provide examples of selling points to users that you would implement in the proposed game (Exemplifying)	1. Market analysis: identify and analyse market size and competitors, make explicit competitors' analysis in the context of market and proposed game.
			2.2. Exemplifying	2. Compare the competitors in the proposed game (Comparing)	User selling points: discuss features that could attract players and give a competitive advantage in the market. Identify unique features that could be implemented for the proposed game.
			2.3. Classifying	3. Perform the game analysis of the industry and market and summarise the key trends (Summarizing)	
			2.4. Summarizing		
			2.5. Inferring		
			2.6. Comparing		
			2.7. Explaining		
To produce an electronic presentation for personal or professional needs	3.Apply	Carrying out or using the procedure in a given situation	3.1. Executing	IIWT.LO4: Create an organisation's PowerPoint template (with logo, firm style) and use for creating presentations	IIWT.LO4: Organization's PowerPoint template (with logo, firm style, etc.) and corresponding presentation
			3.2. Implementing		

Table 4-6: Cross-curriculum competency

	Literature-based: Cross Curricular Competency				
	Parent Competency	Sub Competency 1	Sub Competency 2	Sub Competency 3	Sub Competency 4
1	Learn to learn (Hoskins & Fredriksson, 2008) *Pursue and persist in learning.*	Identify your learning requirements - *Know your learning process and needs*	Identify available opportunities - *Know which resources you can use now to learn*	Be resilient: *Able to overcome come obstacles to learning*	Seek and make use of guidance as an individual and within a group
2	Meta-cognition(Bryony Hoskins and Ulf Fredriksson)	Know your learning: *Know the field you are learning; what the relevant contents are and identify the scope of your learning to avoid wasting time and resources.*	Monitor your progress: *identify milestones for your achievements to visualise your progress*	Effective time Management: *Schedule your tasks based on their priority and basis, on a carefully estimate the task due date, and the length of time required*	Effective information Management: *Identify the most relevant contents to your learning subject*
3	Learning self-regulation: *identify your learning objectives and self-manage the efficient accomplishment of those objectives as the core of what it is to be a self-regulated learner* (Wolters et al., 2006) (Winne & Hadwin, 2008; Zimmerman, 2000)	Set primary and intermediate goals: *Plan how to achieve each one and adhere to it. Write a list and review it daily.*	Prioritisation: Plan your tasks in order, based on which should be completed first, based on their due date, and based on their prerequisites	Help-seeking: ask for clarification, make sure you have shared your classmates' understanding of each concept, approach your teacher or high-achieving students for help	Accept critical feedback positively: Adapt to feedback which you receive regarding your academic progress, and use it positively to improve in your learning (Wolters, C.A., 2010)
4	Problem-solving: "Apprehend the problem situation, think through the processes used to approach the problem and the appropriate solution."((Klieme, 2004)	Identify the nature of the problem: Recognise the problem and formulate its exact nature. Define the desired outcomes: Define the goals as visible accomplished tasks	Break the problem down: Analyse the problem situation, and visualise it (as a table or a diagram)	Solve it stepwise: design the required to solve the problem. What are the inputs and outputs of each step? How will you process it from one step to the next to achieve the desired outcome?	Execute, adjust, and assess: Evaluate each step you apply towards solving the problem and reflect on how you would use it in a different environment
5	Be an active team player: teams perform best when they all communicate, focusing on achieving the	Know your role and be committed to it	Know the direction (aim) of the team	Communicate openly and honestly	Team tolerance: Actively listen to your peers and positively accept opposing perspectives

	desired result (Kauffeld, S., 2006)				
6	Collaborative learning on the Social Media (self-developed)	Content evaluation: carefully read and evaluate the new information in light of the formal resources (trusted websites and not casual forums) Social media relies mainly on users' generating content. Hence, it requires careful evaluation as they might not be valid or based on opinion.	Time Management: Commit to a time frame for your collaboration	Avoid redundancy: do not. re-explain, re-answer, saturated conversation	
7	Critical and Creative Thinkers: to learn a key concept you need to build it in your mind by a chain of cognitive actions. (Paul & Elder, 2012)	Link and build knowledge: connect new information to earlier knowledge	Evaluate the developed knowledge and how it will benefit you differently	Learn how you can extend your new knowledge	
8	Be a self-directed and self-disciplined learner (Rainwater, 2016)	Be clear and precise: Raise vital questions and problems	Evaluate and elaborate: Gather and assess relevant information (use abstract ideas to interpret it effectively and fairly)	Use standards to measure conclusions: Form use well-reasoned conclusions and solutions (test them against relevant criteria and standards) Evaluate your work against previous similar work completed in your field.	Communicate effectively with others in finding solutions to complex problems
9	Mastery is being able to locate similarities with known situations in new situations, in unfamiliar contexts, and to adopt active, known behaviours. (Safta, 2015)	Commitment means "the active and responsible participation of the student in his or her learning process" (Iglesias-Pradas et al., 2015; Klieme & Others, 2004)			

Table 4-6 is for teacher/researcher use, a simpler version of it, for student use can be presented using an infographic. The following figure shows an example of the table for student view/use.

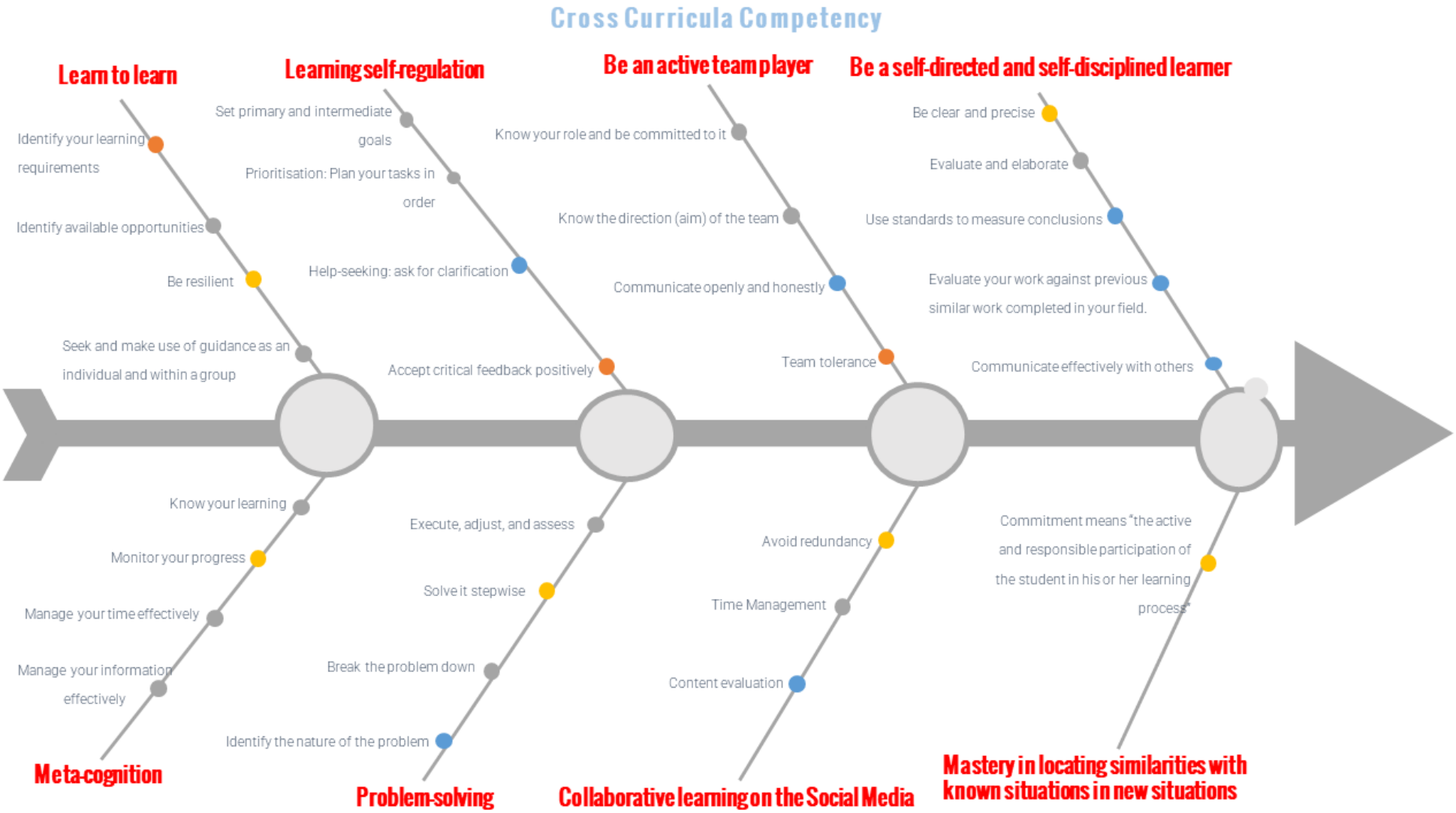

Figure 4-11 Inforgraphic of Cross curricula Competency

4.6. Social Media

The following section sets the theoretical basis for improving the social media and proposes ways of influencing the PCA and PLSR of the LMS. With this theoretical basis, the section to after it presents the design.

4.6.1. Theoretical Basis

The second illustration of goal-setting theory in the present study is through embedding a learning-oriented and familiar social media platform to support learners' help-seeking. The main concerns regarding the use of forums, social media and emails were students' fear of asking questions in public (i.e. in front of their peers) versus teachers' expenditure of time and effort in responding may times to the same questions (i.e. replying to students emails when thye have the same inquiry). The new SM will be customised to eliminate the fear of asking questions in public and, to manage possible distractions resulted from SM platforms.

Thus, there are two tasks which depend on the relationship between the SM and CIU. The first is to develop the ability to get help whenever required, while the second is to find ways of soliciting such help without being perceived negatively. The perception of being able to obtain the necessary help for achieving the goal is a determinant factor that affects the motivation to perform the tasks as well as this performance itself (Bartholomé et al, 2006). On the same lines, the social media can be conceptualised as a mechanism for getting help whenever needed, with a perceived level of trust and credibility. This perceived ability to get the required help can directly affect the intention to keep using LMS in the future.

The second task focuses on the SM as an anonymised platform which could make learners who inquire for information feel emotionally safe (Kim, Jo, & Park, 2015). In other words, some students may find it uncomfortable to ask for help (i.e. they psychologically hate to be perceived as seeking help). Such students feel it more motivating to get help using an anonymised social media platform (hsun Tsai et al., 2018). Help-seeking behaviour is continuous and interchangeable; therefore, collaborations can be improved through using SM (Kumar Sharma et al., 2014). Similarly, Dougherty and Andercheck (2014) asked 170 US students about the perceived benefits of using the SM and noted that the main drivers were seeking assistance, collaboration, and managing the students' learning. Consequently, the present study proposes that the SM could improve the CIU because it empowers the learners by emotionally safe mechanisms to seek help

whenever they wish. Because the barrier shyness in front of peers will be eliminated and this increase their trust of the system hence their willingness to adopt the system will increase.

H19: The usability of the SM affects CIU positively.
H19a: PEOU of SM affects CIU positively.
H19b: PU of SM affects CIU positively.

4.6.1.1. SM P&CA

Cognitive absorption is composed of two main elements: temporal dissociation and focused immersion. The use of social media can improve the flow of people's experience, which makes time pass quickly (Pelet et al., 2017). Another way of describing the relationship between SM use and the PCA is that the former distorts the sense of space. Because the sense of personal presence is physically excluded from an online environment, such as an online discussion, the effect of distorting time and space can improve the flow of experience. This, in turn, affects cognitive absorption (Cziksentmihalyi, 1990; Deci & Ryan, 2012; Tellegen & Atkinson, 2017; Vallerand, 1997). The present study proposes that if the social media are perceived as easy to use and useful, adopting them will affect the CIU of the LMS.

H20: SM usability affects PCA positively.
H20a: PEOU of SM affects PCA positively.
H20b: PU of SM affects PCA positively.

According to the IS Success model, the factors that can improve satisfaction are the key drivers for the intention to use a certain technology. Similar evidence found in the LMS literature, from a study of 294 students in Hawaii University, enabled Leong (2011) to assert that the use of online communications and interactivity affects the students' satisfaction, fully mediated by their cognitive absorption. Similarly, if the VC can improve the PCA, as proposed in the previous hypothesis, it is expected to be a driver of the CIU mediated by the PCA.

H21: SM usability affects CIU mediated by PCA positively.
H21a: PEOU of SM affects CIU mediated by PCA positively.
H21b: PU of SM affects CIU mediated by PCA positively.

4.6.1.2. SM & PLSR

The present study proposes that the use of SM can improve students' perceived learning self-regulation if they have been perceived as useful and easy to use. This is explained by the identified skills of LSR in the literature, including time and resource management, help-seeking, planning and goal setting, and the metacognitive and cognition process (Zimmerman, 2015). Using these

skills, the present research hypothesis (i.e. that students perceive the SM to be a useful and easy-to-use tool for learning and seeking help safely) will increase students' perception of their learning self-regulation. If a learning-oriented SM can offer group collaboration, searching and filtering tools, then it will improve the learners' perception of self-regulation.

This hypothesis has three main aspects. First, in such an environment, where students' "fear of missing out" has evaporated (Alt, 2015), the most critical topics and debatable points are discussed over the social media. In this situation, the students can feel part of the discussion and can see other students' comments on all the topics of study. This helps the learners to plan their resources more effectively because exposure to these discussions reveals the most critical and debatable points, as well as those areas that do not need much effort. The second aspect here is that the structured search engine for SM platforms can provide learners with the feeling that they will be able to find the required information quickly whenever they want. This further improves learners' PLSR. The third aspect is that using the social media can improve learners' perception of swiftly receiving any desired help (Kim et al., 2018). The social media improve the capacity to seek help, which is an integral part of the skill of self-regulation in learning. Therefore, the social media are hypothesised as effective for influencing the PLSR.

In summary, using the social media can improve the perception of help-seeking and the perception of getting the required information whenever required; it can reduce the fear of missing out, and facilitate an awareness of the main discussions and debates. Accordingly, it can improve the management of time and resources, identify gaps and the work that they entail, and reset the goals. Accordingly, they can improve the PLSR.

H22: SM usability directly affects PLSR positively.
H22a: PEOU of SM affects PLSR positively.
H22b: PU of SM affects PLSR positively.

As a self-regulating platform, the social media as a regulating technology can strengthen the users' intention to use LMS. Thus, if SM improves the PLSR, the PLSR can be considered a mediator in the relationship between the usability of the SM and the CIU.

H23: SM usability affects CIU mediated by PLSR positively.
H23a: PEOU of SM affects CIU mediated by PLSR positively.
H23b: PU of SM affects CIU mediated by PLSR positively.

Once the students have established the perceived usability of the SM, their state of flow of the group discussions is improved. This is because minimal effort is required, thanks to its ease of use, to understand how they can use the discussion environment. Furthermore, in the SM group

discussion, the students become highly focused on the discussion, and thus are not distracted by the flood of SM content. This makes them fully engaged and not cognitively overloaded. In other words, SM as a learning support can provide a hassle-free environment in which students can fully engage in learning-related discussions.

The improved perception of cognitive absorption is proposed as a condition for improving students' perceived learning self-regulation. The students feel that they are immersed and fully engaged in the group discussion. This improves their perception of being able to directly seek information whenever they want from the most suitable people (both peers and instructor). This perception makes them feel that they are in control of their time management (i.e. they can seek help at any time), in control of their information sources (i.e. someone can always answer their queries), and in control of their resource management (i.e. all the shared resources and contents are organised and accessible via the group discussion).

H24: SM usability affects PLSR mediated by PCA positively.
H24a: PEOU of SM affects PLSR mediated by PCA positively.
H24b: PU of SM affects PLSR mediated by PCA positively.

If the SM used for learning is perceived as easy to use and useful for learning, then it will enhance the student's intention to use it in the future. However, this perception is achievable only when the students' perceived cognitive absorption and perceived learning self-regulation are improved.

H25: SM usability affects CIU mediated by PCA and PLSR positively.
H25a: PEOU of SM affects CIU mediated by PCA and PLSR positively.
H25b: PU of SM affects CIU mediated by PCA and PLSR positively.

4.6.2. SM Design

There are three main challenges in communication: the privacy of the learners and the effort and time of the tutors. This intervention uses Telegram and sets .rules (can be viewed in section 4.3.9.2) to avoid distortion and to minimise the time and efforts required of the tutors. The following sections detail in turn each of the options selected for implementing the social media.

4.6.2.1. SM Platform Selection

The current communication system was built on direct emails. According to the data, this was regarded as wasting too much time and effort for effective tutoring. It was also considered flawed by its poor regard for privacy in displaying student names regardless of their engagement. After discussing with teachers, the best options for an interactive SM platform fit for purpose, particularly that of overcoming the challenges mentioned above, as well as those of accessibility, privacy, voting, structure, organisation, and the level of familiarity among the targeted students, Telegram was introduced.

Its accessibility was straightforward: students could collaborate through their phones, desktops, or tablets to use the integrated Telegram group. Significantly, social learning theory and social presence in any learning context is a core element in building learners' transferable knowledge. This is why Telegram was used in all the built-in LMS forums. As matters of privacy, among the main challenges of the traditional SM applications (e.g. Facebook and Twitter) were the monitoring and moderation of privacy and cyberbullying (Nepali & Wang., 2013). Although most of the SM platforms implement practical text mining and monitoring tools which can be used to protect group discussions from any form of abuse, crises have threatened their commercial status (Batrinca & Treleaven, 2014; Sykora et al., 2013).

Telegram users do not need to use their real names or tracked accounts, and this increases students' ability to communicate freely. Voting features are essential and for this Telegram provides built-in polls (see Figure 4-10), which were used to collect quick votes on various matters from the group members. For example, the course instructor developed his weekly quiz in multiple-choice questions. The instructor then provided his feedback on the answers to guide the students to the content that they needed to consult for their development. In summary, using SM in HE currently relies mainly on individual teaching staff and their creativity effectively incorporating collaborative learning through SM.

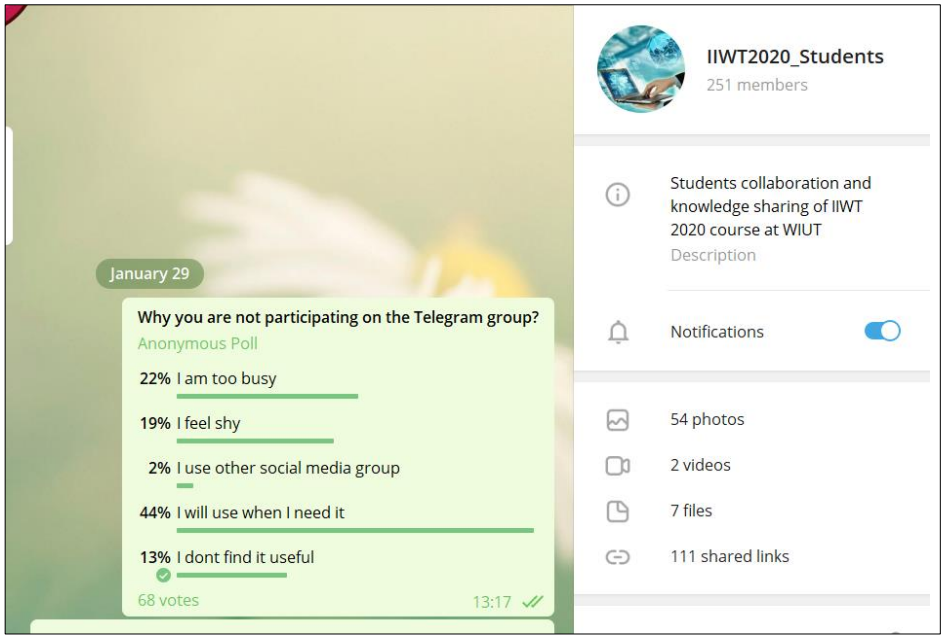

Figure 4-12 elegram Poll

Concerning organisation and structure, for successful peer collaboration some researchers believed that learners should be categorised according to their shared interests and experiences, and then divided into small groups to avoid cognitive conflict and to reduce noise (Topping, 2005). Telegram is preferred over other options due to the summarised points in table 4-7. The key structural role that Telegram can play but Twitter cannot be to separate one group's conversations from another's, i.e. learners can log in to the class group only. Otherwise, their words are distorted by other irrelevant feeds on the interface. The text of the class group also has a search option enabling students to jump between topics and conversations. The familiarity of the application to the targeted audience depends on what people have learned through their recommendations. Telegram is currently the most popular SM platform in this country, as well as being often used by students who demonstrate a preference for its privacy protection settings and its more significant intuition than their mobile phones allow.

Accordingly, in the present study, it is hypothesised that if the preferred SM is implemented on the LMS, it will improve students' collaborative learning. According to the WIUT instructors' interviews, Telegram is widely used by young learners in Uzbekistan. They say that Twitter is not adopted as often as Telegram in this setting. Once Telegram was adopted, it largely replaced email. For example, the course instructors participating in the present case study preferred this proposed SM platform for communication with students and others. Telegram was the preferred social medium for its accessibility, privacy, voting tool, and its more organised structure. One positive response in the online interview data contained this comment:

"Having Telegram group for teachers was helpful; indeed, we could have asked questions from module leaders, to provide the materials or clarify some questions…., it is much faster than email communication. Also, it is quite convenient to share photos, files quickly, I would say more convenient than sending those via email". T5

Table 4-7: Comparison of Social Media use in learning and LMS

Options	Disadvantages
Facebook	FB users are exposed to the vast flow of contents generated from their other social contacts and search history. Moreover, it does not have an ontology tool to filter or reduce the trending contents or to support the users' focus on one channel or a specific trend
Twitter	According to Stat Counter, Twitter is not widely used on Uzbekistan. Although Twitter is facilitated with hashtag technology which allows its users to follow specific topics by following their hashtags, Twitter is similar to Facebook in its content ontology and filtering approach. Users are also exposed to all the trends that they are following, which may significantly disrupt collaborative learning. Another similarity in Facebook and Twitter is the limited control of its users' privacy. Young learners did not have enough confidence to collaborate on an SM platform where they could not conceal their actual name and personal information
Built-in Forums	They are accessible through the LMS website, which prevents them from being mobile-friendly. The students also have to register and collaborate under their actual names, a procedure avoided by a wide range of young learners.
Instagram	Mainly for visual content, but not well structured and not suitable for conversations
Snapchat	Depends on temporary (self-deleting) posts, which disables it for learning purposes.

4.6.2.2. Telegram students group rules

It is widely noted in the literature that the SM could be a destructive tool more than it is an educational one. Thus, to avoid distraction in the social media, tutors and the researcher monitored the use of Telegram in the present study. A moderating Telegram message was generated to list the group policy and rules to be followed by the group members. The rules were written in the cover page of the telegram and students kept notified by them from time to time. It ran as follows.

Welcome to your module Telegram collaboration group. Please read the following rules carefully and adhere to them to ensure effective knowledge sharing.
1. Do not contact your instructors directly; any urgent matter should be addressed on email.
2. Sharing any of the contacts in this group is strictly prohibited
3. Avoid using emoji and emotional expressions
4. Avoid the re-sharing or reposting of content that has already been shared
5. Swearing, mimicking, and abusive conversation are strictly prohibited
6. Sharing ads, irrelevant content such as news, songs, and social media updates are not allowed
7. Please allow time for your classmates and instructor to respond to you
8. Please make sure you safeguard your privacy on your Telegram by navigating through Settings >> Privacy and Security to ensure that you are fully protected from showing or sharing your personal information

4.6.2.3. Integrating Telegram in educational practices

Telegram was also used to ensure effective communication between the researcher and the instructors. All the resources were shared on the Telegram groups and were accessible at any time

by the group members. At the same time, Google shared files were used to provide mutual access to the learning outcome competencies in the revised Bloom's Taxonomy (LOC-RBT) file. This enabled the instructors to complete it by adding their contribution. Moreover, through Telegram, a brief update meeting with the instructors was held every week. This regular knowledge sharing and the recording of feedback were beneficial to maintaining a clearer picture of the daily feedback from students as they interacted with the Moodle features.

The Telegram instructors' group acted as a channel for instant response and feedback. For example, the instructors' group provided a semi-live update regarding the performance of Moodle during students' enrolment, which allowed for instant troubleshooting if any technical issue arose. Some tutorial videos for instructors were also uploaded to YouTube. These videos provided a brief introduction to the implemented features and advice on interacting with them once the course started. In terms of collaborative task management, Trello online tool was used to ensure that the WIUT was updated with the scheduled tasks relevant to the collaborative study. The instructors were required to be aware of and contribute to the following tasks:

Setting the start dates of the first and second survey; sharing the Survey link with the instructors to receive any feedback before the survey began; completing the file shared by LOC-RBT; and; discussing and agreeing on rules for creating the Telegram students' group, which were posted at the beginning of the enrolment period for WIUT students.

4.6.2.4. Technical Design

Telegram was implemented to integrate a collaboration panel into Moodle. This method was aimed to provide a permanent open discussion board where students could collaborate through their mobiles, or on Moodle. However, the technical implementation of this approach was limited because Telegram's web integration did not allow any I-frames or different forms of integration to be used.

The risk of such a solution is that such components require a different back-end environment. The outcomes of integrating Moodle back end with third-party Telegram solutions were not predictable and had never been tested. Hence, this approach was rejected, and an alternative method of embodying Telegram in Moodle was suggested. This approach was based on developing a local form on the course page where the admin could add a Telegram group link. The students could then permanently join the discussion group, which was accessed via their Telegram phones, web browser, and desktop application.

The development of the Telegram group link involved a local form on the course page and was accessible on the Admin edit view. It contains fields that can be added to the Telegram course group link, namely, the click counters and a control box to manage the Telegram group. The plugin of this form is located on Moodle LMS which was used in this research.

The Telegram plugin has three central files. The first plugin (Telegram) contains the back-end of the Telegram plugin, which involves two tables; the first one contains the Telegram-relevant fields, such as group link and group name, and it captures the course that each Telegram belongs to (since Moodle has more than one course and each has its own Telegram group). The second table is "Telegram_click" which contains the click counter of the Telegram group. The click counter in Telegram was implemented after the Telegram form was developed. Therefore, it required an additional file to be created on Telegram: Telegram/db/upgrade.php, which included the non-unique counter feature. The function of the non-unique counter feature is to count the students' clicks, regardless of their ID and not strictly allocate one counter to each user. The second plugin is Telegram/db/access.php. This file defines the permission to view and edits the click counters and the Telegram editing features that are restricted to the Moodle admin, manager, and teacher. The third plugin is Telegram/amd/mod_form.php. As the Telegram activities are added to the course page, this file defines the Telegram form of Moodle. This form processes the data entered by the user into the Telegram database, report/a completion, report/logr, local/skills, and local/tables. All the plugins listed above can be found in the root location of the Moodle installation on the Moodle back-end. The folder structure varies with the type of plugin. The relevant plug-in types of implementation in the present research are activity modules, reports, and local plugins.

4.7. The new proposed LMS interface and architecture

This section describes the implementation of the three LMS features proposed in the present study. These are the Tracking Tool (TT), which was implemented for showing the students' activity completion report in visual form, the visual form of Competency, and the embodied Telegram course group link, as visualised in Figure 4-13. A number of shared functionalities are applied to each feature. The following show the default view of the clicks counters in action.

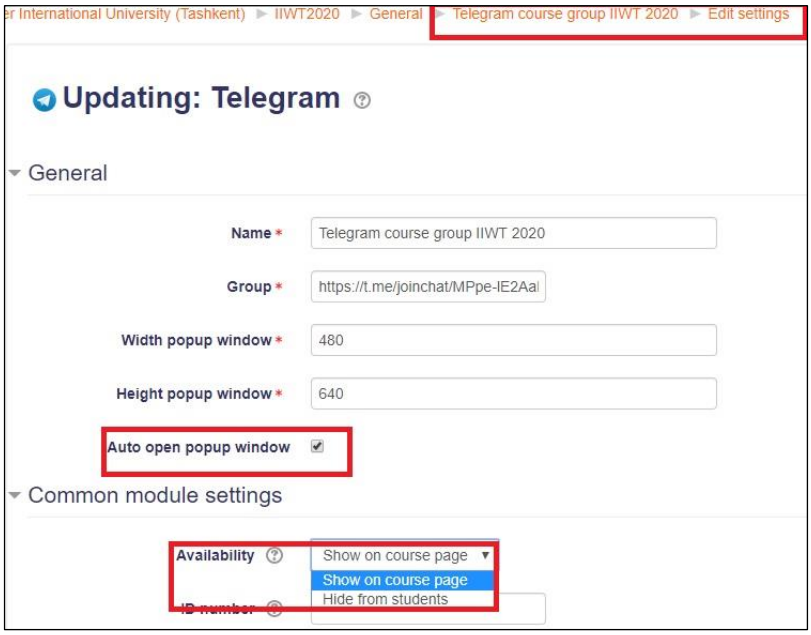

Figure 4-13 Telegram group link form

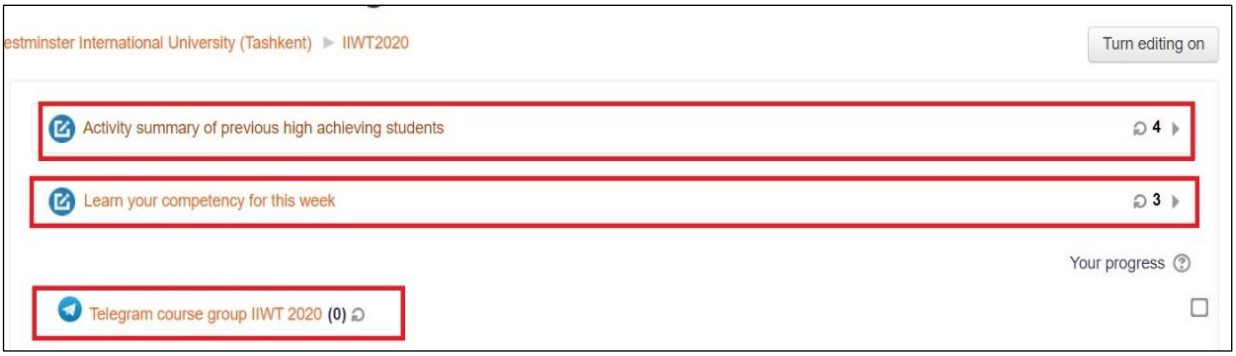

Figure 4-14 Moodle course interface with the Tracking tool, Visualised Competency, and Telegram

Tracking tool and Visualised Competency view: A default view of expanded or collapsed records was implemented on the Tracking Tool (referred to as the visualised Activity Completion) and the Visualised Competency. An option for showing or hiding the entire feature from the course page was also provided. The default view of each feature can be obtained from the Admin view, as in figure 4-12.

Figure 4-15 Controls for the Tracking Tool and Visualised Competency views

4.8. New interface Design Architecture

The new interface design aims to maintain simplicity. The tracking tool and visualised competency were added at the top of the course page since any landing page starts at the top. This approach is presumed to provide maximum exposure to the visually presented tables for the students. Moreover, the tables were developed in an expandable format to allow the students to view them freely. The present study examined the interaction of the application, and the new system format and design were retained to leave undisturbed the theme of the LMS environment. A click counter was added to keep a check of the students' interactions with the visualised Competency and TT. Only the admin could view and reset the click counters for each tool. All the counters were localised only, not stored on the Moodle database.

Accordingly, the researcher logged the click counter once per week to keep track of the students' interactions with the visualised features. All three technological interventions were developed as separate module plugins. The WIUT default Moodle layout was used. No additional JavaScript or CSS files were added, which allowed the plugin to suit the current Moodle installation outfit. All the implementation with Desktop/Mobile views was supported. Such an approach meets Moodle's core update requirements but do not prevent Moodle from receiving updates, fixes or patches and can be upgraded to a newer version. In Moodle, all the modules must be installed using the provided zip archives. The current version of the application (v.1 21.11.2019) requires no additional plugins or components. However, this is the first time that these requirements have been implemented; future updates of Moodle may well need other parts to be installed or developed depending on the functionality implemented in a new version of Moodle and the interventions at its core.

The new interaction architecture was devised to cope with two main interactions: with students and with instructors. While the student section focuses on collecting their data and information regarding their academic performance and interactions, the teachers' section provides updated information and empowers them to change the interface and information provided to students. The main levels of analysis number six: a time horizon (i.e. weeks, historical behaviour, current

behaviour, and expected or modelled future behaviour), physical evidence, students' actions, module actions, instructor dashboard and instructor actions. The students analysis has two main components: the physical evidence (i.e. technical objects) and the level of student action (i.e. tracking learning behaviours).

The physical evidence that models the technological artefacts used by learners in LMS include a student email address, the signup process, the learning content (activities), the tracking technology (represented via illustrations of completed activities), visualised competency, and the participating course Telegram group. The learner's behaviour is reflected on the student action level, which includes access to LMS, views of the visualised TT and Competency platforms, interacting with the learning content (i.e. study lessons, attempted or completed quizzes, views or downloaded files), and the student's interaction with Telegram. As in figure 4-13, the teachers' behaviour consists mainly of "teacher action" according to the information received from the "dashboard". This allows the teacher to modify "Module action" to improve the learning experience. The dashboard consolidates all the information on every learner's exam attempts, performance, interactions, use, social media interaction, the use of different components of the Moodle and the topics covered and completed.

To improve the module design, it was decided to build the new architecture design on a closed loop embracing data collection, analysis, reporting and use. It is an empowering technology that collects the learners' data from the course sign-in and gives access to LMS, the lessons studied and navigated, test scores and the engagement with the social media. All of these sources of information are consolidated into two databases: social media interaction and LMS interaction. These databases are consolidated using the learner's ID so that teachers can effectively manage the module. The main proposed mechanisms here for the teacher are those which enable the count for each topic to be shown or hidden, and to modify the learning outcomes (i.e., competences) per week. Both actions are reflected in the LMS interface.

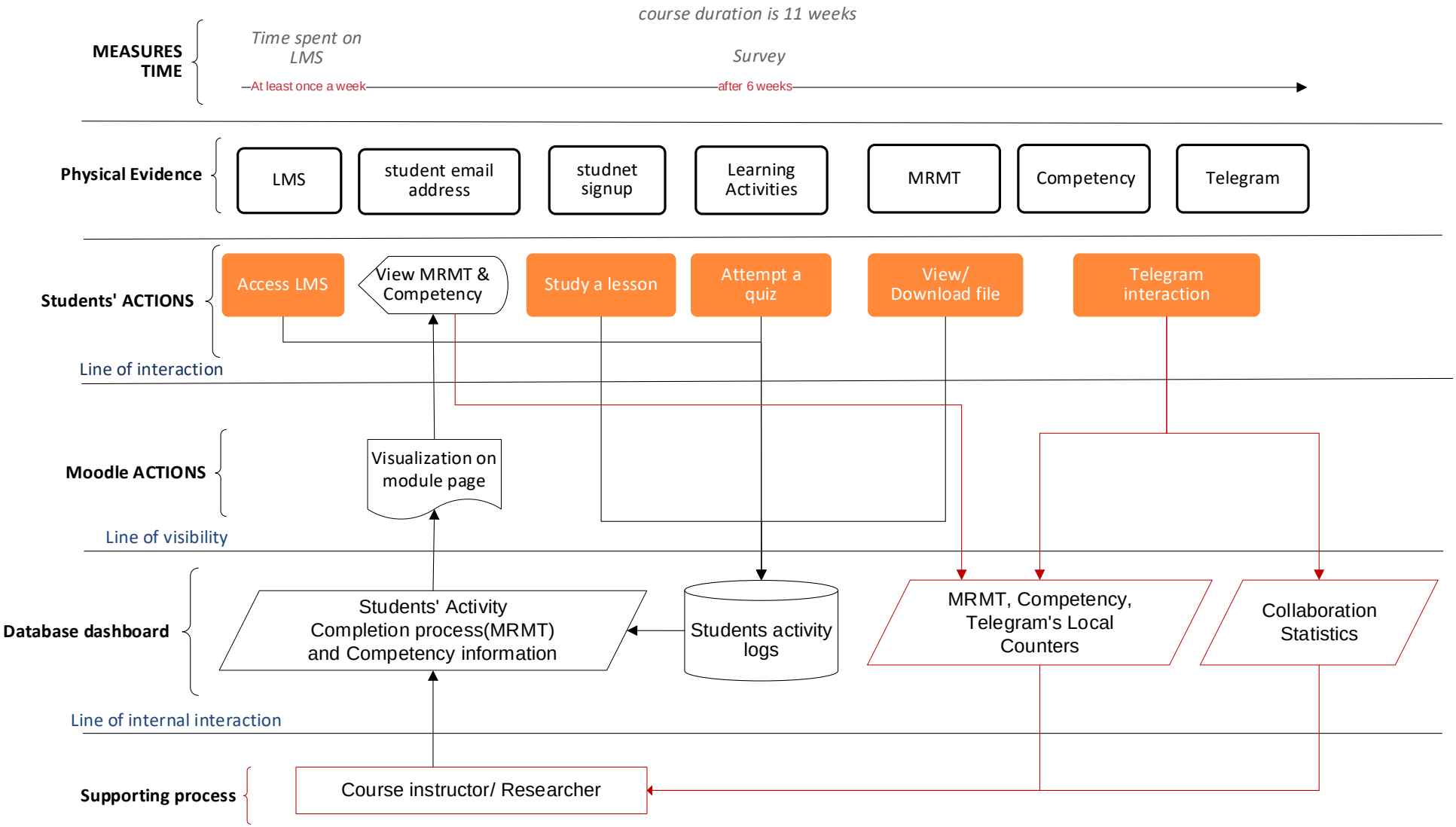

Figure 4-16 High-level diagram of the new proposed system

4.9. Chapter Summary

In this chapter, the development of solutions was discussed, with a focus on the theoretical basis for the technical implementation phase of the present study. First, the chapter introduced the status of the Moodle in use at WIUT and defined which tools were currently used or not used by both teachers and students. In Moodle, three tools were directly concerned with the theories behind the present research proposals, namely, activity reports, competency-based education, and forums. Despite the potential of these tools, neither the students nor teachers had used them for teaching and learning. Accordingly, as the literature suggests, the tracking tool visualised students' competencies, and learning collaboration with the social media was proposed for improving the students' learning experience in LMS. The tracking tool was proposed to enable the instructor to select groups of completed activity logs from the completed activities report on Moodle before displaying them on the course page of Moodle. The visualised competency was also displayed in the weekly topic learning outcomes or relevant cross-curricular competency on the course page. The revised Bloom's Taxonomy was used to plan the LO while relevant CCCs were extracted from the literature and the most relevant for use agreed on by the instructors. Since the forum was never used on Moodle, SM was proposed to increase collaborative learning and to support advice-seeking should help be needed.

Based on the instructor's recommendation and the design requirements (i.e., protecting privacy and reducing distortions), Telegram was adopted. A Telegram group was created for students and instructors to join. Telegram can be accessed through smartphones, desktop, and the web, and the group link was added on the course page. The group link was easy to distribute to the students. The instructors and the researcher enrolled in the group to preserve the code and courtesy of student discussions. Apart from the group link, the Telegram group does not yet support integration into Moodle. However, this issue was not an obstacle since the group can be easily and quickly accessed through smartphones and desktop applications. The group ethics and rules were pinned on the group noticeboard, and all the students read and actively agreed to be bound by them. The tracking tool and visualised competency were plugged in at the top of the Moodle course page because that was where users landed when they first gained access. The design interface of both tools was also controlled to avoid any interface influence from the students' interaction with the tool. The click counter and social vote counter were added to the tools as extra measurement tools for interested students. Moodle admin or the course instructors can view the click counter's statistics only. In addition, the instructor can select whether or not to display the TT and VC on the course page and users can choose to display, expand, or reduce each table.

Chapter 5: Evaluating the usability of the technological interventions

5.1. Introduction

This research uses two different approaches to evaluate and examine the role of TT, VC and SM. The first, which is covered in this chapter, is validating the technological intervention as useful, easy to use, improving the learners' ability to be self-regulated and improving the perception of the cognitive absorption. The second, which will be covered in the next chapter, is examining the effect of the usability of these technological interventions on the learners' perception of the PLSR and PCA of the LMS and the potential effects on the CIU. While the current chapter triangulates the methods for validating the perception of the interventions, the next chapter focuses mainly on examining the effects of these technological interventions on the perceptions of the LMS. In other words, this chapter focuses only on the perception of the usability of the interventions and whether or not they are used, while the next chapter focuses on examining the effect of use on the learners' perception of the self-regulation and PCA from the LMS (and not the technological intervention), which in turn could affect the learners' intention to continue using the LMS (and not the technological intervention).

This chapter aims to evaluate the three technological interventions already discussed –TT, VC and SM – using interaction, interviews and survey data. As visualised in figure 5-1, this chapter is divided into two main sections: the dashboard (TT and VA) and the SM, because the nature and characterstics of TT and VC as dashboard technologies are different from tose of the SM technology. Despite these differences, they are evaluated on the same criteria, as proposed in the theoretical framework. The criteria are not applied to the use of the LMS: the effect on the perceptions of LMS are considered in the next chapter. The criteria are applied in this chapter to the technology: its perceived ease of use and usefulness, the improved cognitive absorption and self-regulation from using this technology, and the intention to use this technology. Thus, section 5.2. and 5.3 cover the validation of the dashboard and social media models. Sections 5.2.1 and 5.3.1 are devoted to the interaction analysis for each of these technologies. The analysis of the survey and interview data for both models is in sections 5.2.2. and 5.3.2. Since the TT and VC are two different elements of the dashboard, the cross-sectional analysis is reported in section 5.2.3.

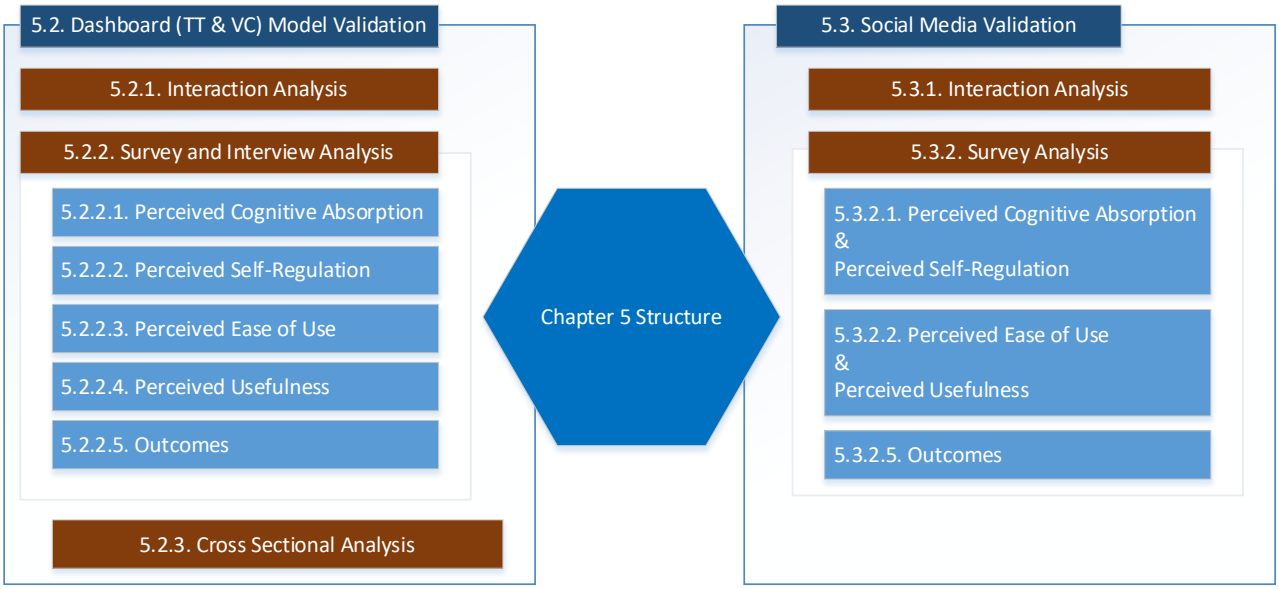

Figure 5-1 Structure of Chapter 5

5.2. Dashboard Model Validation

The dashboard was validated in several assessments: interaction analysis, interviews, and surveys. The interaction analysis involved the use of click counters and heat maps. The findings from the interviews with teachers are presented in the student survey section, where a triangulation of the methods endorsed the credibility of the results.

5.2.1. Interaction Analysis

Interaction analysis was used to assess the actual use of the TT and VC. The interaction analysis relied upon the heat map online tool, Hotjar[2] ,to gauge the learners' interactions with the TT and VC. Evidence from all the weeks' classes is presented in Table 5-1 and figure 5-2, except for the two final weeks, which was a period for revision only. The students used the VC and TT about equally all the time, but for different purposes.

The TT and VC features account for approximately 1% of all the clicks on the platform of the learning management system. This value is significant and constant because the percentage was stable and steady. Moreover, it was not expected that these features would be used every time the LMS was in play. They were used a few times per week, once when the competency table was updated and they also allowed students to review other students' interactions. The number of clicks became steady and relatively fixed at around 47 clicks per week for competency and 49.33 for TT. The clicks declined by around 10 per week for competency (R^2= 60.85%, P<0.00) while

[2] https://www.hotjar.com/

increasing by around 10 clicks per week for the TT (R^2=80.28%, P<0.00). This was because the competency was a planning tool used most often at the beginning of a semester, a week and an activity.

At the same time, the TT functioned as a reviewing tool for benchmarking students' interaction at the end of the semester. Indeed, the explanatory ratio (i.e. R^2) of the TT was higher than that for competency because TT is merely a reviewing tool that is mainly used when time permits. The competency criterion is a planning tool determined by other factors, such as the difficulty and depth of the topic, together with the type of learning outcomes required. Thus, these findings not only validated the use of the TT and VC but allowed students to reflect upon their impact. Interestingly, the click counters showed that the use of TT was different from that of VC, reflecting the weight of importance of each, which was dynamic and changed over time. Table 6-1 and Figure 6-2 provide a summary of the above discussion.

Table 5-1: Click Counter records of VC and TT over the academic term

	Competency					**TT**			
Week	Table header	parent	sub-skills	LO	Likes	Clicks on Table header	visualised activities	Clicks on the visualised activities	Likes
13th – 17th Jan	63	4	56	Yes	0	101	6	33	3
20th – 24th Jan	45	2	19	Yes	0	100	12	16	0
27th - 31st Jan	34	3	30	Yes	1	80	6	20	2
3rd - 7th Feb	19	4	11	No	1	67	7	23	1
10th - 14th Feb	11	4	13	No	1	10	8	33	1
17th - 21st Feb	3	2	7	Yes	1	8	2	56	3
24th - 28th Feb	4	0	22	No	1	5	3	65	3
2nd - 6th Mar	1	12	19	No	3	0	4	98	0
9th - 13th Mar	8	8	13	Yes	0	13	9	100	2

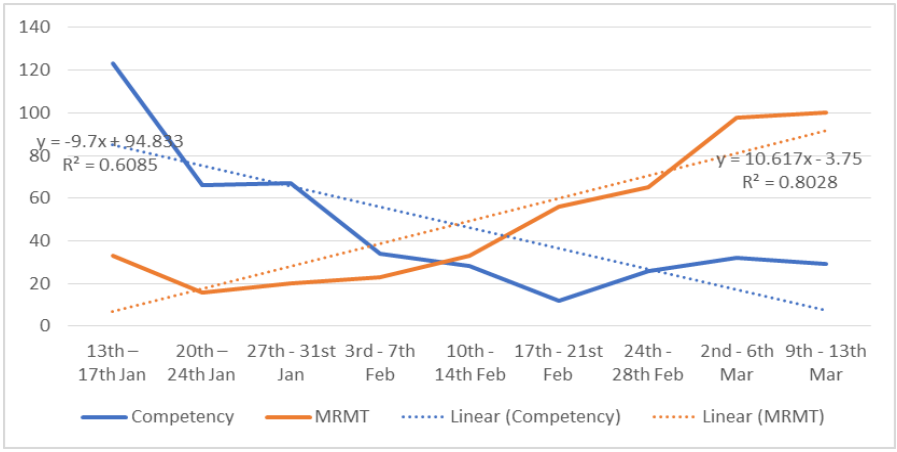

Figure 5-2 Time series analysis of the clicks on TT and Competency

The above findings may have been exaggerated by the frequent use made of these tools by a few students. To improve the evaluation of the intervention, the number of effective users was assessed; i.e. to ensure that a significant number of learners was using these technological

interventions, the effective users measure was adopted. ‘Effective users’ here denotes those who watched more than half of the learning videos on Moodle. The Moodle activity logs yielded the number of effective users. Estimates of the use of TT and VC were based on the great number of effective users; for example, as in table 5-2 and figure 5-3, 31 students watched more than two videos, though only eight watched all of the four videos. Conversely, VC and TT earned around 6 clicks per week for those who watched all four videos and around 1.5 clicks for TT and competency. Similarly, the heat map data validated the actual use of the tools, as reflected in the importance and value attached to them.

Table 5-2:Moodle Log files analysis of effective users (left table)

Number of videos watched	n
1	114
2	56
3	23
4	8
Total number of students	400
Total number of enrolled students	200

Effective students in relation to click counters (right table)

	Competency	TT
Total	417	444
Weeks	9	9
Per week	46.9	49.33
Per top tier students (8)	5.79	6.11
Per tiers 1 and 2 (31)	1.512	1.59

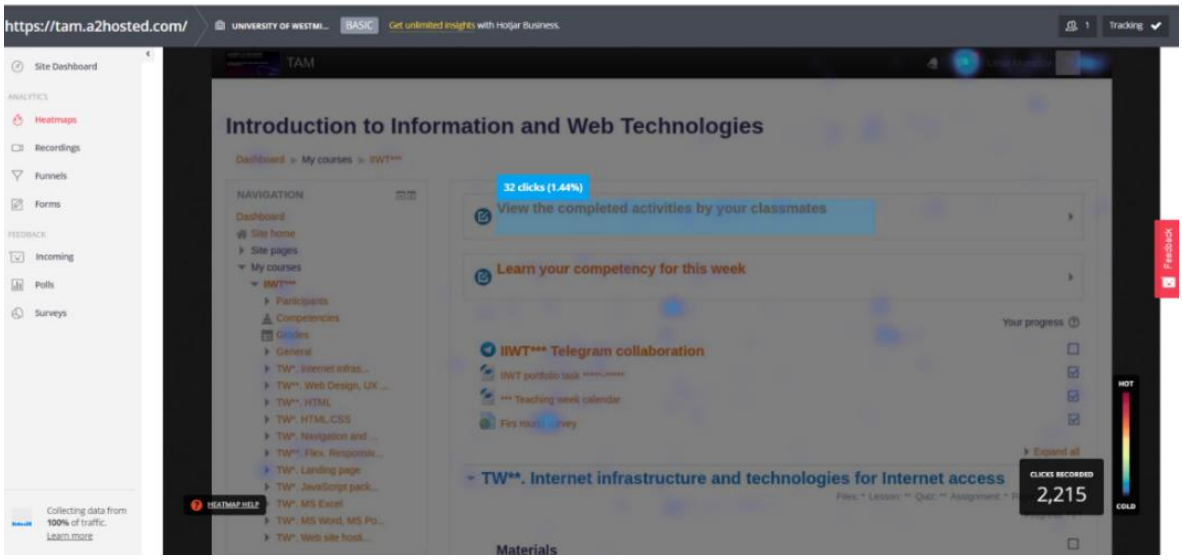

Figure 5-3 Heatmap snapshot over 1k visit to the course page (TT click)

5.2.2. Survey and Interview Analysis

The previous methods focused on assessing actual use. Although actual use is important for evaluating the usability of the interventions, it is important to capture and validate the learners’ perceptions of the usability of these interventions. To this end, a questionnaire was used. The purpose of this interpretive questionnaire was to grasp the learners’ perceptions from different perspectives of a feature among the technological interventions (Lewis & Sauro, 2016). Hence, there was no point in assessing the correlation between the different evaluation criteria; but a

correlation analysis is reported in the next chapter, which assesses the relationship between the use of the technological interventions and the improved perceptions of the LMS. The interviews and questionnaire covered the evaluation criteria of the technological interventions in terms of the Perceived Ease of Use, Perceived Usefulness, Perceived Cognitive Absorption, Perceived Learning Self-Regulation, and Actual Use of the technological interventions (i.e. the Tracking tool and Visualised Competency). A summary of the descriptive analysis can be found in Section 6.2.3.

5.2.2.1. Perceived Cognitive Absorption

The first perspective from which to assess users' satisfaction from a technological intervention is the perceived cognitive absorption. The teachers believed that the learners were highly satisfied and their PCA to this aspect of competency was high. From the teachers' perspective, the VC was perceived as a motivating and engaging tool for their students.

> *"Good tool that helps students to be motivated for studying and to understand the learning material independently. It helps students visually see what teachers are expecting from them and how to divide their efforts properly." T7*

> *"It helps students to concentrate on a certain competency in the certain period of time" T8*

The teachers' opinions were important but, equally, the learners' perspectives claimed attention. The high number of students made a questionnaire advisable. Two dimensions of the usability of the VC from the PCA perspective were assessed: the PCA and satisfaction with the PCA. The PCA statement was borrowed from Roca et al. (2006). The PCA construct was mainly seen in two dimensions, called focus and engagement. Thus, the operational items for measuring the VC and the corresponding statements were as follows: "I become deeply engaged with learning when I follow the visualised competency" and "The visualised competency helps me to remain focused on my study", which indicated the level of improvement in the 'Focus'. These statements indicate that the VC is described by the learner as a tool for increasing engagement. This was similar for the TT. The questions to measure the description of the learners' attitude to TT as an engagement tool are "Time flies when I view the completed activities." and "I can block all other distractions when I view the completed activities."

Learners perceived that the VC intervention was an engagement tool, as in figure 5-4 and table 5-3, with an average score of 3.8, thus, higher than the middle point of the scale (3) by 0.8, at a significant level of ($P<0.00$). Learners perceived that competency on the course page helped them to remain focused on their study with a score of 3.96 (out of 5), indicating 74% of the students

rated their strong agreement with this statement. The second statement suggested that competency was a "cognitive absorption" tool, namely, "I become deeply engaged with learning when I follow the competency on the course page." This was rated at 3.69, higher than the middle point (P<0.00). In other words, 59.6% of the students agreed that they became deeply engaged with learning when they followed the competency functions. Interestingly, the first statement was rated significantly higher than the second point, which meant that competency functioned more as a "focus" tool than an "engagement" one. However, both of them were positive and higher than the middle point.

The second technological intervention for the learners was in the interface of the TT, which was found to have an average score of 3.3 for describing it as a PCA tool; this was significantly more than the middle point of 3 (P<0.00). Two statements were used to measure the description of the TT as a PCA tool. The first one was "Time flies when I view the activity summary of high achievers" which scored 3.43, significantly higher than the middle point. The second statement of TT perception indicated the "improvement of the focus", which scored 3.21 (more than the middle point (P<0.00). Although both statements were perceived as positive ratings of the TT, the TT as an "engagement" tool was ranked significantly higher than the perception of the TT as a "focus" tool. This was due to the nature of the presentation of the TT (visualised completed activities as numeric information). The engagement was perceived to be higher than the "focus" perception because the students interacted with the tool rather than passively reading it.

The satisfaction measures were adapted from (Talantis et al., 2020). Two statements indicated satisfaction with the VC, "I am satisfied with the visualised competency because it helps me to focus while learning" and, "I am pleased with viewing the visualised competency because it increases my attention when I study". Regarding the TT, the statements were: "I am satisfied with the completed activities because they help me to fully concentrate while learning" and, "I am pleased with the completed activities because they help me to block most distractions when I study" This suggested the level of satisfaction with the TT.

Although students agreed on the visualised weekly competencies (3.82), they were perceived to be significantly higher for VC than for TT (3.32), as in table 5-4. The value of the satisfaction with the PCA from the TT was significantly higher than for competency (P<0.00). In other words, the perceived satisfaction with TT for the ability to concentrate ($\bar{x} = 4.15, \sigma = .91$) and the ability to work without distractions ($\bar{x} = 4.18, \sigma = .95$) was significantly higher than for the competency, with the same aspects such as concentration ($\bar{x} = 3.87, \sigma = .97$) and increasing attention

($\bar{x} = 3.83, \sigma = 1.02$). 61% of the students were satisfied with the TT because it helped them to fully concentrate while learning and 56% reported that they were pleased with it because it helped them to block out many distractions. 71.2% of the students reported that they were satisfied with the competency because it helped them to focus while learning. 68.3% of the students indicated that they were pleased with the competency because it increased their attention when they studied.

To sum up, the PCA was measured using two dimensions, engagement, and focus. Learners perceived the TT and VC as PCA tools (i.e. tools that could improve their engagement and ability to regulate themselves).

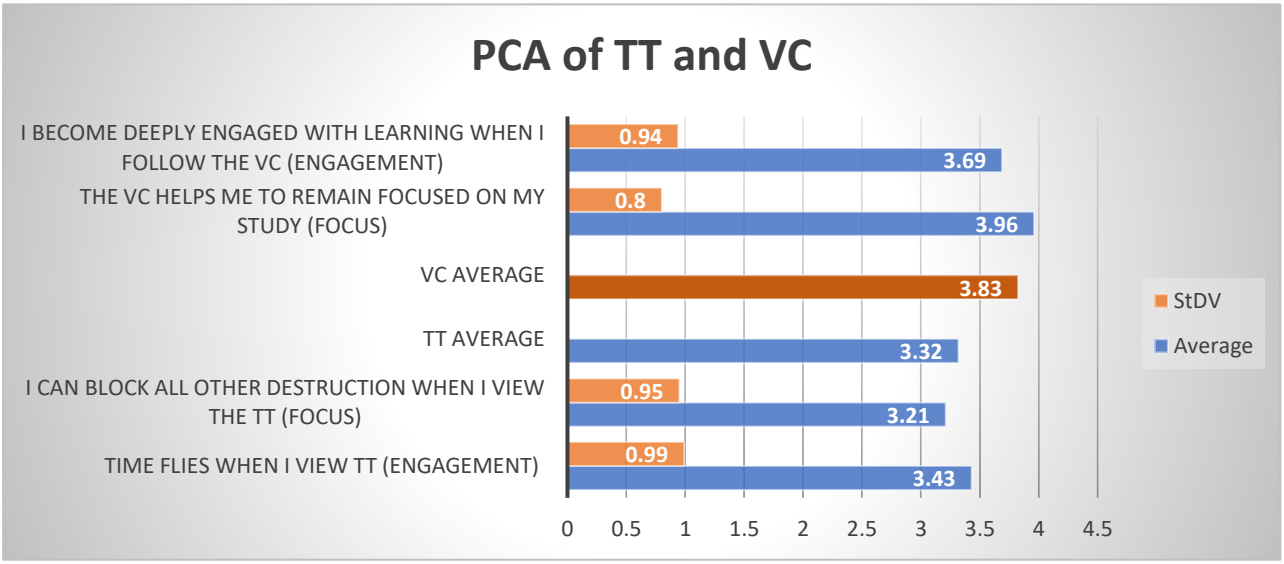

Figure 5-4 Students' PCA of TT & VC

Table 5-3: analysis of students' perception of TT as a survey item

Tracking Technology	$\bar{x}$	σ	**SE**	**t**	$\bar{x} - 3$
Perceived Usefulness					
I believe that the completed activities are useful for my learning	3.99	.91	.08	12.77	.99**
Viewing the completed activities improved my learning performance	3.82	.90	.08	10.62	.82**
Viewing the completed activities is useful in improving *my self-motivation* toward learning	3.34	1.25	.11	3.14	.34**
Perceived Ease of Use					
I find it easy to understand the completed activity summary	3.72	.89	.08	9.42	.72**
I find it clear to follow the completed activity summary	3.81	.95	.08	9.88	.81**
TT made it easier for me to *track the progress of my learning*	3.85	.84	.07	11.85	.85**
Perceived Cognitive Absorption					
Time flies when I view the completed activities (Engagement)	3.43	.99	0.08	5.04	.43**
I can block all distractions when I view the completed activities (Focus)	3.21	.95	.08	2.61	.21*
PLSR					
Viewing the students' completed activities *helped me* to *keep track of my learning progress*	3.37	1.18	.10	3.64	.37**

The completed activities improved my *concentration* on *keeping track of my learning progress*	4.20	.86	.07	16.27	1.20**
Viewing the completed activities makes *it clearer* for me to plan *my learning goals*	4.15	.86	.07	15.62	1.15**
The completed activities view makes *me fully focused* on achieving my *learning goals*	4.23	.88	.08	16.32	1.23**
Viewing the completed activities makes *it easier* for me to self-manage *my learning strategies*	4.10	.85	.07	15.05	1.10**
TT improves my independent learning	3.90	.83	.07	12.63	.90**
Outcomes - Satisfaction					
I am satisfied with viewing the completed activities because it helps me to fully *concentrate* while learning (focus)	4.15	.91	.08	14.75	1.15**
I am pleased with viewing the completed activities because it helps me to block most distractions when I study (focus)	4.18	0.95	.08	14.45	1.18**
I am satisfied with viewing the completed activities because it is practical	4.09	.91	.08	14.00	1.09**
I am pleased with viewing the completed activities because I can effortlessly follow it	4.19	.93	.08	14.92	1.19**
Outcomes – Use					
I follow the completed activities while I study because I find it understandable	4.13	.91	.08	14.52	1.13**
I use the completed activities for my learning because it is simple	4.08	0.92	.08	13.71	1.08**
I follow the completed activities when I study because I find it practical	3.37	1.20	.10	3.56	.37*
I use the completed activities because I believe itis useful for my learning	3.46	1.19	.10	4.48	.46**

(P<0.01; *<0.05)**

Table 5-4: Analysis of students' perception of VC in relation to survey items

VC Competence	$\bar{x}$	σ	SE	t	$\bar{x} - 3$
Perceived Usefulness					
Competency improved my productivity in my study	4.21	.82	0.68	294	1.21**
Competency is advantageous for my learning	4.17	.86	0.74	294	1.17**
Perceived Ease of Use					
It is easy to understand how to use the competency on the course page for my learning	3.88	.83	.07	12.32	.88**
It is easy to implement the competency on the course page for my daily learning	3.85	.73	.06	13.71	.85**
Perceived Cognitive Absorption					
The visualised competency helps me to remain focused on my study (Focus)	3.96	.80	.07	14.01	.96**
I become deeply engaged with learning when I follow the visualised Competency (Engagement)	3.69	.94	.08	8.58	.69**
PLSR					
Using the Competency on the course page *helps me* to extend my thinking on *my knowledge of the course*	4.08	.66	.06	19.21	1.08**
Viewing competency on the course page makes *it easier* to become a *self-directed learner*	4.02	.69	.06	17.19	1.02**
Using the competency on the course page makes me *fully engaged* in *extending my thoughts on the course contents*	3.91	1.00	.09	10.64	.91**
Using the competency on the course page enhances my *concentration* on *achieving my learning goals*	3.78	1.02	.09	8.95	.78**
Outcomes Satisfaction					
I am satisfied with the visualised competency because I found it practical	4.04	.65	.06	18.64	1.04**

I am pleased with the visualised competency *because I was able to use it effortlessly*	3.96	.72	.06	15.51	.96**
I am satisfied with the visualised Competency because it helps me to focus while learning	3.87	.97	.08	10.41	.87**
I am pleased with viewing the visualised competency because it increases my attention when I study	3.83	1.02	.09	9.48	.83**
Actual Use					
I read the competency on the course page because I found it easy to follow	4.04	.69	.06	17.45	1.04**
Competency is practical to use in learning	4.2	.83	.69	294	1.2**

****P<0.01; *<0.05**

5.2.2.2. Perceived Learning Self-Regulation (PLSR)

The learners and teachers perceived the new interventions (the tracking tool and visualised competency) as self-regulation tools. The teachers believed in the importance of the TT. They argued that it not only improved the learners' ability to self-regulate but also the teachers' ability to let the students self-regulate the teaching delivery. The teachers perceived the TT to be an efficient intervention and believed that it could improve the ability to self-regulate:

> *"I find the TT efficient, easy to track what is done and what is not. Additionally, I can easily track the progress and statistics of my students" T1*
>
> *"It is a very good indicator for analysing the students' performance" T2*
>
> *"I think it is interesting for the learner to track his/her progress" T4*
>
> *"... helps them identify the files which are more often consumed by their group" T5*

From the learners' perspective, the captured dimensions of the PLSR were the perceptions of "becoming self-directed learners, improving the ability to manage strategies, tracking learning progress, achieving goals and able to evaluate self-knowledge". Learners perceived the TT as helpful for managing strategies, tracking learning progress, and improving the focus in learning. Tracking learning progress and achieving goals were perceived by the students as capable of making them self-dependent learners. The learners rated highest the power of TT to improve the PCA (i.e. the focus). They rated their belief that "Focus" most enhanced the ability to keep tracking the learning progress in terms of "helping" (4.2) and achieving planning goals (4.23) which were rated respectively 69.1% and 57.86% of the student's positive agreement. The learners ranked second the importance of the TT as a facilitator of the PLSR activities. The students responded with 'highly agree' (14%) and 'agree' (42%), making a total of 56%. In agreement with the claim that TT facilitated the planning of learning goals and self-managing the learning strategies, 12% chose as their response 'agree' and 44% chose 'highly agree', where the mean scores were 4.15, and 4.10, respectively.

The order of importance can reflect the primary view of the TT as an organiser that learners believe to improve the focus on planning, reviewing, and achieving targets more than it improves the facilitating, setting and planning of learning goals and self-managing learning strategies. The students perceived that TT improved their ability to be self-dependent learners ($\bar{x} = 3.9, \sigma = .8$); indeed, 75% of the students had a positive attitude to it. The teachers similarly argued that TT helped their students to identify the most consulted contents every week and led them to complete the same content, meaning that they could plan and review their performance better.

In contrast to the perception of improving the "focus" of "tracking my learning performance" which was highly scored (4.2), the statement that "tracking my learning performance" "helped me" and "[made] it easier" scored lowest of all the PLSR statements (3.37) and (3.85), even though the score was significantly higher than the middle point of 3 ($P<0.05$). The two scores of 3.37 and 4.2 used t-testing and were significantly different (0.83, $P<0.05$). This rating of students may have been due to the nature of the TT itself; it gives a perception of the focus by setting the benchmark (i.e. other students' performance) without visualising it or comparing it with the learners' activities, i.e. it provided the students with details of the completed activities of others, without seeing their performances. The current TT was not so selected, since it provided only information about others.

The use of the weekly VC was perceived by learners and teachers as a PLSR tool. Instructors believed that the VC planner gave helpful guidance in mapping, structuring and distributing the module learning outcomes over the weeks of the course. The teachers found the VC helpful in identifying the required resources and strategies allocated for students. The VC planner was also perceived to be a good reminder for the instructors of the weekly LO that they needed to deliver, instead of their accessing the module handbook, and as a good LO road map visualiser for the students:

> "*It helps to structure the process of education. Because of this file, we easily divide the LO of the module that further helps us to create a proper structure and necessary materials for the module. Moreover, it helps to create a strategy that students should follow in order to achieve the goals independently."*
> *"Competency LO planner is helpful for it always keeps reminding me the LOs that I am supposed to focus on" T3*
> *"You will not forget about the competencies while you are focused on teaching specific area" T4*
> *"It is quite useful to see a competency plan for the week" T6*

In addition, the teachers found that the use of the revised Bloom's Taxonomy for structuring the learning outcomes was useful and helpful.

> *Furthermore, the column of the Bloom Taxonomy structure helps to understand what we expect from students in terms of cognitive learning. It makes my work easier since I can easily divide LO, and it helps students better understand what they should do and study during the module." T2*

The learners perceived and rated the VC positively, as in figure 5-5. The students perceived the VC as an enabler for self-directed learning. They also perceived it to help them manage their strategies and to improve their focus on achieving their goals effectively. The students also rated the VC as a positive tool for improving their engagement with knowledge self-evaluation. Hence, these interventions were perceived as vital enablers for improving learners' self-regulation activities.

Unlike TT which was perceived as a tool to improve focus (i.e. the PCA), the main perceived use for the VC was as a facilitator for self-regulation activities because the learners believed it to improve the amount of knowledge and skills absorbed from the topics studied each week. The two highest scores for facilitating were awarded to "extending my thinking on the knowledge of the course" (4.08) with a 62% total of positive agreement from the students and becoming "self-directed" learners (4.02) with a 59% total in positive agreement. The second perceived improvement was the cognitive absorption for learners in terms of "engagement" and "focus". These fully engaged the students' rating of 'extending the thinking on the course context', to which a total of 67.79% positively agreed, and 'its improved concentration for achieving learning goals' to which a total of 63.76% positively agreed (3.91 and 3.78) respectively. All the scores were significantly more than the middle point (3, P<0,00).

To sum up, TT and VC were perceived ~~positively~~ useful by the learners. At the same time, TT appeared to improve the PCA (i.e. the focus) that ultimately improved abilities, while competency improved the facilitation of self-regulation knowledge, skills and abilities. In other words, the two interventions were complementary and supportive of each other. Figure 6-5 illustrates the earlier discussion.

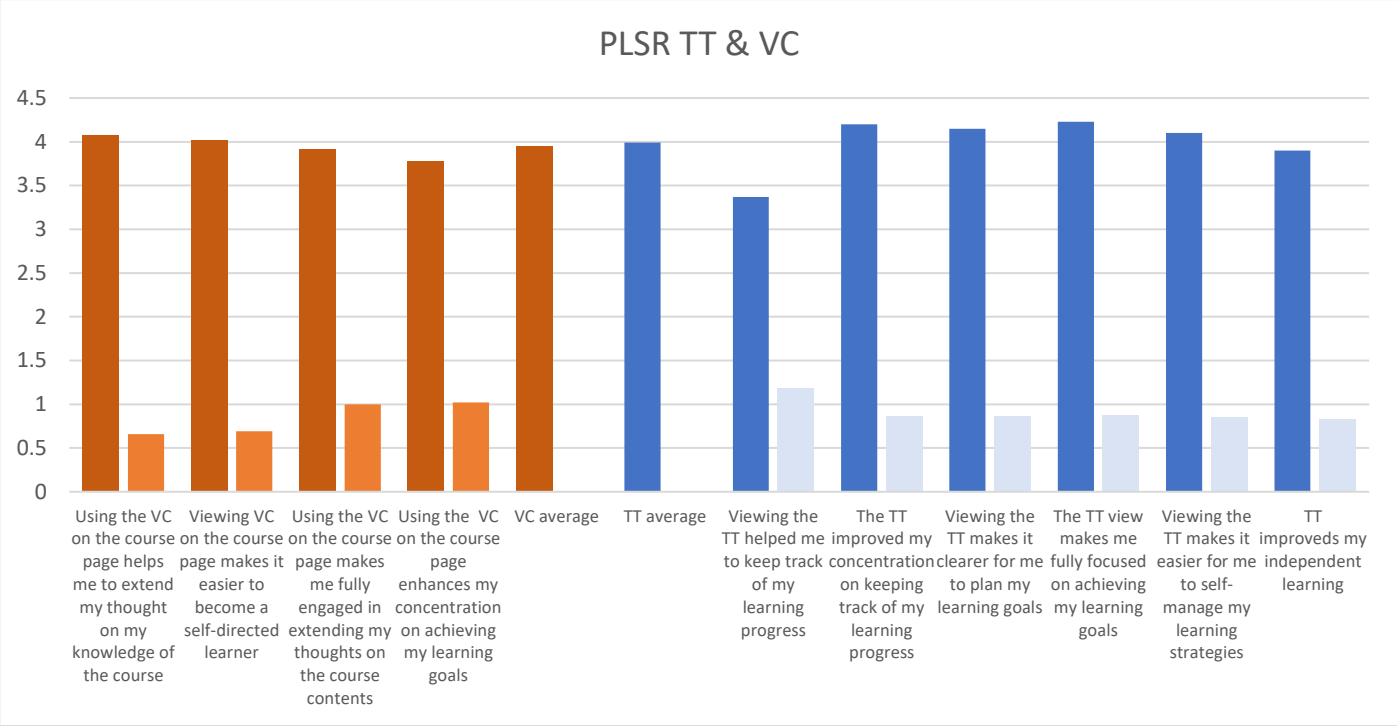

Figure 5-5 Students' PLSR with regard to TT (Blue) & VC (Orange)

5.2.2.3. Perceived Ease of Use

One of the main objectives of the design was to ensure that the simplicity and practicality of the design were useful for learners. Both features were perceived to be easy to use, and this positive perception is believed by learners to contribute to their satisfaction with using a technological intervention. For TT, two statements measured PEOU, namely, how far it was "easy to understand the completed activity summary" and how far it was "clear to follow the completed activity summary". Both statements scored significantly higher than the middle point of the scale (3). The first statement had an average of 3.72 and a standard deviation of 0.89, while the second statement had a similar average of 3.81 with a standard deviation of 0.95. The PEOU for VC was measured by two statements: that it was easy to "understand how to use competency on the course page" and "easy to implement the competency on the course page", which earned respectively the scores of 3.88 (standard deviation of .83) and 3.85 (standard deviation of .73). These results are presented visually in Figure 5-6. For their part, the teachers believed that, compared to the TT, the visualised completed activities were an efficient and convenient tool which provided them with an easy way to track students' progress.

"A convenient tool that helps to see how many students completed the activity" T1

They believed that their students struggled with the TT because it was a new tool, so at first the students resisted using them when they were displayed.

"TT looks great. Students expecting more practice on that" T7

The empirical evidence supports the teachers' arguments because the PEOU for the VC was slightly higher than for the TT ($\underline{x}_{VC} - \underline{x}_{tt} = .10, P > .05$)

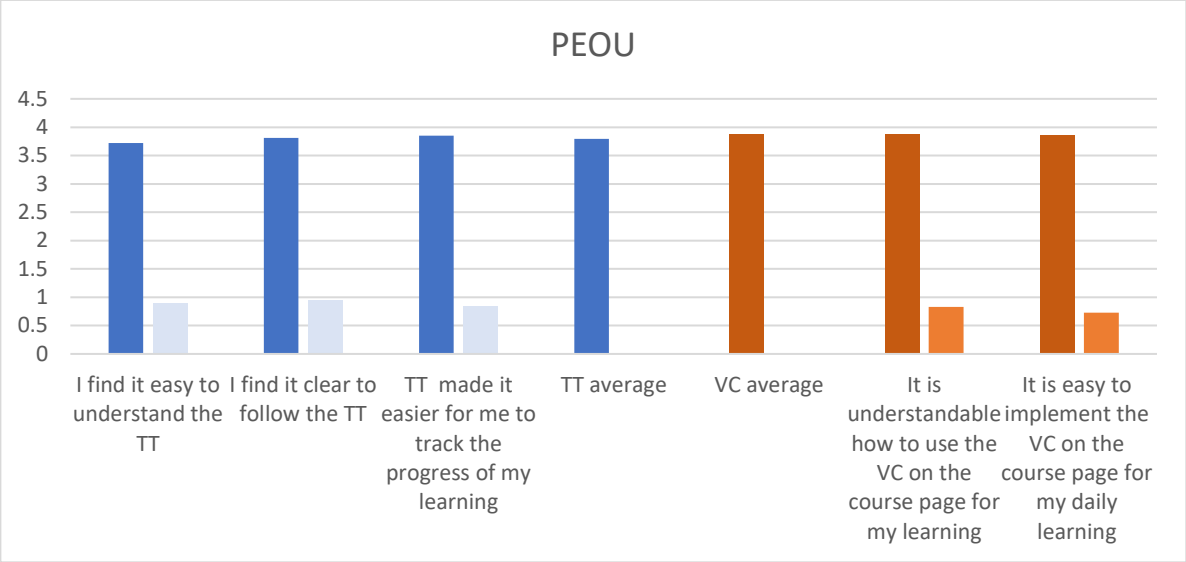

Figure 5-6 Students' PEOU for TT and VC

5.2.2.4. Perceived Usefulness

The two interventions were rated by learners and teachers as useful, but the one for visualising competencies was rated as significantly more useful than the TT was. Possibly, the ease of using the competency explains this higher rating, plus the nature of the data that each presented (i.e. numeric values versus instructions). As in figure 5-7, this power of the weekly visualisation of the competencies to improve their productivity was rated by learners as $(\bar{x} = 4.21, \sigma = .82)$, perceived as advantageous for the learners $(\bar{x} = 4.17, \sigma = .86)$ and practical to use $(\bar{x} = 4.2, \sigma = .83)$. The teachers similarly argued that visualising the competency was useful for students because it helped them to understand their learning outcomes independently (i.e. improved PLSR). It also reminded them about what they needed to focus on (i.e. improved their PCA). The teachers believed that their students found this interesting and therefore it helped them to concentrate for more extended periods (i.e. improved PCA).

> *"Competency LO planner helped me to identify if I am balancing module content across module LO. After I created a map, I identified that several learning outcomes were given more time compared to others. I slightly adjusted the module content to achieve balance." T1*

The positive rating of TT was slightly less than that of the VC, in terms of the students' perception of usefulness. The highest measurement among the four aspects was the students' perception that it was effective for their learning (3.99), with which 22% positively agreed. This was followed by the perception of it as a feature that improved their learning performance (3.82) with which 19% positively agreed. That TT was considered "useful" highly "improved learning performance" because the technology increased learnability without necessarily improving performance. This was possibly due to other social and psychological factors beyond the effect of this technology on performance. The perception of improving the ability to learn independently by more closely examining specific roles could reveal more insights. The teachers experienced the TT as a practical intervention for its motivating qualities, which improved the learners' performance.

> *"I think seeing what other students completed could be interesting for students, I believe it would enhance the students' interaction with this platform" T3*

The students perceived TT as a useful feature for improving their self-motivation in learning (3.34), although it was the lowest rating of all the useful figures. This may have been due to the nature of the learners' ego, meaning that some learners might resist admitting that someone else's achievements stemmed from their self-motivation.

In summary, students positively experienced TT as a useful feature for their learning but found it slightly challenging to apply it in practice. Moreover, students resisted referencing dependency on self-motivation as an explanation for others' achievements.

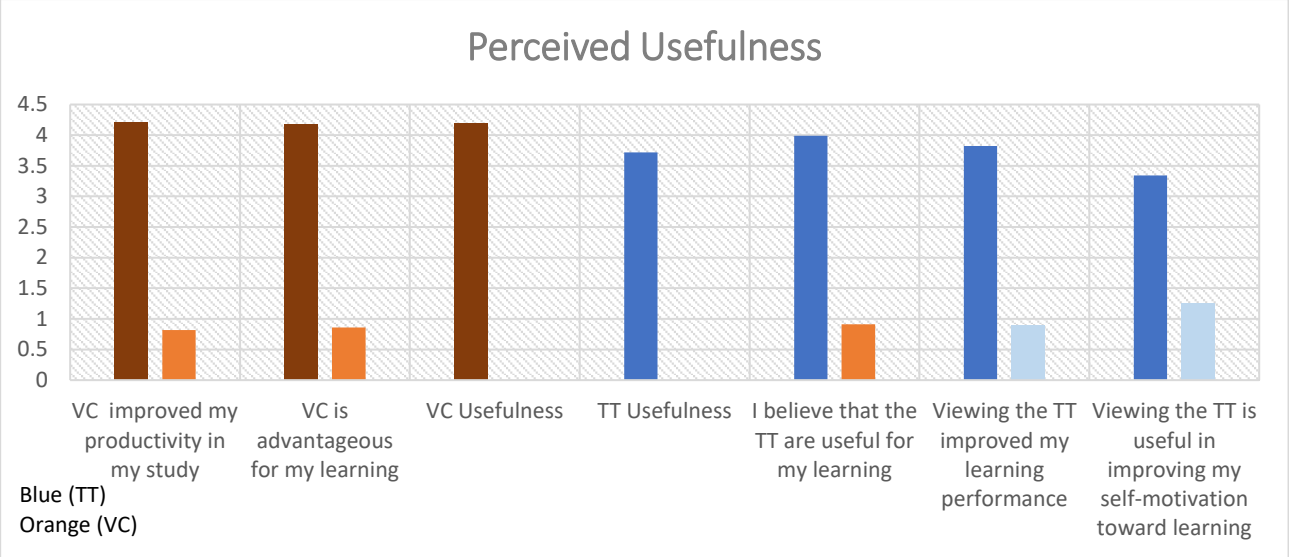

Figure 5-7 PU of TT (Blue) & VC (Orange)

5.2.2.5. Actual Use

This research used interaction analysis to assess the actual use, which is reported in Section 5.2.1. This section also reports asking the learners whether they are using the technological interventions, and if so, for what reasons. The students used both interventions, for different reasons.

The main reason for using TT was for the sake of being understandable and simple (respectively, 4.13 and 4.08) and positive acceptance from 54% and 53% in total. The statement, "I use the [intervention of] completed activities because I believe it is useful for my learning." was perceived with significant positive acceptance (3.46) which corresponded to 52% total positive acceptance. However, it was lower than for the similar statement, "I believe that the completed activities are useful for my learning" (3.99).

The TT was perceived to be a practical feature (3.37), but despite the acceptance of this aspect, it remained lower than its previous context in measuring TT usefulness. This may have been due to the nature of the TT itself, where students could see the finished work, but no details of how it was completed. For young learners or those who depended mainly on guidance, applying the TT in practice (when it was visualised as a set of completed activities) was challenging. VC was also notable for its perceived usefulness and easiness. Both scored more than 4.0 and being "practical" scored 4.2, higher than being easy, which scored 4.04.

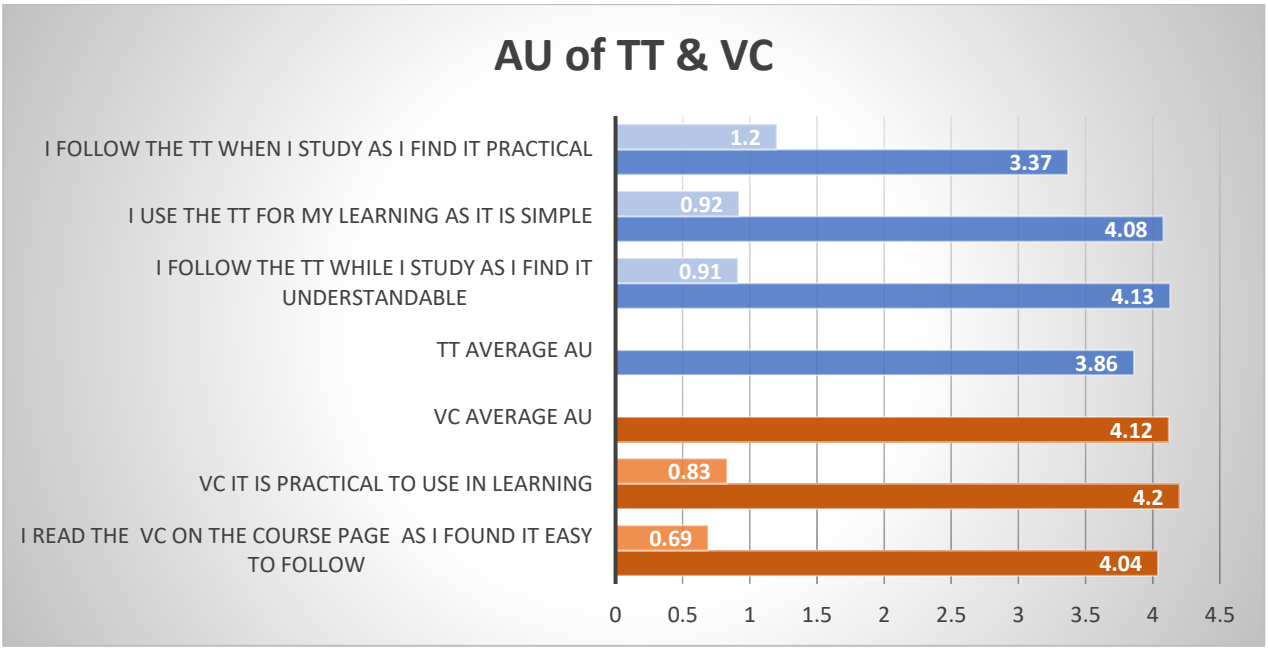

Figure 5-8 AU of TT & VC

5.2.3. Cross-Sectional Analysis

This section compared the TT and VC on the different axes of the usability of the intervention. In this research the perceived usability is measured by perceived Satisfaction PS, PCA, PLSR, PEOU, PU, and AU. These interventions are usable because all figures from the quantitative data of the students' surveys that were significantly higher than the middle point 3 ($P<0.00$) were accepted. Although the values were clustered between 3.3 and 4.18, there were some variations across them. For PCA, the visualisation of the competencies per week (3.8) seems to have been perceived as improving the student's cognitive absorption significantly higher than the TT data (3.319). However, satisfaction with the improved PCA for TT (4.16) was significantly higher than with the visualised competency (3.85). Possibly, students were happier with the TT than with the competency because TT may have seemed more engaging mainly because it told learners how others were using the LMS.

Nevertheless, as detailed in other sections, above, and summarised here, the perception of usefulness of TT (3.7) was less than that of visualising the competencies (4.2), as shown in figure 5-9 and figure 5-10. Three reasons may be proposed for this. First, TT was based on quantitative data which limited some students' ability to absorb and use them to help plan studies more effectively. Second, the competency offered more precise guidelines for expectations each week, making it easier for students to plan their work more effectively, with improved focus on their more important skills and topics. The teachers also supported the argument that competencies provided clearer and more straightforward instructions. More than four teachers indicated that

students feel more comfortable using the competencies because of the ease of use and usefulness of this intervention.

Third, the nature of the TT did not show the learners how their interactions were different from those of an average student, making it difficult for them to assess what stage they had reached and what interactions needed to be improved. Thus, because of these factors, the actual use of the visualised competencies (4.1) was greater than that of the TT (3.79). For these reasons, some teachers stated that they preferred the visualised competency to the completed activities.

"I believe it gave my students clear vision of a roadmap for the module"

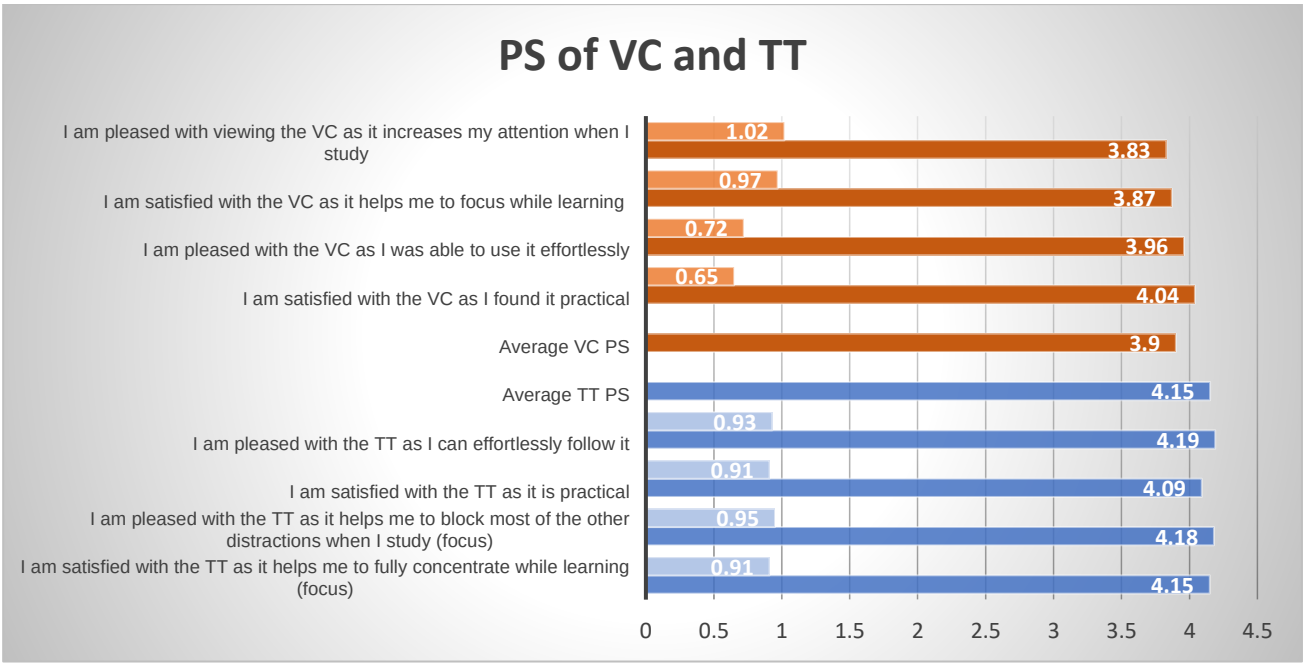

Figure 5-9: Students' PCA of VC (Orange) &TT (Blue)

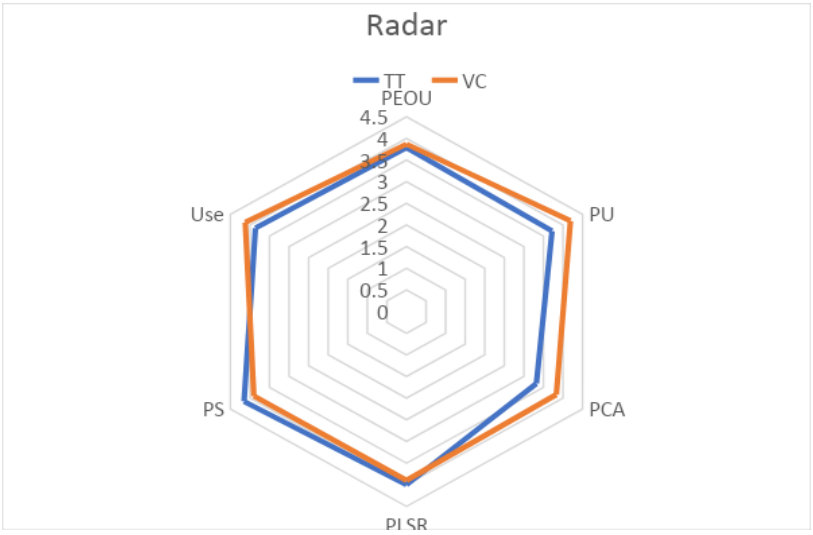

Figure 5-10: A cross-section of TT and VC across students' perspectives

5.3. Social Media Model Validation

This section aims to validate the usability of the social media interventions. The usability of the SM as perceived is covered in a separate section of the TT and VC, due to its differences and to the tools that can be used to assess this usability. The validation goes through user interaction, content analysis and survey analysis. Content analysis is used here owing to the SM nature of the learners' creation of content through it. Thus, content analysis is used to assess the level of use and the purpose of use.

5.3.1. User Interaction Analysis validation

There were two primary sources of data on the learners' interaction to validate the adoption and use of social media, namely, users' interactions through Combot and content analysis through Telegram primary. Both of these methods show that SM intervention is used by learners.

5.3.1.1. Students Interaction Data

Two methods were used to validate the actual use of the SM through Combot. These were the number of enrolled students and the density of use. Regarding the enrolment rate of the SM, 289 (72.25%) of the 400 students who registered with Moodle enrolled on the module Although 114 users had watched at least one video on Moodle, the registered students on the Telegram were 289, which amounted to 350% of those watching videos on Moodle. These results validated the claim that students of Group 1 used the SM as Figure 12 below displays, between 10th January and 5th April 2020 (IIWT module). In order to measure the density of use, a detailed analysis was conducted. The students exchanged a total of 11577 messages, 40 per student. These messages consisted of 505 photos, 12 videos, 41 files, 2 audio files, 223 shared links, and 61 voice messages, which meant that 10724 text messages were exchanged.

This was a validation point for the use of the SM in the learning process. Ten course instructors monitored the group in addition to the researcher. Accordingly, non-relevant shared content (e.g. casual socialization discussions, funny multimedia files) rarely appeared because students were constantly reminded to adhere to the group rules and policy. The pattern of use was not constant; the daily average rate of exchanged messages reached 1567 with 91 active students in the submission period. Nearly, half of the group participated during the final year project (46.15%), as is shown in the third line of the figure 5-11 and figure 5-12.

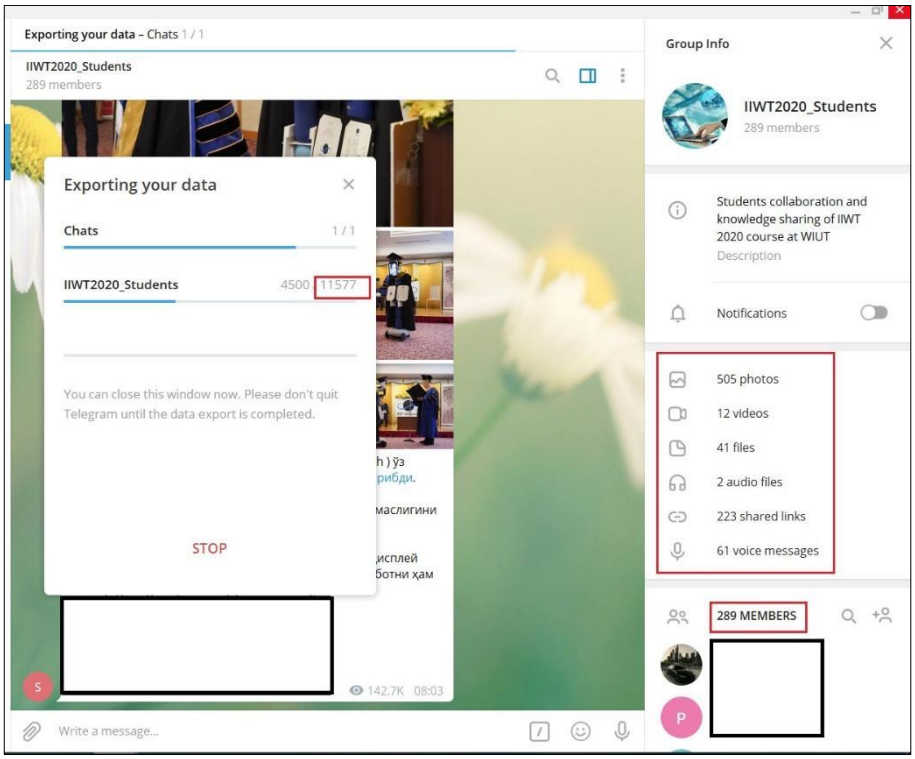

Figure 5-11: Statistics retrieved from the Telegram Group

5.3.1.2. Instructor Interaction Data

The instructors' group had 10 members, seven of whom registered with Moodle. Interestingly, there were nine active users. These numbers suggested that two teachers who were not registered with Moodle had used the SM and also confirms that the teachers were using Moodle. The density of use was used in addition to validate use behaviour. The nine active users had 429 interactions in the period between 14th January to 4th April. This implied an average of two messages per day. As with the students' interactions, the highest incidence of messages from the group occurred at the beginning and end of the academic term. This can be accounted for by preparations for beginning the semester, and by the coursework/examination period that ended it. These results validated the use of SM by teachers.

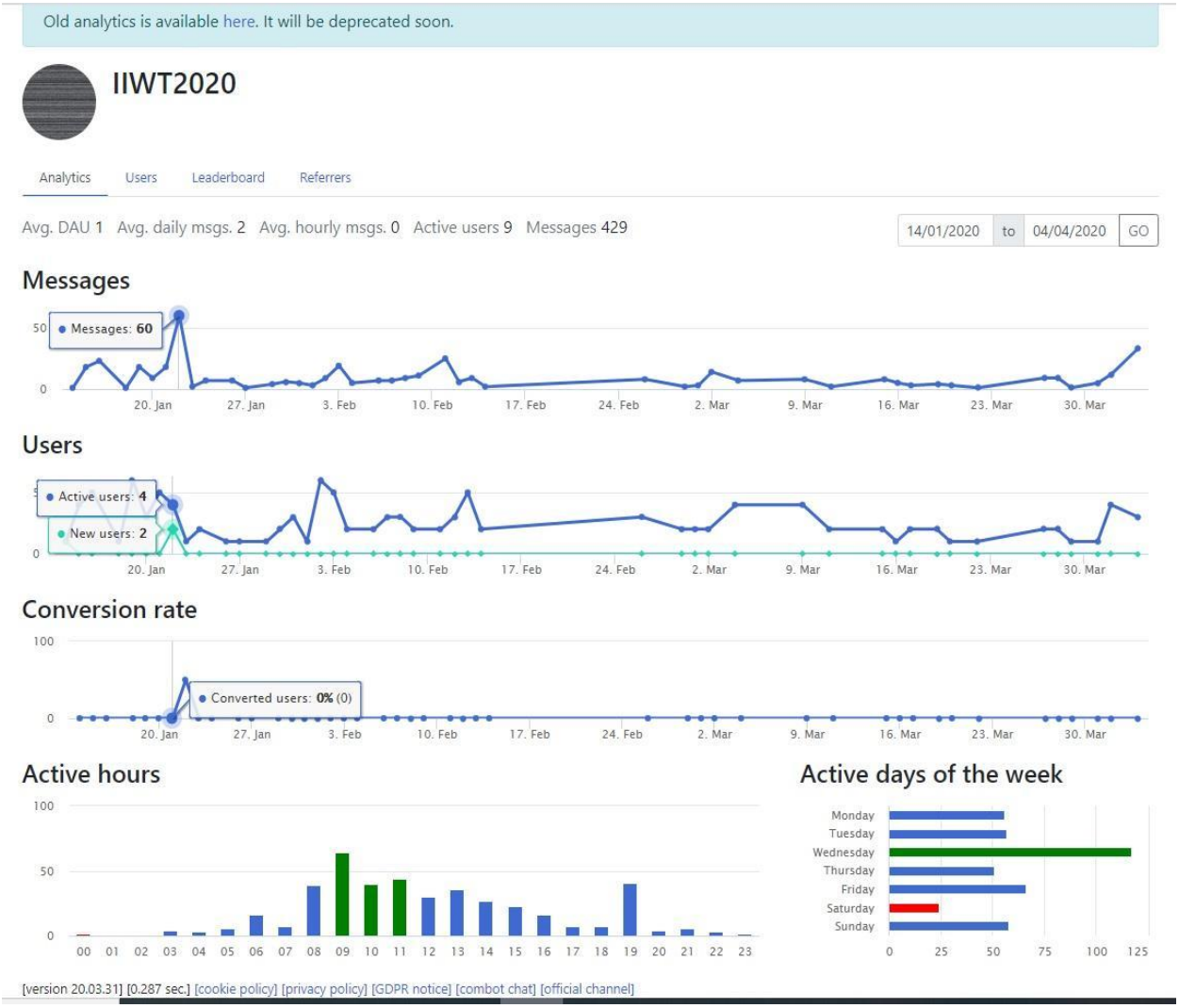

Figure 5-12: Instructors' interactions in the teacher group

5.3.2. Content Analysis

Content analysis was performed using narrative text analysis. The aim was to summarise the frequency of help-seeking and other advice in the group using relevant keywords such as, "Please advise", "question", "help", "How can I solve", "please explain." From this evidence it appears that 1353 messages were exchanged to discuss questions or elaborate on technical content. The total of text messages exchanged was 10724 and 12% of the exchanged messages concerned advice and help, seeking or querying the learning content, as in figure 5-13.

These results confirmed that the students were using the SM to improve their self-regulation because it was mainly used to seek help. In order to ensure and validate these conclusions during the academic term, the students were asked to participate in a poll that asked for the main reason for their use of the Telegram group. 124 students from both groups responded, with 48% of them stating that they turned to the group to solve coursework problems, while 32% said they used it as a source of help. Thus, 80% of those who responded had used the group for actual collaboration

and help in their learning. The rest of the students (4%) said that they had used it to seek advice on how to submit their course work, 12% engaged in casual conversation about the module, and 4% in casual conversation about the University. This confirms the point that social media can serve to reduce the fear of seeking help in the process of learning.

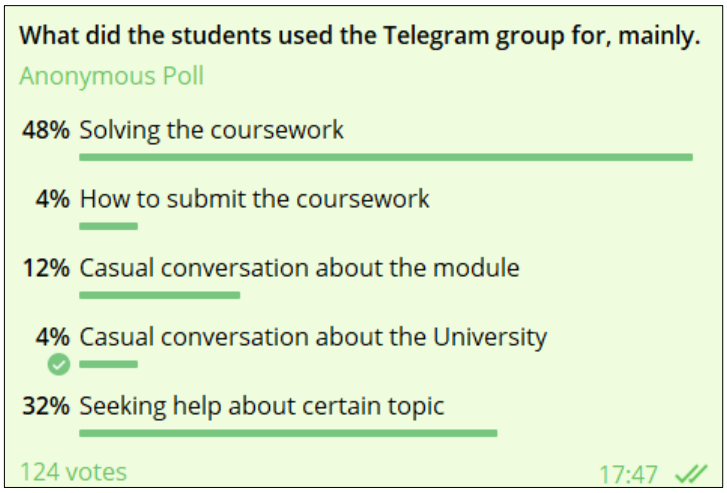

Figure 5-13: Students' responses on Telegram group poll

5.3.3. Survey analysis

The dimensions of the usability evaluation concerned ease of use, usefulness and the PCA and PLSR of the SM. In the previous chapter, the ease of use and usefulness in the examined model were explored to test the intention to continue to use LMS in the future, where the PCA and PLSR of LMS improved. In the validation model, the focus was to measure the ease of use, usefulness, PLSR and PCA of the SM. Table 5-5 summarises the descriptive analysis of the survey on learners' feedback on Telegram.

Table 5-5: Descriptive Analysis for the Telegram

Social Media	$\bar{x}$	σ	SE	t	$\underline{x} - 3$
Perceived Usefulness					
I find collaborating on the Telegram group advantageous for my learning	3.73	1.16	.10	7.29	.73**
Collaborating on the Telegram group is useful for my collaborative learning	3.75	.90	.08	9.71	.75**
Collaborating on the Telegram group is beneficial for my learning	3.76	.87	.07	10.24	.76**
Perceived Ease of Use					
It is easy for me to collaborate on the Telegram group	3.76	.92	.08	9.57	.76**
Collaborating on the Telegram group is clear and understandable	3.75	.88	.08	9.99	.75
Cognitive Absorption					
The Telegram group helps me to block most distractions	3.24	1.07	.09	2.64	.24**
Time flies when I use The Telegram group	3.35	1.04	.09	3.89	.35**
The Telegram group makes me fully engaged in reflecting my knowledge on the course	4.13	.86	.07	15.18	1.13**
Perceived Learning Self-Regulation					
The Telegram group makes it easier for me to seek help about the course content when needed	3.92	1.01	.09	10.60	.92**

The Telegram group enhances my concentration on seeking help regarding the course content	4.13	.90	.08	14.65	1.13**
The Telegram group makes it easier for me to re-evaluate the knowledge I have compared to my classmates' knowledge	3.81	1.02	.09	9.23	.81**
Outcomes - Satisfaction					
I am satisfied with The Telegram group because it helps me to concentrate on collaborative learning	4.10	.87	.07	14.72	1.10**
I am pleased with The Telegram group because it makes me fully engaged in collaborative learning	4.07	.95	.08	13.21	1.07**
I am pleased with Telegram group because I can effortlessly follow it	3.78	1.15	0.10	7.89	.78**
Outcomes – Usage					
I use the Telegram course group because it is easy	3.89	1.04	.09	9.93	.89**
I use the Telegram group because it is simple	3.88	1.11	.09	9.23	.88**

5.3.3.1. PEOU and PU

First, as in figure 5-14, the ease of use and usefulness of the Telegram were positive, and they were significantly higher than the middle point of the scale. The average score for ease of use and usefulness were equal at 3.75. The teachers also found the Telegram easy to use, stating the following,

> *"I could easily broadcast announcements there. Messages reached students faster than with WIUT Web Mail" T1*

Similarly, PU was significantly higher than the middle point of the scale. Interestingly, items measuring PU had almost similar scores. The Telegram was beneficial for collaboration (3.76) with 68.4% agreeing with the statement that it was useful for collaborative learning (3.75). with The statement that it was advantageous for learning (3.73) was accepted by 61%, with a 66% total acceptance rate . Similarly, the instructors perceived the students' group as useful:

> *"It is convenient to share the files in this platform" T4*
>
> *"… shy guys feel more relaxed. This liberates them, and they are more willing to make contact and take part in discussions" T5*

The students rated the Telegram group with significant positive acceptance because it was easy (3.76) and clear and understandable (3.75) for use in online collaboration with 65% and 64% respectively reporting acceptance. This view of the group was summarised by one of the teachers as follows: *"It is fast, accessible, instant and widely used" T 6*

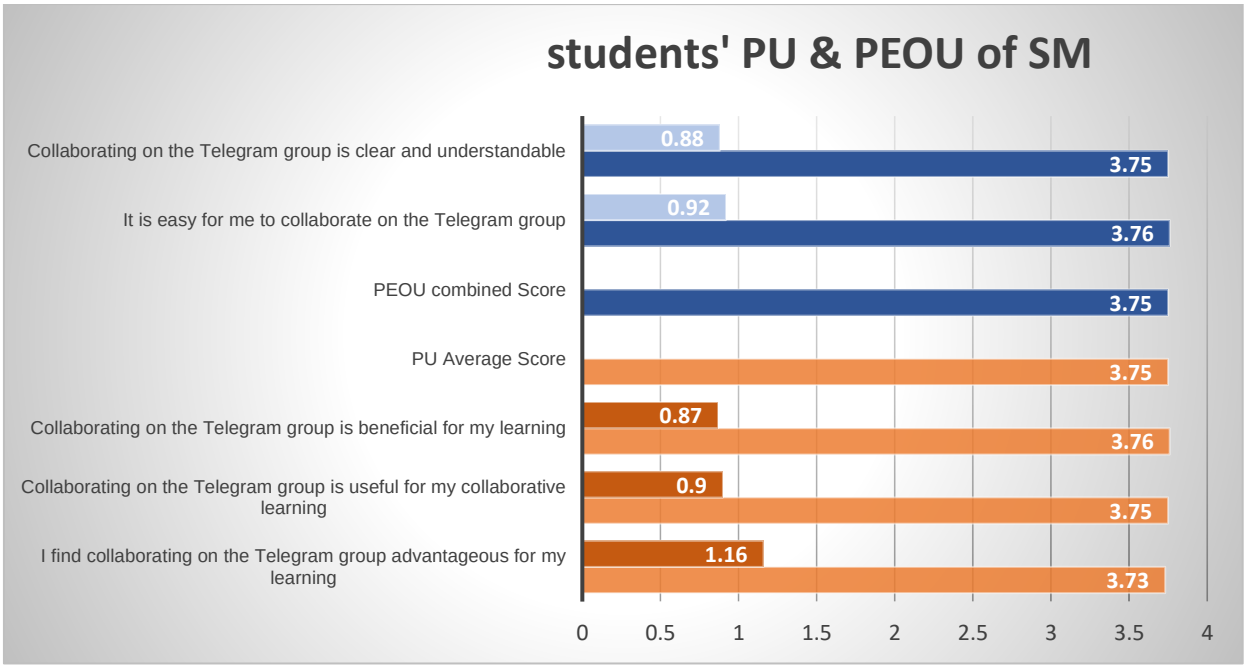

Figure 5-14 Students' PU (Orange) & PEOU (Blue) of SM:

5.3.3.2. PCA and PLSR

The second and third aspects of evaluating the usability of the technological intervention are the definition of the intervention as a PLSR tool and a PCA tool. The students who rated the use of Telegram as a PCA tool said that Telegram most enhanced their engagement and was least useful as a tool to improve their "focus", although all figures were significantly above the middle point of the scale. The validation of the SM as PCA was assessed using three statements. The first and the second were, "It engages them fully in reflecting my knowledge" and, "Time flies when I use the Telegram group." As illustrated in Figure 5-15, these were with scores of 4.13 and 3.35, with significant positive acceptance above the middle point (3, P<0,00). This difference in the rating may have arisen because a collaboration with social media may improve students' learning engagement because it enabled them to be self-reflective in a discursive learning process, "feeling that time flies". The social media were not used for fun nor without a workload. The learning process was always given a cognitive burden, which reduced the feeling of a cognitive engagement rather than being engaged in reflecting knowledge.

The third, and the lowest score for the PCA usability dimension of the SM, was for the Telegram and its help them in blocking most distractions (3.24). So, despite its significant acceptance, the students' response to improving the focus was the lowest. This may have been due to using the SM as an ancillary application mainly for peer discussions and not continuously moderated by the teacher. The instructors and teachers did not use it to direct the conversation. Instead, from the data log, it appears that students were using it without complying with the guidance. This

occasionally allowed their discussions to degenerate to a personal level, even when moderated by the researcher.

Third, the PLSR (3.95), as in figure 5-15, was perceived to be significantly higher than the PCA (3.57) for the use of the Telegram. In fact, the learners perceived Telegram as a PLSR tool because they believed that PLSR improved their concentration on getting the help that they needed for organising their work. The Telegram interaction data and content revealed that 74% of the students' text had been used for seeking help and planning work. Thus, the students conceded the highest positive rate for this to the Telegraph (4.13). Interestingly, the teachers also believed that Telegram helped them to track the students' level of understanding of the content and this assisted them to prepare better help for their students.

> *"I can really see in which subjects' students are excelling and vice versa exactly what topics were not clear to them. Overall, a good place where I can talk with students honestly, about how they feel about the module" T7.*

The second measurement of the Telegraph to gain a positively rating by students was in making it easier for them to seek help about their learning (3.92). Their responses were logical and could be justified due to the structure of Telegram and the facility that encouraged students to focus and follow their conversation. The teachers had a similar judgement regarding the use of Telegram in supporting students who were seeking help and advice for their learning, which was combined with exposure to the students' feelings toward the module.

> *"Some of the students could get help from their peers. I think it was rather a Students-Students group, as the interaction with teachers was very low. They did discussions themselves. And I think it is a good practice. Information about the coursework spread better through this group, rather than the upload of coursework tasks to Moodle" T8.*

> *"I have a chance to get to know students' feedback informally. In the Telegram group, students show their emotions and satisfaction/negativity rather [more] openly than in formal Course Committee Meetings. This can motivate me to focus on the areas that students expect" T9*

The last measurement was rated positively "The Telegram group makes it easier for me to re-evaluate the knowledge I have, compared to my classmate's knowledge" (3.81). This slightly lower acceptance rate may be justified by the fact that the collaboration was mainly in the form of peer discussion. Hence, students could not take it for granted that the answer they received was the correct one, since it came from their peers.

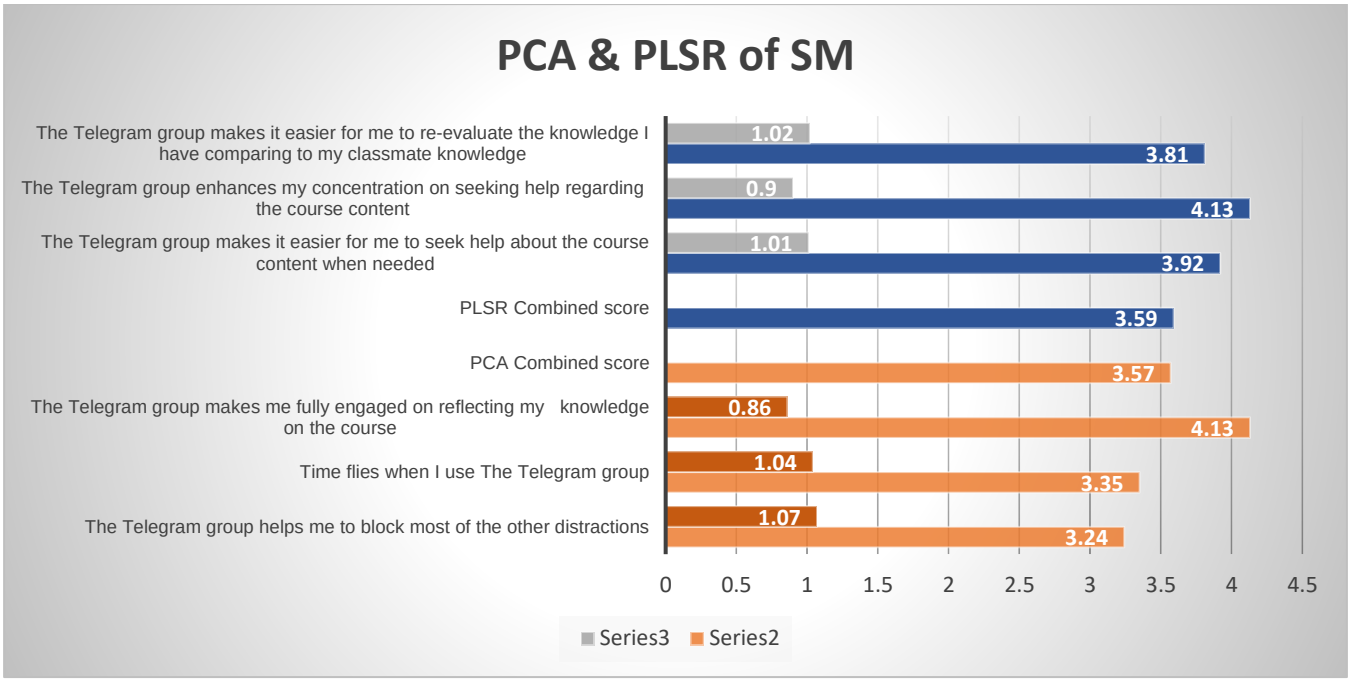

Figure 5-15:Students' PCA (Orange) & PLSR (Blue) of SM

5.3.3.3. Satisfaction and Usage

The last two aspects of evaluating the usability of the Social Media technological intervention are satisfaction and use. The actual use was reported in the interaction analysis, but this section records the self-reported use. The students were positively satisfied with the Telegram group because they experienced it as helping them to concentrate on collaborative learning (4.10). Another positive satisfaction rated by the students was with the Telegram, which made them "fully engaged in collaborative learning" (4.07). Both measurements may be justified on the same grounds as discussed above, that the Telegram environment provided more structure and support groups, discussion and concentration. The students also were positively satisfied with the Telegram platform because they could follow it effortlessly. Despite its significance, this measurement received the lowest satisfaction rating of all the related items (3.78). This response here was anticipated because the process was eased by setting more structured conversation streams to help a large number of users to collaborate. The students reported that they had a positive attitude to the Telegram because they found it easy and simple (3.89, 3.88).

5.3.3.4. Evaluation Radar

The evaluation process accepted the evaluation of the Telegram as usable in terms of PEOU, PU, PLSR, PCA and Actual Use. The learners and teachers believed that the intervention improved communication and collaboration. From the teachers' point of view, SM helped the collaboration between them, as in Figure 5-16. According to them, the Telegram provided them with quick

access to material sharing, updates, reminders, and notifications. However, using this group required time and effort to follow up discussion with the group.

Regarding the relationship between teachers and students, the instructors provided positive feedback. Most of the instructors mentioned that it was an easy, quick, accessible collaboration tool. In addition, instructors agreed on the usefulness of an SM and that its improved student learners' collaborations with one another and with teachers. The instructors confirmed that even shy students felt more comfortable in using it than communicating face-to-face or via e-mail chat because it could be anonymised. It seems to have reduced the fear of seeking help. Nevertheless, all the instructors agreed on the drawback of the high flood and non-relevant discussions that were carried on between the students, distracting them from their learning and wasting the instructors' time.

> *"Somehow unable to track common issues. But still email is priority. Hope students receive quick responses on their concerns. Drawback - a lot of flood" T2*

The results from the teachers are in line with the radar charts in the figure below. In this figure, the average scores of the student's feedbacks about the usability (PU and PEOU, PLSR and PCA) were plotted to illustrate the significant range of students' perspectives on each other. The diagram suggests that the strongest positive perception of the collaboration with Telegram was the students' PLSR while the weakest was for PCA. The reason here could be the nature of the SM as a discussion platform, which could at times lead the students off track. Guidance and moderation could reduce this, but probably more strict guidance would help to eliminate the distractions.

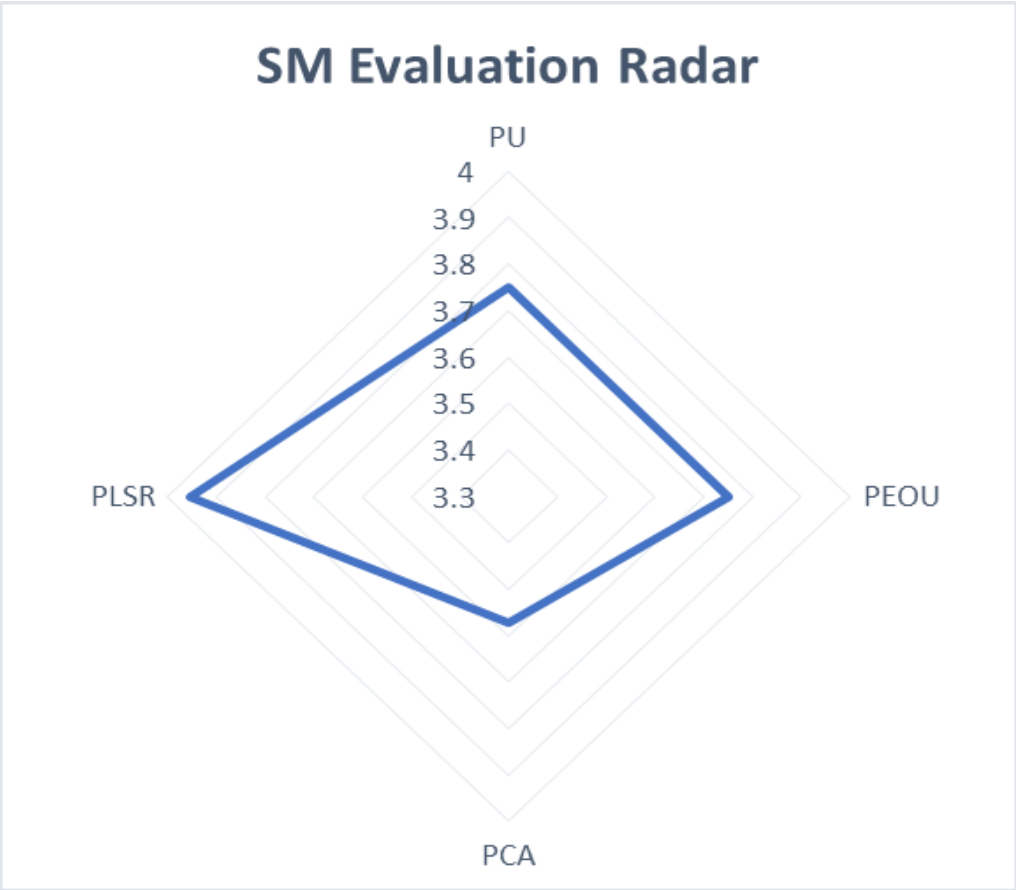

Figure 5-16: SM evaluation radar of students' perspectives

5.4. Chapter summary

The perceived usability measures show that all three interventions were successful and can be used to improve the LMS, as examined in the next chapter.

The dashboard model evaluation went through three types of analysis, namely, interaction, survey, and interview analyses. On the interaction analysis, the Moodle course page was plugged into a heat map website using its free demo. The heat map data validated the students' actual use of the tracking tool and the visualised competency on the course page which showed continuous and consistent use compared to the students' use in the rest of the Moodle content. The result also showed that students were using the competency less as the term went by, which is justified by the fact that they gained confidence and required less guidance, whereas the TT showed incremental use over the term. Moreover, the students worked hard to prepare for their final exam and project and wanted to see how their peers were also developing.

The survey offered a scale of 1-5 for grading and investigated the students' evaluation of each construct involved in the proposed research model. This entailed thinking through, cognitive absorption, perceived learning, self-regulation, perceived ease of use, perceived usefulness, and actual use. A cross-sectional analysis was performed to compare students' evaluation of all constructs to test overall usability. Across all constructs, the range of survey values was relatively narrow; however, some variation did exist. On the PCA, VC was significantly higher than TT, while satisfaction with the improved PCA for TT was significantly higher than for VC. This was possibly due to the type of information the TT provided about other peers. The PU of TT was less than that of VC, which may be attributed to the potential confusion of the numbers for TT. For example, while learners see VC as more useful in planning learning, the use of numbers on TT for learning is not straightforward. The teachers also reported that VC was more useful than TT, which is described as having significantly higher use due to its easiness and practicality.

The validation of the social media model underwent user interaction analysis which involved data on the interaction between students and instructors. Content analysis was also applied to the collaboration groups. Finally, survey analysis was conducted to evaluate the impact of each construct of the proposed model on the students' perceptions. Evaluation radar was also used to explain further the differences between the constructs of the SM model.

The interaction analysis showed that the students were engaged with the SM more than their engagement on Moodle content, such as video watching. The students' group involved the researcher

and the module instructors, who ensured that an agreed code and the ethics of collaborative learning were maintained. The instructors regularly communicated through their Telegram group, reporting high levels of satisfaction with its use for faster and easier methods of communication. Content analysis was also performed on the SM, showing that the students' group used help and advice-seeking keywords. In fact, 12% of the students' discussion involved direct help-seeking keywords, a percentage which may have been much higher. The poll was also used to collect students' direct responses regarding the main reason for their use of the Telegram group. 80% of the students said that they had used the group for help-seeking and guidance in solving coursework problems.

From the analysis of data from the teachers' interviews, the Telegram was perceived as a useful platform for enhancing learning and supporting learning-related discussions. The instructors experienced it as useful, easy and fast communication platform. It helped peer collaboration, instructor communication, and student-instructor discussions. However, a drawback repeatedly mentioned was that it generated a high flood of content. Finally, the survey analysis reported positive perception among students overall of using the Telegram for collaboration. The perceived usability was significantly high. However, the most decisive reason for using the Telegram for collaboration was the students' PLSR while the weakest was for PCA. This could have been due to the nature of SM; the platform often lent itself to distractions, which reduced PCA; but it was a powerful tool for seeking help and reflection, which improved PLSR.

To sum up, in this chapter, the three technological interventions were evaluated on the basis of their usability measures. The usability measure had 5 dimensions: PEOU, PU, PLSR, PCA, and Actual Use. All the interventions passed in every aspect. This indicates that they can be used in the courses and they are proposed to have significant effects on the LMS Success (the PLSR, PCA and CIU of the LMS).

Chapter 6: Testing the effects of the interventions on the learners' Continued Intention to Use the LMS

6.1. Introduction

The purpose of the previous chapter was to evaluate the usability of the technological interventions. This chapter examines, and found improvements using quantitative and qualitative evidence, of these interventions on the learners' perceptions of the LMS as PLSR, PCA and CIU. This chapter examines the hypotheses developed in Chapter 4, using the Partial Least Square (PLS) Method as detailed in the research methodology chapter. All the constructs used in this chapter are valid and reliable for use as detailed in the research methodology chapter. These hypotheses examine the effects of three different technological interventions (TT, VC, and SM) and therefore can be divided into three. Each model is tested in isolation from the others. In Section (6.2), Model 1 is used to examine the effect of tracking technology on students' PCA and PLSR from LMS, which in turn could affect the intention to continue using the LMS (the LMS (CIU)). Sections 6.3 and 6.4 examine the effects of the VC and SM.

6.2. Model 1: Tracking Technology

The first model of the analysis focuses on the effects of the tracking technology on the PCA and PLSR from the LMS and the consequent effect on the CIU. TT is measured by the level of PEOU and its PU. Thus, there are six main relationships here, as shown in Figure 6-1. The first two relationships come from the effect of TT on PCA and on PLSR. The second two come from the effect of PLSR and PCA on the CIU. The last two derive from the effect of TT on the CIU both directly and mediated by the PLSR and PCA. The model is well-fitted and r^2 is significant (56.3%, 52.1%, 28.4%) for the dependent factors (CIU, PLSR, and PCA). All the factor loadings of the items building the constructs are also significant and more than 0.6 as illustrated in the diagrams below. The analysis is conducted in three stages: direct analysis, indirect analysis and total analysis, as reported in Figures 6-1. The analysis is described in detail in the next sections.

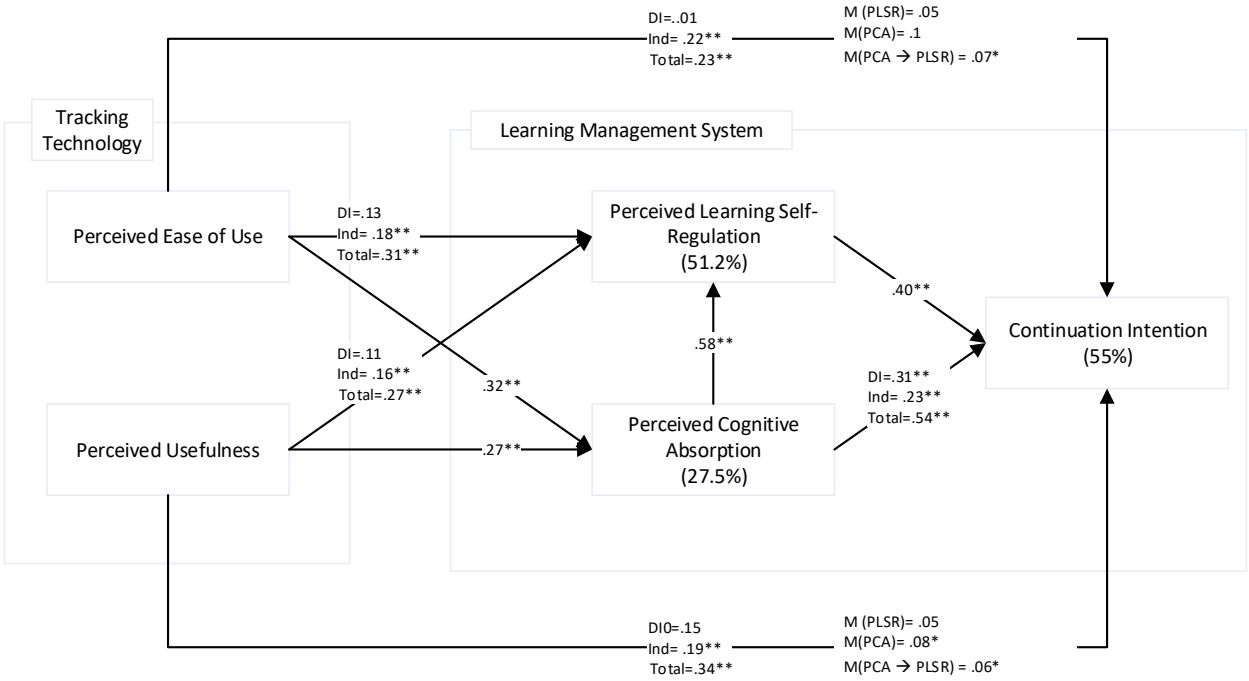

Figure 6-1: TT Model

6.2.1. LMS PCA & PLSR on the LMS CIU

Table 6-1 reports the significant effects of the learners' PCA and PLSR from the LMS on their intention to continue using this system. There are four relations to be examined here. They are the effect of PLSR on CIU (*H1*), of PCA on CIU (*H2*), of PCA on PLSR (*H3*) and of PCA on CIU through PLSR (*H4*). The PLS model results suggest that the PLSR have a significant effect on CIU (.404, P<0.01), confirming *H1*. PCA has three significant effects: on PLSR (.58, P<0.01): direct on CIU (.307, P<0.01) and indirect on CIU through PLSR (.234, P<0.01) to validate *H2*, *H 3* and *H4*. Thus, PCA has a total significant effect on the CIU (0.541, P<0.01).

Table 6-1: Impact of TT on PLSR and of PCA on CIU

H		O	M	STDEV	T	P Values	Remark
H1	PLSR → CIU	0.404	0.404	0.112	3.594	0	Supported
H3	PCA → PLSR	0.58	0.577	0.078	7.449	0	Supported
	PCA → CIU						
H2	Direct (Path-Coefficient)	0.307	0.307	0.099	3.112	0.002	Supported
H4	PCA → PLSR → CIU	0.234	0.234	0.074	3.162	0.002	Supported
	Total indirect	0.234	0.234	0.074	3.162	0.002	Supported
	Total effect	0.541	0.54	0.063	8.529	0	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.2.2. The effects of the TT usability on the LMS PLSR and PCA

This research found, as proposed, that the usability of TT significantly affects the perceptions of the LMS, i.e. the PLSR and PCA, of the LMS. TT usability (PU and PEOU) had positive significant

effects on LMS PCA (.281, P<0.01 and .314, P<0.01) which confirm *H6a* and *H6b*. However, there is no significant evidence found to support the direct effects of the PEOU (.131>.05) and PU (.113, P>0.05) of the TT on the LMS PLSR, causing *H8a* and *H8b* to be rejected. Further analysis found there is a relationship between TT and PLSR, but it is mediated by PCA. The PCA had a strong mediating effect on the relationship of PEOU (.179, P<0.05) and PU (.163, P<0.05) on the PLSR, which confirms *H10a* and *H10b*. Thus, the TT usability aspects, i.e. PEOU (.315, P<0.05) and PU (.274, P<0.01) had a total significant effect on the PLS. Table 6-2 provides a comprehensive summary of the earlier discussion.

Table 6-2: TT Usability impacts on PCA and PLSR

	PEOU → PLSR	**O**	**M**	**STDEV**	**T**	**P Values**	**Remark**
H8a	Direct (Path-Coefficient)	0.131	0.136	0.107	1.224	0.222	Not Supported
H10a	PEOU → PCA → PLSR	0.183	0.179	0.065	2.831	0.005	Supported
	Total effect	0.314	0.315	0.123	2.544	0.011	Supported
	PU -→PLSR						
H8b	Direct (Path-Coefficient)	0.113	0.111	0.086	1.315	0.189	Not Supported
H10b	PU→PCA→ PLSR	0.159	0.163	0.056	2.831	0.005	Supported
	Total effect	0.272	0.274	0.087	3.125	0.002	Supported
H6a	**PEOU → PCA**	0.316	0.314	0.111	2.846	0.005	Supported
H6b	**PU →PCA**	0.274	0.281	0.085	3.234	0.001	Supported

6.2.3. TT on the CIU

In Table 6-3, the TT usability aspects had a significant total effect, total indirect effect but no direct effect on CIU. The direct effects of the PEOU (0.011, P>0.05) and PU (.137, P<0.05) were weak and statistically non-significant, which disqualifies H5a and H5b. The total effect of the PU (.337, P<0.01) was greater than the effect of the PEOU (.233, P<0.05) and both of them had significant effects on the LMS CIU. However, the total indirect effect of the PEOU (.222, P<0.01) and PU (.2, P<0.01) was relatively, as demonstrated, positive and significant. Regarding the three proposed mediators PCA, PLSR and PCA→ PLSR, interestingly, PLSR did not play a significant role in mediating the PEOU (.053, P>0.05) and PU (.046, P>0.05) which causes H9a and H9b to be rejected. Nor did PCA alone show any significant impact as a mediator (0.097, 0.084) on PEOU and PU, respectively (P>0.05), which invalidates H7a and H7b. However, the PCA→ PLSR was a significant mediator for the effects of both PEOU (.074, P<0.05) and PU (.064, P<0.05) on the CIU, stressing the role of PCA in the model, which confirms H11a and H11b.

Table 6-3: the impact of TT on CIU

	TT-PEOUE-→CIU	**O**	**M**	**STDEV**	**T**	**P Values**	**Remarks**
H5a	Direct (Path-Coefficient)	0.011	0.011	0.076	0.138	0.891	Not Supported
H7a	PEOU → PCA →CIU	0.097	0.097	0.051	1.894	0.059	Not Supported
H9a	PEOU→PLSR→CIU	0.053	0.052	0.045	1.18	0.239	No Supported
H11a	PEOU→PCA→PLSR→CIU	0.074	0.073	0.035	2.118	0.035	Supported
	Total indirect	0.224	0.222	0.083	2.697	0.007	Supported
	Total effect	0.234	0.233	0.111	2.115	0.035	Supported
	TT-PU→CIU	**O**	**M**	**STDEV**	**T**	**P Values**	

H5b	Direct (Path-Coefficient)	0.149	0.137	0.104	1.441	0.15	Not Supported
H7b	PU→PCA →CIU	0.084	0.087	0.04	2.103	0.036	Supported
H9b	PU→PLSR→CIU	0.046	0.049	0.043	1.076	0.282	Not Supported
H11b	PU→PCA→PLSR→CIU	0.064	0.065	0.027	2.345	0.019	Supported
	Total indirect	0.194	0.2	0.056	3.459	0.001	Supported
	Total effect	0.344	0.337	0.119	2.891	0.004	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.3. Model 2: Visualised competency

There were three main relationships to consider here: the PCA and PLSR of the LMS on the CIU, the VC usability on the PCA and PLSR of CIU, and the relationship between VC usability and the LMS CIU. The findings are shown in graphic form in Figures 6-2 and detailed below.

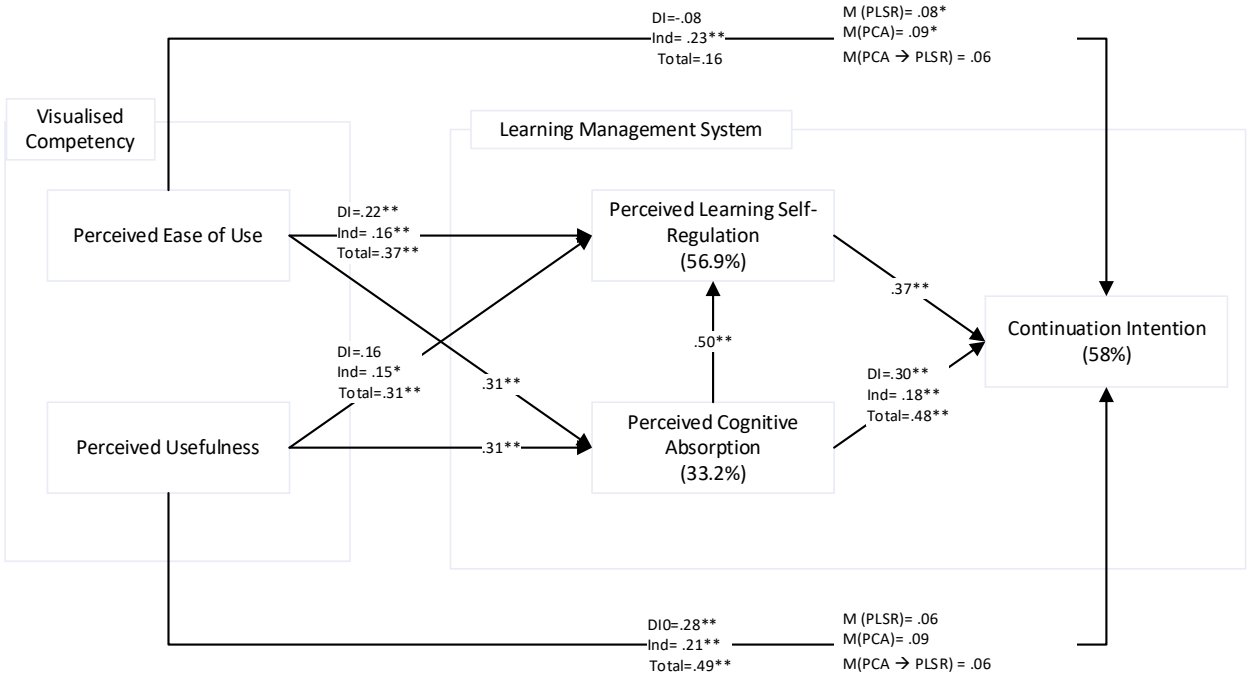

Figure 6-2: Visualised Competency Model

6.3.1. LMS PCA & PLSR → CIU

As with the VC model, LMS PCA and PLSR, in this model, show in Table 6-4 that both constructs had significant positive effects on the learners' CIU for the LMS. PCA had a direct effect (.299, P<0.01) confirming H2, an indirect one through PLSR (.181, P<0.05) confirming H4, and a total effect (.481, P<0.01). PCA affected the PLSR with positive significance (.495, P<0.01) to confirm H3. PLSR had a significant positive effect on the CIU (.366, P<0.01) to confirm H1.

Table 6-4: VC model – effect of LMS PCA and PLSR on CIU

	PCA → CIU	**O**	**M**	**STDEV**	**T**	**P Values**	**Remark**
H2vc	Direct (Path-Coefficient)	0.299	0.293	0.098	3.057	0.002	Supported
H4vc	PCA→ PLSR→CIU	0.181	0.191	0.077	2.34	0.02	Supported

	Total indirect	0.181	0.191	0.077	2.34	0.02	Supported
	Total effect	0.481	0.484	0.078	6.147	0	Supported
H1vc	PLSR→CIU	0.366	0.377	0.126	2.902	0.004	Supported
H3vc	PCA→PLSR	0.495	0.502	0.088	5.649	0	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.3.2. The effects of VC usability on students' PLSR and the PCA to LMS

In table 6-5, VC usability affected the LMS features (i.e. PCA and PLSR). VC usability had a significant positive effect on the PCA (.313, P<0.01, .308, P<0.01 for PEOU and PU) which validated H13 a and b. Similarly, as summarised in Table 18, VC usability had significant positive direct effects on the PLSR (0.218, P<0.05) for PEOU but not for PU. The lower effect of 0.16, P>0.05, is illustrated, which confirms H15a and rejects H15b. The perceived usability showed a significant mediated relationship between PCA and PLSR, (0.155, P<0.01) and (0.153, P<0.01) for PEOU and PU, respectively, which confirms hypotheses H17a, H17b. The total effects of PEOU and PU were significant (.373 and .312, P<0.01).

Table 6-5: Impact of VC usability on PCA and PLSR

	PEOU→PLSR	**O**	**M**	**STDEV**	**T**	**P Values**	**Remark**
H15a	Direct (Path-Coefficient)	0.218	0.208	0.095	2.288	0.023	Supported
H17a	PEOU→PCA→PLSR	0.155	0.154	0.057	2.744	0.006	Supported
	Total indirect	0.155	0.154	0.057	2.744	0.006	Supported
	Total effect	0.373	0.362	0.104	3.587	0	Supported
	PU→PLSR						
H15b	Direct (Path-Coefficient)	0.16	0.163	0.095	1.683	0.093	Not Supported
H17b	PU→PCA→PLSR	0.153	0.154	0.062	2.446	0.015	Supported
	Total indirect	0.153	0.154	0.062	2.446	0.015	Supported
	Total effect	0.312	0.318	0.089	3.508	0	Supported
H13a	**PEOU→PCA**	0.313	0.31	0.104	3.015	0.003	Supported
H13b	**PU→PCA**	0.308	0.308	0.090	3.01	0.002	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.3.3. VC Usability on CIU

VC usability had total, direct, and indirect effects. PEOU did not demonstrate a significant total effect on the CIU (.155, P>0.1) but the PU had a significant positive total effect (.489, P<0.01). These findings invalidate H12a but approve H12b. Among the direct effects, PU, but not PEOU (-.076, P>0.1), had a significant effect on the CIU (.282, P<0.01). The total indirect effects were both significantly positive for PEOU and PU (.23, P<0.01) and (.206, P<0.01) but the mediators were not all significant.

As shown in Table 6-6, the proposed mediators were PCA, PLSR and PCA→ PLSR. The first mediator, PCA, played a significant role for PEOU (.094, P<.05). It validated H14a but the role for the PU did not (.092, P>.05) causing H14b to be rejected. The second mediators were PLSR and PU.

The PLSR for PEOU showed (0.08, P=0.05) but the PU showed (.0.058, P>0.05), which made H16a acceptable but not H16b. The third mediator for the relationship between PEOU and CIU was PCA→PLSR did not have this significance (.057, P>0.05) which eliminated H18a and H18b as well; its PU showed (0.056, P>0.05).

Table 6-6: the effect of VC usability on CIU

	PEOU→ CIU	**O**	**M**	**STDEV**	**T**	**P Values**	**Remarks**
H12a	Direct (Path-Coefficient)	-0.076	-0.08	0.085	0.893	0.372	Not Supported
H14a	PEOU→ PCA→ CIU	0.094	0.09	0.044	2.145	0.032	Supported
H16a	PEOU→ PLSR→ CIU	0.08	0.075	0.041	1.963	0.05	Supported
H18a	PEOU→ PCA→ PLSR→ CIU	0.057	0.06	0.033	1.731	0.084	Not Supported
	Total indirect	0.23	0.225	0.073	3.173	0.002	Supported
	Total effect	0.155	0.144	0.112	1.387	0.166	Not Supported
	PU→ CIU						
H12b	Direct (Path-Coefficient)	0.282	0.28	0.096	2.933	0.004	Supported
H14b	PU→ PCA→ CIU	0.092	0.091	0.049	1.896	0.059	Not Supported
H16b	PU→ PLSR →CIU	0.058	0.065	0.046	1.258	0.209	Not Supported
H18b	PU→ PCA→ PLSR→ CIU	0.056	0.058	0.03	1.836	0.067	Not Supported
	Total indirect	0.206	0.214	0.065	3.167	0.002	Supported
	Total effect	0.489	0.494	0.108	4.54	0	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.4. Model 3: Social Media

This revealed three main impacts: that of PCA and the PLSR of LMS on the CIU; SM usability on the PCA and PLSMR of the CIU; and SM usability on the LMS CIU. The findings are represented graphically in Figures 6-3 and described in more detail in the next sections.

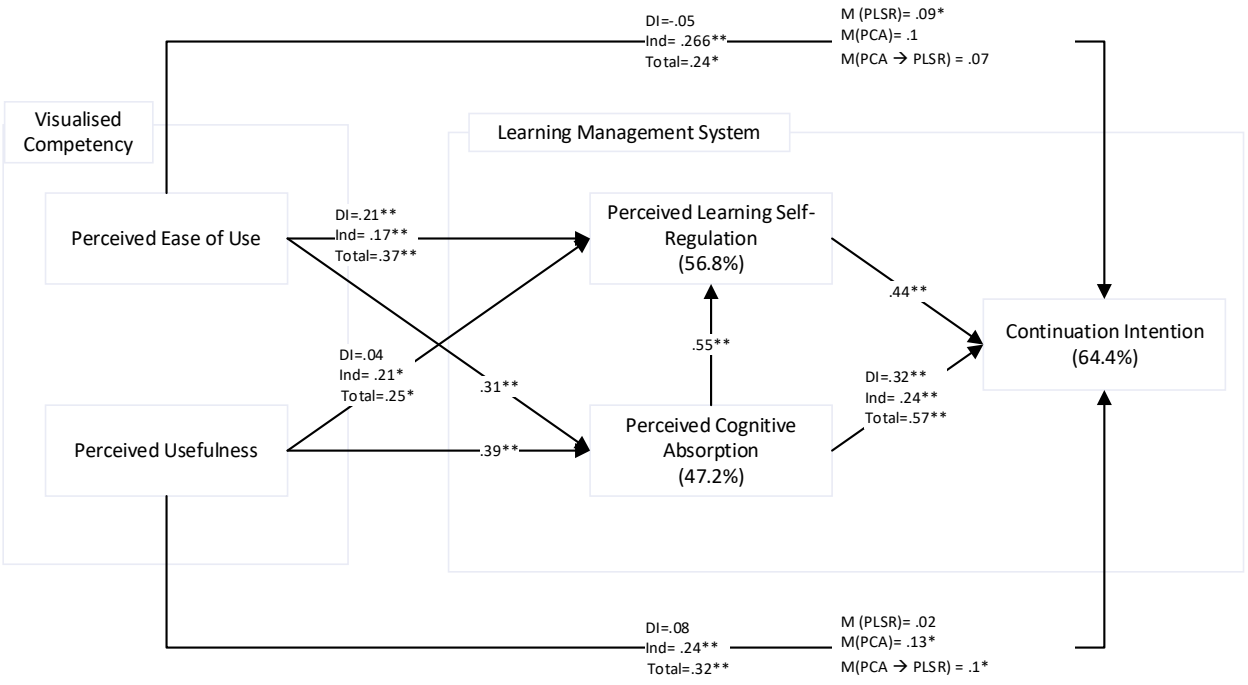

Figure 6-3: SM Model

6.4.1. LMS PCA & PLSR on the CIU

In Table 6-7, PCA and PLSR are shown to affect the CIU positively. This research found significant evidence that PLSR affected the CIU (.442, P>0.01) thus confirming H1 in the SM model. PCA also had a direct positive significant effect on the CIU (.324, P<0.01) supporting Hypothesis H2 in SM. PCA showed significant mediation through the PLSR (0.244, P<0.01), which supports Hypothesis H4. In addition, PCA affected the PLSR positively and significantly (.551), as predicted by H3.

Table 6-7:SM model - The effect of PCA and PLSR on CIU

	PCA→CIU	**O**	**M**	**STDEV**	**T**	**P Values**	**Remarks**
H2sm	Direct (Path-Coefficient)	0.324	0.328	0.126	2.576	0.01	Supported
H4sm	PCA→ PLSR→ CIU	0.244	0.25	0.089	2.746	0.006	Supported
	Total indirect	0.244	0.25	0.089	2.746	0.006	Supported
	Total effect	0.567	0.578	0.1	5.681	0	Supported
H3sm	PCA→ PLSR	0.551	0.557	0.115	4.777	0	Supported
H1sm	PLSR→ CIU	0.442	0.446	0.112	3.93	0	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.4.2. The effect of SM usability on PLSR and PCA

SM usability was proposed to influence the PLSR and PCA of the LMS, as shown in Table 6-8. In general, these propositions were accepted. The PEOU (.316, P<0.01) and PU (.385, P<0.01) of SM had significant effects on the PCA of the LMS, confirming H20a and H20b. Similarly, PEOU (.376, P<0.01) and PU (.255, P<0.05) of the SM had significant total direct effects on the PLSR of the

LMS. The PEOU of the SM had a significant positive direct effect on the PLSR from the LMS (.207, P<0.05), which confirms H22a. At the same time, the PU aspect of this feature of the LMS failed to show significant evidence for a similar direct effect on the PLSR from the LMS, which invalidates H22b (.04, P>0.05). Regarding the indirect effects on the PLSR, the perceived usability mediated by PCA for PEOU is .169 (P<0.05) and for PU is .214 (<0.01) which confirms H24a and H24b.

Table 6-8: The effect of SM usability on PLSR and PCA

	SM-PEOU→ PLSR	**O**	**M**	**STDEV**	**T Statistics**	**P Values**	**Remarks**
H22a	Direct (Path-Coefficient)	0.207	0.198	0.095	2.172	0.03	Supported
H24a	SM-PEOU→ PC→ PLSR	0.169	0.175	0.068	2.496	0.013	Supported
	Total effect	0.376	0.373	0.086	4.344	0	Supported
	SM-PU → PLSR						
H22b	Direct (Path-Coefficient)	0.04	0.047	0.125	0.324	0.746	Not Supported
H24b	SM-PU→ PCA→ PLSR	0.214	0.215	0.081	2.652	0.008	Supported
	Total effect	0.255	0.262	0.1	2.545	0.011	Supported
H20a	**SM-PEOU→ PCA**	**0.306**	**0.316**	**0.1**	**3.055**	**0.002**	Supported
H20b	**SM-PU→ PCA**	**0.389**	**0.385**	**0.108**	**3.587**	**0**	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.4.3. SM usability on LMS CIU

The PEOU and PU of SM showed a significant total effect on LMS CIU (0.24, P<0.05) and (.316, P<0.01). In fact, no evidence was found to support the direct effect of PEOU and PU on CIU (-0.025, P>0.05) and (0.077>0.05); hence Hypotheses H19a and H19b are rejected. For both measures of SM usability, the relationship was fully mediated by the LMS PLSR and PCA, for the PEOU the total indirect effect was .265 (P<0.01), and for PU the total indirect effect was .238 (P<0.01). There were three proposed mediators: PCA, PLSR, and PCA→PLSR.

PCA as a mediator had a significant role for PU at P<0.05 confirming H21b, but no such role for PEOU (P>0.05), causing H21a t be rejected, as indicated in Table 6-9. The effect is slightly higher for PU (.126) than for PEOU (.099). However, for PLSR, the mediator had a dissimilar effect; while it was significant for PEOU at P<0.01 which confirmed H23a. For PU it rejected H23b because it is not significant (P>0.1) with effects of only .091 and .018 respectively. The last proposed mediator was PCA → PLSR which was similar in the significance of the PCA effects. It played a significant role in mediating the PU and CIU (.095, P<0.05) which confirmed H25b but was not significant for PEOU (.075<0.05). Thus H25a is rejected.

Table 6-9:The effects of SM usability on students CIU

	SM-PEOUE→ CIU	**O**	**M**	**STDEV**	**T**	**P Values**	**Remarks**
H19a	Direct (Path-Coefficient)	-0.025	-0.026	0.097	0.259	0.796	Not Supported
H21a	SM-PEOU→ PCA→ CIU	0.099	0.103	0.052	1.912	0.056	Not Supported

H23a	SM-PEOU→ PLSR→ CIU	0.091	0.087	0.045	2.019	0.044	Supported
H25a	SM-PEOU→PCA→PLSR→ CIU	0.075	0.079	0.039	1.893	0.059	Not Supported
	Total indirect	0.265	0.269	0.064	4.113	0	Supported
	Total effect	0.24	0.243	0.1	2.403	0.017	Supported
	SM-PU→ CIU						
H19b	Direct (Path-Coefficient)	0.077	0.07	0.091	0.853	0.394	Not Supported
H21a	SM-PU→ PCA→ CIU	0.126	0.127	0.064	1.974	0.049	Supported
H23b	SM-PU→ PLSR→CIU	0.018	0.022	0.057	0.313	0.755	Not Supported
H25b	SM-PU→PCA→ PLSR→CIU	0.095	0.097	0.047	2.026	0.043	Supported
	Total indirect	0.238	0.246	0.076	3.158	0.002	Supported
	Total effect	0.316	0.316	0.093	3.398	0.001	Supported

*O is Original Sample data, M is the Sample mean, STDEV is Standard Deviation

6.5. Summary

This chapter discussed the results of testing the proposed theoretical framework. The framework of the current research proposed an integration of the IS Success and TAM models to measure students' perspectives on two levels. First, the IS model was proposed to measure students' PLSR and the PCA of LMS CIU. In addition, TAM was used to borrow perceived usability measurement constructs, perceived ease of use and perceived usefulness. Hypotheses 1 to 4 were integrated in the IS model to assess the effects of the interventions on the LMS CIU. H1 proposed that students' PLSR positively affected their LMS CIU, which was confirmed through the three proposed technological interventions – tracking technology, visualised competency, and social media. H2 suggested that students' PCA affected CIU positively, which received similar results to those of H1 across the three technological interventions.

H3 and H4 also had similar results: significant positive confirmation across the three technological interventions. H3 proposed that PCA positively affected PLSR, and H4 declared that PCA had a positive effect on CIU mediated by PLSR. The perceived usability (PU and PEOU) was used to measure the impact of the proposed technological interventions on the students' perceptions of their PCA, PLSR, and LMS CIU. Since the usability construct consisted of two variables, each hypothesis consisted of two parts, a and b. In the tested framework hypothesis, Hypotheses 5 to 11 measured the tracking intervention. The TT perceived usability had no direct impact on students' CIU, which rejected H5 a and b. However, it showed a significant impact on students' PCA, which confirmed H6 a and b. Interestingly, PCA was not sufficient to mediate a positive effect alone on the TT perceived usability of students' CIU, which rejected H7 a and b.

Similarly, both parts, H8 and H9, rejected any idea of the perceived usability of TT, showing no effect on students' PLSR in H8. In H9, also, the PLSR was not sufficient to mediate a positive impact alone on TT perceived usability on the CIU. However, both parts of H10 and H11 were

confirmed. In H10, the perceived usability of the TT showed a significant positive impact on PLSR mediated by PCA. H11 also confirmed the positive effects of TT's perceived usability on students; CIU mediated by the impacts of PCA on the PLSR. Regarding visualised competency, the first part of H12, H12a, was rejected, while the second, H12b, was confirmed. The VC PEOU did not show a positive impact on students' CIU; but PU had a significant effect on CIU. Nevertheless, both parts of H13 a and b were confirmed.

The perceived usability of VC showed significant effects on students' PCA. H14 also partially accepted the hypothesis, the VC PEOU showed a positive impact on students' LMS CIU mediated by CIU, which confirmed H14a, but PU did not show similar results and thus invalidated H14b. Similarly, H15a was confirmed because the VC PEOU had a significant effect on students PLSR, yet H15b was rejected because VC PU did not show any effect on PLSR. The impact of the perceived usability of VC on CIU mediated by PLSR was partially confirmed. H16a was confirmed as PEOU positively affected CIU mediated by PLSR, while H16b was rejected because PU was not sufficient to affect CIU mediated by PLSR. However, H17 was confirmed in both parts, a and b, by VC's perceived usability showing a significant impact on PLSR mediated by PCA from the PEOU and positive impacts from PU. In contrast, H18 was rejected in both parts because the perceived usability of VC did not sufficiently confirm a positive impact on the CIU mediated by PCA and PLSR.

The last tested technological intervention was embodied as SM. Both parts of H19 were rejected because the SM usability showed no effect on the students' CIU. However, H20 was fully confirmed since the SM usability had significant positive impacts on students' PCA. H21 was partially confirmed, but SM PEOU showed no effect on CIU mediated by PCA which left H21a without support. However, SM PU showed a positive impact on CIU mediated by PCA, thus confirming H21b. Both H22 and H23 were partially confirmed on the same parts. H22a was confirmed because the PEOU of SM had a positive effect on students' PLSR whereas PU showed no effect, invalidating H22b. Similarly, in H23a PEOU showed a positive effect on CIU mediated by PLSR, confirming H23a while H23b was rejected since SM PU showed no effect on CIU mediated by PLSR. H24 was fully confirmed when the SM usability showed positive impacts on PLSR mediated by PCA, and the PU even showed a significant impact. Finally, H25 was partially confirmed by the fact that SM PEOU showed no effect on CIU mediated by PCA on PLSR, thus rejecting H25a, while PU showed positive impacts which confirmed H25b.

Chapter 7: Discussion and Conclusion

7.1. Introduction

This chapter concludes the present work by answering the research question (see Section (8.2)) and addressing the aims (see Section (8.3) and the objectives (see Section (8.4)) of the research. Section (8.5) describes the design and evaluation of the interventions proposed in this research. The research contributions to knowledge are presented in Section (8.6). The research implications of these contributions (see Section (8.7) were explored from the standpoint of the materials developers, teachers and academics. Below, the research limitations in Section (8.8) are set out so as to suggest directions future research (see Section (8.9).

7.2. Research Aim

To develop a framework that evaluates and examines the impact of interventions on improving learners' perceived cognitive absorption and perceived learning self-regulation and further on affecting learners' continued intention to use a LMS.

Two novel models are developed in this research. The first model helped to design an intervention for improving the perception of an LMS while the second model was used to examine the effect of such interventions on the LMS. The key common constructs in these models were the PLSR, PCA, CIU. The design criteria for a learning management system were deduced from the literature, in order to be useful in ensuring the easy use of new features and in focusing on improving the learners' ability to plan and to organise the learning tasks (i.e. Perceived Learning Self-regulation) with the least possible distortion (i.e. to improve Perceived Cognitive Absorption). This model helped the researcher to design successful technological interventions which strengthened the learners' intention to continue using the LMS in the future.

The second model was to examine the effect of the new interventions on the perceptions of an LMS and the intention to use it. Thus, the key constructs of the model were the perceived ease of use and perceived usefulness of the new intervention, the PLSR and PCA from the LMS and the dependent factor of the study, namely, the CIU. In other words, the assessment model claimed that if the new intervention was easy to use and perceived to be useful, the learner would use it, according to the theory of reasoned action (Fishbein & Ajzen, 1977; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) . If it were used, the intended benefits of the LMS would be shown, according to the Information System Success model. The intended benefits of the LMS were to improve the learners'

ability to be self-regulated and to improve their cognitive absorption. If these intended benefits were improved, the predicted outcome would be a stronger intention among learners to continue using the LMS in the future.

7.3. Research Question

What are the antecedents of the CIU and how can interventions to improve them be developed?

The first aspect of the research question was identifying the factors that could improve the learners' Continued Intention to Use (CIU). Since a learning management system aims to improve the learners' ability to organise their work, learners who perceive the system to be a good organiser will keep using it in the future. Accordingly, the thesis proposed that if the system improved learners' perception of self-regulation, this could improve the intention to continue using the LMS in the future. Being more organised could also improve the learners' ability to focus, concentrate and engage (i.e. their cognitive absorption). This theorisation of the antecedents of the CIU is examined and approved in the present research.

The second aspect of the research question is the mechanisms to improve these perceptions (i.e. PLSR and CA). The academic literature uses three theoretical perspectives from which to introduce new technological interventions. Two of these are the theories of herd behaviour and goal seeking. According to herd behaviour theory, the choosing to follow the crowd could help people to feel that they were following the right path. Thus, the first proposition was to introduce a technology that might help learners to see others' behaviours and interactions and thereby improve their perception that they themselves were self-regulated, concentrated and focused (i.e. their cognitive absorption). This new technological intervention, called "tracking technology", was developed by the researcher, who found by the Partial Least Square – Structure Equation Modelling method that this intervention had significant direct and indirect effects (through improving learners PLSR and PCA) on the LMS CIU. This technological intervention met five main criteria which had been developed from the usability literature to evaluate the technological interventions that could fit the LMS: these were being easy to use, useful, capable of improving PLSR, and of improving PCA, and being satisfactory. This intervention met all of these criteria, as confirmed by the descriptive analysis of the data interaction analysis, the survey of the students' views and the interviewed teachers.

The second theoretical task was to develop new interventions via the goal seeking theory. That is to say, the more it empowered learners to find the information they needed whenever they needed without fear, the more their ability to organise and plan (PLSR) and their focus on the things they

wanted (i.e. their PCA) would be improved. From this prediction two interventions were developed. The first was weekly visualised competences, which regularly informed students about the latest learning outcomes. Exposing students every week to all the necessary material in advance could help them to identify their learning objectives in a more focused way. The proposed intervention of a weekly VC was examined, using the Partial Least Square – Structure Equation Modelling method, to see whether it would improve learners' PLSR, PCA and the CIU the LMS. Like the TT, the VC was designed to satisfy five criteria: perceived ease of use, perceived usefulness, PLSR, PCA and satisfaction with technological interventions. To ensure the quality of the design and value of the content of the information, the researcher invited teachers to use a revised Bloom's Taxonomy and a Cross Curriculum Competency function. The teachers perceived that they planned better while the data showed that learners became more organised when they used the application to engage with the work. In their evaluation, the learners and students gave significant scores to these aspects, confirming that they had enhanced the quality of the design and the data interaction analysis.

The second intervention, based on goal seeking theory, was a structured social media platform that protected privacy. The underpinning theory here was that when students could identify a safe platform which would not put their personal details at risk, it might help them to feel safe whatever they wanted to ask. Thus, the research proposed SM technological intervention to affect the learners' PLSR, PCA and CIU of the LMS. The empirical and examination findings using the Partial Least Square method found significant effects from using the SM on the learners' PLSR, PCA, and CIU. As with other interventions, the design process covered 5 areas to ensure the quality of the interventions. The SM was designed to ensure the safety of the learners by using Telegram, which does not require personal information. The use of the SM was also moderated to ensure that everyone's privacy was protected and distortion was reduced. Thus, in the evaluation process, teachers and learners found the use of the SM improved their PLSR and PCA to the LMS, and they were consequently satisfied with it.

7.4. Research Objectives

There were two main objectives in this research. The first was to develop solutions that could improve the learners' PLSR and PCAs and thereby improve the CIU. The second objective was to develop and test a theoretical framework for examining the effects of these interventions on the learners' CIU.

7.4.1. Developing a model for describing the effect of the PLSR and PCA on the CIU.

The first objective concerned the possibility of improving the learners' CIU through affecting the learners' perceptions of the LMS as a self-regulating technology to improve cognitive absorption. This research successfully delivered this objective by finding that the PLSR and PCA influences the CIU positively. Thus, any technological intervention can influence the learners' perception of the LMS either as PLSR or as the PCA could affect the LMS. In addition, the perception of cognitive absorption (PCA) was found to influence the learners' perceptions of being self-regulated as a result of using the system.

7.4.2. Developing a herd-theory based model for designing a new dashboard to improve learners' PCA and PLSR.

This research was able to deliver the second objective, which was to develop a herd-based model for designing a new technological intervention that would improve the perceptions of LMS. The new model claimed that technology could help learners to notice peers' behaviours and could encourage them to be more regulated and increase their cognitive absorption. Thus, this research developed and examined the effect of a tracking technology on the learners' perception of being self-regulated and the improvement of their cognitive absorption and found that this technology not only affects the PCA and PLSR of the learners but also sustains this effect in influencing the learners' CIU of the LMS.

7.4.2.1. Developing and evaluating the TT Intervention

This research used Tracking Technology (TT) to improve the perception of self-regulation and cognitive absorption. The herd behaviour-based design represented the numeric representation of completed learning activities, which told the other learners about the tasks completed by the class as a whole ('the herd'). The primary rationale for using TT was based on the theory of herd mentality. In order to minimise this, it was proposed that the level of engagement could be improved through the improving the PCA. In this way the imitation of the herd could be downplayed, and the PLSR improved. The use of TT was evaluated on the basis of interactions, and data from the interviews with instructors and students.

The instructors perceived TT to be a simple, easy, and effective technology. Moreover, TT was considered effective for summing up students' weekly completed activities and providing quick reminders of what had to be delivered in any given week. Furthermore, teachers considered the TT an efficient, easy technology for tracking students' progress and performance. They also believed

that TT could be interesting for students and could enhance their interaction with the LMS. The intervention was successful in improving the PCA and PLSR. This in turn affected the LMS PEOU and PU and so the CIU of the LMS. The intervention was validated on the five dimensions. Students agreed that this feature improved their PCA and PLSR and these features improved the perception of ease in using of the LMS and hence its use.

With regard to learning self-regulation, the students felt that TT helped to track the progress of their learning. The students also believed that it improved their concentration on tracking their learning progress. They believed that the self-management of their learning strategies and the improvement of their independent learning was thus made easier. TT was positively perceived as a technology for planning and helping the students to be fully focused on their learning goals. They were pleased with it because it helped them to block out distractions. In other words, the herd behaviour intervention started up the students' interaction with the content. This positively improved their cognitive absorption because it provided them with a rational content, instruction, access to content, and guidance. Students also considered aspects of an evaluation model for TT to form a useful technology for their learning. It improved their learning performance and their self-motivation for learning. The students experienced the actual use of the TT as simple and practical.

In summary, the more the students experienced TT, the more it increased their cognitive absorption of the learning content. They were entirely focused and engaged, and this positively affected their perceived learning self-regulation. The tracking technology is found to influencel positively the learners' perception of organising their learning, tracking their concentration, and keeping them fully focused on their learning goals. This sense of organisation and control derived from the use of the TT positively affected the students' perception of ease and usefulness, and this created the main motive for continuing with LMS in the future.

7.4.2.2. Examining the effect of the TT on the LMS CIU

The first model theorised, developed, validated, and examined the role of integrating TT by improving the perceptions of the LMS. According to herd behaviour theory, one's decisions and emotions are highly influenced by herd decisions and behaviours. Thus, the first proposed model was the use of TT on the LMS PLSR and PCA so as to improve the CIU of the LMS. The use of TT was measured using TAM through the PEOU and PU of the TT. Based on herd theory, when learners saw that the class was completing learning activities, they felt motivated and engaged to do the same (Banerjee, 1992). The leading feature here was the students' knowledge of the tasks and activities that other learners had completed, which engaged them in similar tasks and was also able to help

them plan more effectively now that they were conscious of the gap between their achievement and that of the herd. Using this theory, the intervention proposed to increase student's cognitive absorption by providing a feature that told them what others were doing.

The first proposition concerned the relationship between TT and PCA. The use of a tracking technology in this research was inferred from proximity. That is, the perception of usability (PU and PEOU) in this research indicated that a user must have accessed and used the tool in order to register the perception. In operational terms, H6a and H6b suggested that PEOU and PU of TT positively affected PCA. Since the perceived usability of TT positively impacted learners' PCA, this tool provided a meaningful learning experience. This research finding contributes to those of (X. Zhao et al., 2020), who found the number of downloads affected the software application downloader by following herd behaviour without having a clear rationale. The present research is novel because it is the first to reflect similar propositions but in an educational and technological context.

Additionally, this research supplements that of Jivet et al. (2017), Bodily and Verbert, (2017), who believed the use of dashboards in education improved students' engagement. However, this research is different from that of Jivet et al. (2017) because it presents the learners' interactions. In the present research, only other people's behaviours are presented, to avoid issues of being frustrated or disappointed by being compared with those others. In other words, having a tracking tool that did not compare people's behaviour could still improve the PCA without sacrificing one's well-being through comparisons with others. It is recommended for a new research to replicate the study with another sample to see if you get the same results.

The second proposition concerned the effect of PEOU and PU on the PLSR. The leading underlying theory here was that students would be able to benchmark their completed activities and tasks against those of the herd, allowing them to perceive that they could plan their activities better. This research found no significant evidence to support this argument. The ninth hypothesis in this research was confirmed. H9 theorised that the perceived usability of the tracking tool had a positive impact on students' perceived learning self-regulation mediated by their PCA. The confirmed theory corresponded positively with the logic that H9 was based on: learners could become deeply focused on completing their activities in order to follow the herd (their peers), which initiated improved cognitive absorption. Only then did students experience the improvement of learning self-regulation. This result contributed to the findings by Jivet et al., (2017) that viewing and copying the completed activities could develop a deeper engagement with learners since thought-out tasks made the learning

content meaningful. In a nutshell, the use of TT, unless it improved the LMS PCA, would devalue the benefits from the LMS.

The third proposition involved the relationship between TT and CIU. Interestingly, both parts of the fifth hypothesis, H5 (a) and (b), in this research were rejected. H5(a) and (b) named two ways in which PEOU and PU could arguably directly improve students' CIU. Additionally, the role of PCA as a mediator was not verified in this research. In H7, perceived usability showed no impact on the students' intention to continue through their PCA directly, except when the PCA and PLSR acted as mediators. Hypothesis 10 was confirmed in this research; it proposed that the perceived usability of the TT had a positive impact on students' continued intention to use the LMS and this impact was mediated by the relationship between PCA and PLSR.

H10 brought together all the theories on students' viewing and interacting with the tracking tool. It improved their perceived cognitive absorption and deeply engaged them, renewed their focus on their learning and satisfied them by immersing them in their work. This increased their perception that learning self-regulation was attainable. Once students felt that they received all these benefits of engagement and at the same time were in control of their resources, they could effectively regulate their learning tasks and became enthusiastic about using the LMS again.

7.4.3. To develop a goal-setting-based model for designing new weekly based visualised competencies to improve the PLSR and PCA.

This research was successful in delivering the second objective' it used goal setting theory to develop a new technological intervention which could improve the learners' perceptions of the LMS. The next section covers the theoretical basis for designing and evaluating the weekly visualised competences and the section after that examines the effect on the LMS perceptions of using this technological intervention.

7.4.3.1. Developing and evaluating the VC Intervention

The second intervention proposed in this research introduced weekly visualised competences. The VC presented a structural breakdown of the module and relevant competencies and/or weekly planned learning outcomes. The researcher redesigned the use of competency into a simple visualising interaction tool that required less effort from the teacher and the students. It was displayed on the module page where the students navigated through an expandable hypertext hierarchy with a brief set of instructions that simply and directly guided the students to initiate their learning independently. Through the developed VC planner, the teacher defined the learning outcomes each

week. This VC development allowed teachers to organise and plan the learning outcomes of every week's module. Students could also revise these competencies each time they returned to the material required for study.

The research introduced VCs based on learning outcomes and cross-curricular learning skills. The researcher was a participant-observer training and working with teachers to develop the weekly VC. She developed a comprehensive list of transferable skills from the literature and helped instructors to define their module learning outcomes. Frequent meetings were held with the instructors to build a complete final list. The revised Bloom's Taxonomy was introduced as a guide to the instructors in setting the VC and a template for dividing the learning outcomes according to the knowledge level of students. The list was made by juxtaposing the required learning outcomes (allocated by the module leader) with the cross-curricular competencies extracted from the literature (and filtered by the module leader). The final list was added when entering the weekly allocation of data on Moodle.

The evaluation was completed using data interaction, interviews with teachers and students. Findings from the teachers' interviews indicate that the competency planner helped learners to organise, set strategies, and understand how to plan the learning outcomes for their students. The instructors found that the visualised competency planner was a helpful guide in mapping, structuring, and distributing the module learning outcomes throughout the semester. It helped the teachers to identify the resources and strategies to allocate to the students. Moreover, it reminded the instructor of the weekly LO to deliver the module handbook. In addition, the reviewed Bloom's Taxonomy on the competency planner told the teachers the cognition learning levels of the students.

The students had a positive experience of visualised competency where cognitive absorption was concerned. For example, the students believed that it helped them to remain focused and they became deeply engaged with their learning when they followed it. The students made positively use of the visualised competency to improve their perceived learning self-regulation. For example, they believed that it extended their thought on the course, making them self-directed learners, who were fully engaged in thinking more deeply about the course content. The students had an overall positive perception of visualised competency in that they appreciated its usability for learning and the ease of incorporating VC into their daily practice.

The students, therefore, were satisfied with the visualised competency. They positively perceived it as an advantageous technology for improving their productivity; thus, they agreed to adopt it. Finally, the students were also satisfied with the increased level of attention that the visualised competency afforded them. The data interaction analysis found the students using the VC

significantly but slightly less often as time passed until just before the end of the year; then they began to increase their use of it once more. This was the pattern of its importance for students over the year.

7.4.3.2. Examining the effect of the VC Intervention on the LMS CIU

The second model theorised, developed, validated, and examined the role of integrating VC by improving LMS perceptions. The visualised competency aimed to make visible the weekly learning goal and its strategies for the student. This research model focused on the effect of PEOU and PU of the VC on the LMS PCA, PLSR and CIU. The first proposition concerned the relationship between VC and PCA. In adopting goal theory, the clarity of the goals improved the students' engagement with the tasks. By analogy, this research proposed that VC improved the PCA. The research approved this deduction from goal theory about the use of VC in the LMS context. H12 (a) and (b) were supported by significant evidence to show the effects of the VC on the PCA.

This indicated that the detailed weekly basis of VC improved the clarity of goals and significantly improved students' engagement. This research complemented the work of other researchers such as (Labarrete, 2019), who was able to improve learners' commitment to their learning by exposing them to the required study skills before they began their study. This research contributed also to the work of Labarrete (2019) and the PEOU and PU; in finding that presenting these skills was the key to improving the students' engagement and so was its being detailed weekly, due to the clear determination of the goals.

The second proposition referred to the relationship between VC and PLSR. The visualisation of the competencies was proposed to improve the perceived self-regulation because it could improve goal determination, which in turn influenced help-seeking behaviour. Thus, if the competencies required for each week were presented to students, this goal determination, i.e. the time frame, and the mechanism to deliver it were enough for learners to perceive that they could control and plan their study effectively. VC helped by improving their goal-seeking behaviour, which was a central dimension of LSR. This research confirmed this explanation by finding significant objective and quantitative evidence. In other words, H14 (a) and (b) testified and verified that the perceived usability (i.e. PEOU and PU) of the visualised competency showed a positive effect on students' PLSR.

This research contributed to the work of Lee et al. (2016), who found that presenting LO improved the PLSR, by showing that improved determination of the goals could be the primary driver of the

PLSR. In addition, instead of presenting the LOs before the course, as Lee et al. (2016) did, the present research in PEOU and PU used scales to measure the level of VC use. H15(a) and (b) were confirmed in this research. The perceived usability of VC showed a strong impact on students' PLSR mediated by an improved PCA. Based on self-regulation theory, learners felt more organised and well-prepared when they knew their goals clearly. Accordingly, the visualised competency improved the students' perceived learning self-regulation, supported by an improved PCA. VC improved the students' perception of control and flow, and hence it improved their PCA, which led them to use the LMS for organising their tasks and planning more effectively.

The third proposition was the relationship between VC and CIU. Based on the role of VC in improving the PCA and PLSR, this research found that the relationship was complex. A direct relationship with the VC on the CIU, without the effect of the PCA and PLSR, was not clear. This research found that H11a, which proposed that the PEOU of VC could positively affect students' CIU, was rejected. However, the PU of visualised competency showed a positive impact on students' CIU, which confirmed H11b. This result indicated that the PU of the VC was an essential factor for driving the CIU of the LMS while the PEOU of the VC was not a key factor.

The mediators here played an essential explanatory role in understanding the relationship between VC and CIU. Regarding the mediating effect of the PCA, H13a was confirmed. It proposed that the PEOU of the VC affected CIU mediated by PCA. In contrast, H13b proposed that PU of VC affected CIU mediated by PCA, which was declined. This indicated that the PEOU could be useful only if the PCA improved while the PU of the VC did not need this mediator for improving the LMS CIU. It seemed that the PEOU could trigger the PCA of the LMS, which in turn improved the CIU. The mediating effect of the PLSR, both the PEOU and PU of the VC, was found on the LMS CIU. However, the mediating effect of PCA → PLSR was not significant for setting the relationship between the PU and PEOU and the LMS CIU. This confirmed the absolute importance of PLSR as a mediator with the mixed role of PCA in understanding the relationship between VC and LMC CIU.

7.4.4. To develop a model for incorporating the SM in the LMS to improve the PLSR and PCA.

7.4.4.1. Developing and evaluating the SM Intervention

The third intervention introduced in this research concerned the embedding of the SM platform into the LMS. This intervention had been achieved before but had proven to be distracting. However, by introducing the Telegram platform, with its clear conditions and rules, the moderators could manage the students more efficiently. This proved to be a successful move, demonstrating an effective,

collaborative learning platform. The Telegram focused on closed groups and closed channels of content sharing, which obscured irrelevant materials. Telegram also supported PLSR skills, including one for organising shared content, making it possible to discuss and retrieve data by an easy keyword search. It also supported students' privacy.

The current research showed that the SM environment had a significant impact on students' adoption of the learning application. This research found that it increased their focus on learning, which helped learners to remain organised while following their learning progress. Telegram proved to be an example of a learning-oriented SM platform. The learners joined in and collaborated on relevant topics in Telegram's support group for discussions, a feature which is not fully supported on Facebook and Twitter. However, regardless of the hashtag features, page or group discussions available on both these platforms, users continued to be attracted to flooding by other content as they interacted with each of the LMS applications.

Moreover, Telegram provided a keyword search engine which aided each discussion. Learners could retrieve any discussion by using the keyword search to filter the collaborative content they were searching. Furthermore, Telegram provided shared content history where users can retrive different types of file and multimedia content that have been shared in the group . These features supported LSR skills; resources, time management and help-seeking. Telegram also supports users' privacy which seemed to be a mandatory feature for young learners using social media (Adnan & Bahar, 2019). According to Burtăverde et al. (2019), people with a fear of rejection, fear of conflict, doubt, and no interest in personal disclosure avoid using social media. Telegram, however, was found to reduce the fear of seeking help, so it attracted more people.

The teachers believed that their Telegram group was helpful, saved time and effort, provided quick access to material sharing, kept the users updated and reminded them of the things they had to do. However, some teachers thought it was a time-consuming tool. Similarly, the teachers had a positive perception of the students' Telegram group, and used it to interact with students. Most of the teachers were satisfied with the students' easy, quick, accessible collaborations. Teachers could follow students' interaction to identify areas of concern and learning struggles. Some teachers believed the Telegram platform improved their communication with students. Yet the instructors largely agreed that the Telegram student group generated an unwieldy amount of content, which was distracting and time consuming even if it was moderation and complied with the rules.

The students had a positive perception of Telegram because it made collaborating with the rest of the group easy, clear, understandable, beneficial and advantageous for learning. In addition, the

students had a positive sense of the Telegram platform as improving their cognitive absorption and their self-regulation. Students felt that the self-regulation with the Telegram platform made it easier for them to re-evaluate their knowledge in relation to that of their classmates. They also felt that it enhanced their concentration, making it easier for them to seek help regarding the learning content. In terms of improving cognitive absorption, the students experienced using the Telegram collaboration as fully engaging, and able to reflect their knowledge. They also found that extra focus encouraged them to resist competing distractions. Most of the students also agreed that time passed quickly in the collaboration group.

An interaction analysis tool was used to investigate the teachers' and students' engagement with the Telegram groups. All groups presented a significant level of engagement during the academic term. The highest engagement was during enrolment, assignment, and just before final project deadlines, or final exam periods. This was when students sought most help and advice on completing the required tasks. Moreover, data on the students' Telegram group were analysed in two ways: poll and narrative text analysis. One was performed by asking the students in the group what the primary uses of the Telegram group were. The majority answer was that it was used to solve course work problems and to find help about specific topics. Regarding text analysis, the word search bar to retrieve discussions found evidence of help-seeking. The results showed that 12% of the exchanged messages were initiated from advice or queries about learning content . The narrative analysis calculation was discussed in section 5.3.2 .

To develop and examine a theoretical framework for improving LMS CIU based on the theoretical framework of this research, the two main areas of investigations were the impact of PCA and PLSR on the LMS CIU, the impact of PEOU and PU of TT, and that of VC and SM on the PCA and PLS, which in turn could affect the CIU. Across the three models, RLSR and PCA influenced the CIU and PLSR in a partial mediating role between the PCA and CIU. The first hypothesis in this research, H1, contended that the improved learners' experience in self-regulation positively affected their mindset for the continued use of LMS. PLSR was about the belief in the goals and plans set possibility of following it with absolute commitment. This research is consistent with the work of Kasim and Khalid (2016) and Cheng et al. (2018), who argued that LMS improved learning by improving the learners' ability to make a similar commitment in the future. According to expectation theory, the likelihood of maintaining a commitment to practice rises after the experience of or direct benefits from the system improve (Lee, 2010). Thus, if a system can deliver the targeted objectives, the users are likely to repeat their use of it.

This research supports the findings of (Concannon et al., 2018), who interviewed participants to discover whether the ability to self-regulate lies in the persistence of learners to continue to learning from the same or a similar course in the future. This research contributes to the present study because it provides confirmation based on quantitative evidence from a survey, widening our understanding by showing that PLRS could be a more theoretically fitted concept to use than the "ability to self-regulate". "Ability" is a subjective concept, and the technology and other interventions play a role in improving this perception. In addition, this research found that the PLSR was not only a main driver for the CIU but was also affected by other concepts (i.e. PCA and PEOU and the PU of the new intervention).

The present research, influenced by Lee (2010), argues that if users benefit from the system, this will enhance their CIU this system by revealing its benefits. Nevertheless, this research contributes by proposing that the terms 'benefits' could be misleading; they might cause confusion by reflecting the "usefulness" of a system. A preferable concept might be the "use" of PLSR because it is a more robust and nuanced way of referring to these benefits. This research shows that PLSR was the key construct for operationalising the PU, because PU can be a confusing construct for LMS. This finding may explain why research by (Moreno et al., 2016) did not find the effects for PU on the CIU, although the present research found that PLSR had a significant effect.

Like PLSR, PCA was found to have a significant effect on the CIU. Testing the second hypothesis (H2) confirmed that learners had perceived that cognitive absorption positively affect their CIU of the LMS. The research findings also complement other studies which found that PCA affected the learning performance (see Roca (2008) and Léger et al. (2014)), by establishing that PCA could improve the CIU, indicating a significant level of interest in studying. This positively corresponds to previous findings by Moreno et al. (2016) that PCA does improve the CIU of a system through improving the PEOU. This research contributes to these findings by showing that PCA can have a direct effect on and can be mediated by PLSR. This research result is aligned with the findings in Venter and Swart (2018). However, this research provided stronger evidence than theirs because they did not assess and validate the quality of their model. Besides, they argued that the PCA was a standalone construct while this research extended their model by showing that PCA improved by adding new features to the LMS.

Indeed, the third hypothesis presumed that improved learners' confidence in cognitive absorption positively confirmed their learning and self-regulation experience. H3 outcomes were positively associated with similar results reported by Basol & Balgalmis, 2016; Karlinsky-Shichor & Zviran,

2016;Moreno, Cavazotte, & Alves, 2017, who believed that when a system was used effectively, the user has perceived benefit (i.e. PLSR) improved.

Another confirmed hypothesis was H4. It proposed that a positive perception of learners' cognitive absorption could improve their purposeful benefit of the system, which in return mediated their continued intention to use the LMS in the future. In other words, improved perception of learners learning self-regulation would mediate a meaningful impact on the students' cognitive absorption, which in return would increase their intentions to continue using the system. The current research results distinguish the importance of the PLSR in producing a positive impact on learners' PCA for their CIU.

Without an improved PLSR to mediate this relation, the PCA could have a negative impact on the students' deep engagement with an application which was defended by Rouis et al. (2011). This research developed three models to test the role of TT, VC, and SM on the CIU directly and through the PCA and PSLR. Each model was measured and tested independently. The following sections summarise, discuss and conclude the results of these results.

7.4.4.2. Examining the effect of the SM Intervention on the LMS CIU

The third model was to theorise, develop, and examine the role of integrating SM in improving LMS perceptions. Two theoretical aspects characterise the relationship between the SM and CIU. SM improved the ability to get help whenever required, and the ability to get this help without being perceived negatively. Therefore, guidelines were initiated, and the group moderator was assigned to overcome distraction. Telegram was used because it has sufficient privacy control. These aspects were proposed to enhance CIU directly. The CIU was improved by increasing the engagement on the LMS and by enhancing the perceived benefits of the LMS.

The first proposition was the relationship between SM usability and LMS PCA. This research proposed that SM usability improved the PCA of the LMS because it helped learners to be engaged in debate and discuss education topics and to find whatever help they wanted. This research found significant supporting evidence to confirm that the PEOU and PU of the SM affected the SM PCA (H18a and H18b). This extended the finding by Leong (2011) that SM affects only learners' cognitive absorption in the educational process but also the PCA for using the LMS. The second proposition brings up the relationship between SM usability and LMS PLSR. An anonymised social media platform was theorised as a mechanism that students could use to get help without compromising their privacy, which might improve their help-seeking activities.

Thus, the use of the SM improved the LMS PLSR. This research found that SM PEOU had a direct effect on the PLSR but no significant evidence supported a similar effect from the SM PU on the LMS PLSR. This indicated that SM PEOU could be more critical than PU. The findings align with those of Revythi & Tselios, (2019), who found that PEOU did not affect the PU nor the attitude to using it but affected the behavioural intention towards the system. The present research contends that the PEOU of the SM does have a significant effect on the benefits from the LMS (i.e. PLSR). It could be reasoned that the SM was a useful helper for students who want to ask questions; it may enable them also to plan more effectively. This result contradicts some previous papers, due to differences in the level of analysis.

For instance, Akman & Turhan, (2017), found that PEOU did not affect the intention to use the LMS. The reason here was that learners were obliged to use the LMS for retrieving their material and doing their studies. Thus, over time they may familiarise themselves with the application and this will dilute the effect of PEOU. However, in this research, the PEOU applied to using an extension that was not obligatory. Thus, if it is not perceived as easy to use, it is unlikely to be used. Even being perceived as useful is not enough to make anyone use an SM, but being perceived as easy may be a main driver, among others, for its use.

Regarding the PU, although this research did not find that it had a direct effect on the LMS and PLSR, it was found to have a significant total effect through the PCA. This indicated that the PU of the SM could be translated, improving the perception of the benefits (i.e. PLSR) from the LMS, only if the use of the SM engaged people in using the LMS. To spell it out, as the students immersed themselves and engaged with the LMS, it improved their perception of being able to seek information so long as this information came directly from relevant people (peers and instructors). This increased their positive perception of control and time management. For example, they could seek help at any time. They are also in control of their information source (i.e. they all could have their queries answered), and in control of the management of their resources (i.e. all the shared resources and contents were organised and accessible via group discussion).

The third proposition was the relationship between SM usability and LMS CIU. The relationship between the SM and CIU was mixed and was not direct. There was no significant evidence in this research to support a direct effect of PEOU and PU of SM on the CIU of the LMS. However, there was a total effect from the LMS PLSR and PCA mediators. For the SM, the PEOU and PU played different roles in explaining the possible relationship between the SM and LMS CIU. While SM PEOU affected the CIU through the PLSR, the SM PU affected the CIU mediated by PCA and

PCA→PLSR. These results indicated that the PEOU of the LMS was not important unless the LMS benefits (i.e. PLSR) were improved and the PU of the LMS was not a driver for the LMS CIU unless the engagement of the LMS (i.e. PCA) was improved.

In other words, being easy to apply does not improve the use of the application except when it changes the perception of its usefulness; and being a useful feature does not necessarily improve the use unless the engagement is improved.

7.5. Contributions to knowledge

The contributions to knowledge claimed by this research are on three levels. They are the design/evaluation-based model, the assessment-based model, and the functional-based models.

This research developed a new design/evaluation-based model to set the overarching perspective for designing and evaluating technological interventions that could enhance the perceptions of the LMS. The second contribution to knowledge was to develop a new assessment model to examine and measure the effects of the new technological interventions on the perceptions of the LMS. The third contribution to knowledge was the functional based model which directed the design process into certain functions. The proposed functional models here were to underline the role of herd behaviour and goal seeking on the learners' behaviours. Each of these functional theories was new to the LMS literature in general and to literature on interventions by educational technology in particular. Details of each model and how it differs from precedents in the literature may be found in the following sub-sections.

7.5.1. Contribution 1: A novel CIU-oriented framework for designing, evaluating and examining new technological intervention

This research contributes to knowledge by developing a novel CIU-oriented framework via technological interventions for LMS design and evaluation and its impact on learner's performance and experience. This new framework provided a new perspective from which to develop, understand and measure the effectiveness of technological interventions in terms of social media, TT and VC on the continued use of an LMS. This framework consists of two models: one for designing/evaluation and one for examining.

Contribution 1.1.: A design and evaluation based model

The design/evaluate model is different from any in the previous literature because previous models focused only on such aspects as ease of use and usefulness or on feeling and emotions. The developed model is new because it is the first to combine factors related to LMS functionality (self-regulation, focus and concentration). Thus, research here adopts a new perspective to underline the nature of the main products and deduce the relevant usability criteria. Thus, the new model here focused on five aspects of the quality of the design. They were ease of use, usefulness, perception of self-regulation, perception of cognitive absorption, and satisfaction. These aspects were found to be necessary for successful technological interventions.

Contribution 1.1.: An assessment model

The second model was a measurement model to examine the effect of the use of these new interventions on the LMS. Unlike the other measurement models that focus on ease of use and usefulness in the main system (i.e. LMS), this research invented a measurement model that focuses on the ease of use and usefulness of the intervention and the effects of these perceptions on the LMS. Unlike the use of the Information System Success Model, which focused on the effect on the intention to use of benefits (Cheng et al., 2018), which can be a vague construct; or of satisfaction Dalle et al. (2020), which is not sufficient for continued use, this research focused on the clear defined benefits of the LMS of the PLSR and PCA as they affected the intention to continue the use of an LMS. This research model was novel because it combined the PEOU and PU from the theory of reasoned action to assess the use of interventions and measure their effect, using an adaptation of the Information System Success model for a LMS on the intention to continue using it.

7.5.2. Contribution 2: Developing Functional Based Models

The second major contribution to knowledge was introducing two new theories for proposing new technological interventions to improve the use of the LMS. These two new theories were used to propose three interventions: Tracking technologies, weekly visualised competences, and the social media.

Contribution 2.1. The use of HBT to improve the LMS CIU

This research contributes to the educational technology literature by borrowing herd behaviour theory from the field of sociology (Hirshleifer & Hong Teoh, 2003;Lux, 1995) to propose the possible role of tracking technology in learners' LMS interface. Tracking technology is introduced

in this research to implement this proposition. The new TT is different from any other in the literature. Its design is based on the five dimensions proposed in the design model and is unlike the models by other researchers, who set these indicators in a specialised dashboard. The present research makes the TT at the interface continuously visible, whether consciously or unconsciously. In addition, unlike others who compare learners' interactions with their own (Jivet 2017), this research avoided benchmarking the learners' interaction against others' because it was noted in the literature that such a comparison could lead to unintended consequences.

Thus, the present research used herd theory to discuss potential mimicking by students and showed how this could affect their experience of being engaged in using the LMS and perceiving that they were self-regulated by discovering others' interaction data. The concept of letting the learners see the herd's behaviour was a novel idea theoretically applied in the new context of learning technology. This research was novel in proposing this type of design.

Contribution 2.2. : The use of Weekly Visualised competences- Goal Setting theory

Goal setting theory is used in educational literature as a means to improve learners' performance. This research has borrowed the concept from this discipline to use in the field of educational technology. Goal-setting theory was adapted to design the weekly visualised competencies and SM on the perception of LMS and predict their effect.

The current literature used visualised competencies once per semester made it difficult for learners to find and use them. Goal seeking theory dictates that a new intervention should be visible and available, and tasks should not be broken down per semester and should be set in a shorter time frame. Thus, the new VC was designed to appear once per week so that learners can see the relationship between the topics covered per week (goal-setting) and all the topics to be studied. By setting this mental connection, learners' consequent perceptions of being self-regulated and the cognitive absorption from the LMS were proposed and found to be significantly increased.

Contribution 2.3: The role of SM on the LMS

The second new application of goal-setting theory used a certain SM application with particular arrangements. Goal-setting theory addresses the importance of having the required information and getting the required information without "fear" of seeming ignorant (Alt, 2015). Thus, the current SM applications are criticised because of privacy issues (Nepali & Wang., 2013) and high levels of distortion in getting the required information. Thus, according to goal-setting theory the new SM should be designed to protect privacy and avoid distractions. The new design of the social media is

found to significantly affect the learners' perceived learning self-regulation and cognitive absorption from the LMS, which translates into CIU.

This research enriches the debate regarding the contribution of integrating the use of social media with LMS. Further, it agrees with Tess (2013) that the social media do more than improve students' engagement with LMS. However, it contributes to knowledge by showing that if the perceived usability of social media can improve students' PLSR or PCA for the LMS, it could improve their will to maintain their use of an integrated system of learning management. This finding was different from those of Pelet et al. (2017). They argued that cognitive absorption affects the use of the SM, while the present research argues that SM usability affects the PCA of the LMS. There are no contradictions with the findings from the research by Pelete et al. which focuses on CA in the context of SM, although the present research conceptualised SM as a tool that could be used to improve the PCA of the LMS. Thus, the researchers complement and support each other because the present research found that students' PCA of LMS improved their CIU of the system (LMS and SM).

7.6. Research Implications

These research findings and results yielded several research implications. They relate to developers, teachers, and academics as stakeholders.

7.6.1. Blended Learning Developers

Several research implications relate to the LMS developers who want to improve the possibility of students being engaged and their perception of being more self-regulated. The recommendations are classified under four headings: data collection, data representation tools, planner tools, and social media integration.

Regarding the data collection, currently, Moodle does not provide a click counter feature to measure the number of clicks per student and report them in a meaningful way. Following the present research data, the TT, which reports on the click counter figures, was found to engage students and improving the PLSR, which improved the CIU. Thus, the first recommendation to the developer was to incorporate an integral click counter that would collect all the clicks from all students and report them to the teacher. This was to enable the teacher to show some of them to the students, i.e. developing a click counter which, connected with a live database, would be a powerful asset to teachers and students. The click counter capture information on the date, the user's gender, correlational analysis and data mining tools.

Regarding data representation, traditionally, the reports and information were presented to the students on the learning dashboard and not on the main interface. This research argues that exposing students to the VC and TT in their day-to-day routine learning activities improves their PCA and PLSR, affecting the CIU. Thus, the present research recommends that developers break down the dashboard elements and allocate these analytic tools to the interfaces related to day-to-day use. This would push learners and teachers to use the relevant analytic tools in taking decisions based on relevant information. Besides, reporting data and constantly exposing the learning goals to the students could have a psychological effect on their thinking and behaviour.

Regarding the planner tools, the weekly VC planner integrated with VC evaluation system improved the evidence-based system and provided a method of feedback which improved the future LOs. First, evidence was found that teachers benefited from the VC planner tool developed by the research. The current planner tool focused mainly on presenting the semester LOs while this research planner tool provided the number of. LOs to use per week and presented them to the students. This enabled the teacher to see the number of clicks on each LO and the transferable skills that were gained. The research found that weekly LOs made students more focused and more determined to follow their learning goals when they became clearer. This engaged them, making them more capable of planning their activities.

Second, the planner currently in use did not store LOs and did not connect with the literature about compiling a comprehensive list of transferable skills. The researcher had to conduct her own systematic review to discover what the transferable skills for the teachers were. The teachers judged this to be a useful way of improving their planning ability. Thus, a system for the planners to learn transferable skills imported from the literature was recommended. Third, to guard against the chance of miswriting or misunderstanding the use of specific transferable skills, it was recommended to ensure clarity by setting up evaluation technology that would recommend the best wording for the LOs and the transferable skills. Fourth, planners would benefit from the click counter feeding into its interface to report on the number of clicks on each LO and implementing a system to receive students' feedback on the comprehensibility of the LOs and the transferable skills.

Regarding the social media, and following the data, it was found that there were four main issues with the adoption of the SM in education: the threat of help-seeking, the threat of privacy issues, communication overload for teachers, and the ability to link the topics discussed by the learners with their interaction data (TT and VC). Thus, four primary recommendations are made here to improve the perception of the SM; they will also make it more beneficial for teachers to plan and personalise

their teaching to engage students so that they feel in a safe environment. The first two issues, i.e. the threat of help-seeking and the threat of privacy issues, were resolved in the present research by using Telegram, which makes it easier for students to communicate on the chat platform without being known to others.

In order to resolve the privacy issue, other recommendations should be made, such as Connection, which allows data interaction and personalising of the materials and teaching.. Moreover, because the students' registration form generates two accounts that are linked through the system but encrypted so that nobody can define the connections between the LMS account and the SM account, every student's two usernames should be connected at the same registration interface. Only the data analytics can link the textual analysis with students' data interactions So, for analytical reasons, it would be useful if the textual analysis of the student could be integrated with their clicks and performance so that teachers could fit and personalise their courses better.

Thus, the system could personalise the suggested search keywords and searches could be categorised as LOs, VC, topic and planning activities. According to the research data, the main reasons for using the SM were asking help and searching for specific topics. The greater the ability to search for and find help, the easier it becomes to be engaged and self-regulated. The last challenge facing the teacher was communication overload. Teachers could not follow up all the threads and catch all the relevant questions, primarily because this module was delivered by different tutors. Thus, SM could be connected to the mailing system so that the teacher could receive an email for specifically selected hashtag topics and mentions. This would help teachers to follow up more effectively.

7.6.2. Teachers

The main research implications for teachers were the focus on awareness and the adoption of new practices. Regarding awareness, during the interviews, it was noticed that the teachers' perception of the importance of having LOs was growing less keen. However, when they engaged in the development process, they found it to be useful for improving their module design. Thus, the first recommendation for teachers was to be aware of the importance of breaking down the LOs into weeks. Without such awareness, the usefulness of having the VC planners and TT would be undermined. The value of the technology came from using it rather than its mere existence.

The second recommendation was about changing teaching practices in terms of planning the module, using the LMS to direct herd behaviour, and engaging in SM discussions. Regarding the planning of the module, the module was designed to provide a certain number of LOs per semester. The design

was optimised for the topic and not for the LOs. However, when teachers used the planned LOs each week using the revised Bloom's Taxonomy, it enabled them to design programmes based on the LOs and not on the topics.

The use of data analytics was minimal, but the present sample of respondents suggested that they found it is useful to plan not only the basis of academic performance but on the interactions with the system and the SM discussion. Embedding the data analytics in the planning activities of teaching could improve the module design and fit the design more accurately to the students' requirements. Third, VC was optimised when using cross-curriculum skills, which were grounded in the literature. There was one recommendation to the developers to have a system for integrating this literature review in the bank of competences, but, if this system were not in place, it was advised that teachers should do this exercise because the present research found that it improved their planning activities and opened the door to their improving the module design.

Fourth, they had to ensure that the LOs were concise, clear and determined, since the present research found that these requirements crucially ensured the level of engagement and improved learners' ability to be self-regulated by means of LMS. This could be done by interviewing the students or using the social media analytic tools to revise the LOs that were too debatable and unclear. Second, TT leads to the unintended consequence of herd behaviour being used by students as a guide to planning their activities. The herd is not always correct. Thus, the teacher used the TT feature wisely to ensure that positive behaviour was communicated and students were discouraged from following misdirected interactions. For instance, the links that had a high number of clicks but were not very meaningful for the module objectives were removed to prevent misguided actions.

Third, teachers' engagement in the social media is essential and keeps students engaged in using it. However, as suggested by the research data, teachers faced a challenge with communication overload, i.e. there were so many threads and topics in the chat that it was challenging to keep them in focus. Thus, it was vital for them to use the automatic moderation and mentoring tools for reducing the effort and time required to keep track of the chat threads. Additionally, it was helpful for them to use the SM analytic tools to explore the main threads and debatable points, in order to identify weaknesses in articulating the LOs, course assessment methods, topics and materials in the module. This data can be used to improve these aspects in the next courses, as noted earlier in this section.

7.6.3. Academics

Academics are advised to spread awareness of the TT and VC and also to invest in improving the LMS infrastructure. Although these noted benefits for TT and VC exist, it was necessary to raising awareness about these technologies among teachers and students. As a solution, orientation on the use of them could be given to prevent some from being neglected. One of the reasons these initiatives succeeded was that the researcher gave teachers orientation and introduced them to the use of the features which has allowed them to appreciate how much time has been invested in them. Thus, some instructors suggested that the teaching staff needed to be trained to use Moodle in general (i.e. how to enrol, navigate through the weekly contents) and to tackle the proposed features as well.

The instructors carried out training with the students before the commencement of the academic course. The teachers may have more influence in extending students' understanding of learning self-regulation. Briefing the students at the beginning of the academic term on ways of benefiting from the interaction design increased their interaction and ultimately improved their learning perspectives. Additionally, the university had to invest in the LMS infrastructure, which covered the technical and human resources departments. Thus, training the academic staff on the use of TT, SM, and VC was highly recommended. Investment was required in learning data analytic tools and thus empowering teachers to plan their modules effectively. Examples included dashboard features that acted as a learning progress predictor, a recommender system, and a reflection tool for the students. However, the integration or implementation of these features risked exceeding the institutional budget.

7.7. Research Limitations

The methodological limitations come from the nature of this research as a pragmatic case study. The work adopted the positivist paradigm to set the research hypotheses and test them while the interpretive paradigm was used to design and validate the solution. Thus, the present research used interviews with teachers to develop and validate the solutions, and questionnaires to test the theoretical framework and to validate the design by collecting students' feedback. Interaction data analysis was used to validate the use of the interventions proposed in this research and to investigate the use patterns. Although there were benefits from the triangulation of methods and paradigms, there were methodological challenges. The methodological areas for improvement were generally categorised as research method challenges and measurement scales issues.

The nature of this case study meant that the generalisability of the results was limited to this case. However, it could be applicable in a different context with similar environmental conditions in terms

of module design, teachers, students, and a university context. The research boundaries here were limited to Moodle as the LMS, Telegram as the SM, Tashkent as the country and culture, and the IT course module as the educational material. Moodle can be different on other platforms that could engage students differently. For instance, Blackboard is limited in its features and engagement tools, compared to Moodle. Moreover, some new LMS integrate advanced dashboard systems with plenty of information. This research focused on Moodle as an LMS with limited options on the dashboard but with high interactive features.

Telegram was used in the present research because of the privacy benefits that protected students. In the context of Tashkent, privacy issues held the highest importance in the use of SM. The case may be dissimilar in other countries where learners can see no difficulty in disclosing their names in a learning context. Telegram was popular and a very acceptable platform for this context, but this may not be the same in another country. The learners who gave feedback may have been familiar with this platform, but in other contexts, this platform might not be so well known to learners. Last, the present research was conducted with students studying an IT course, which indicates a high level of acceptance of the technology. Potentially, students taking history or biology, for example, might not have the same preferences for using technology as IT students. These aspects have to be considered in the case of replicating the research results in other contexts. On another note, the welcoming message on the Telegram group which list the group rules could be positively worded.

This research adopted several methods to fulfil its objectives. The noted areas for improvement were the data interaction tools and the survey. This research used a wide variety of interaction analysis tools such as the click counter, heatmap, and Combot. The study could generate more value by adopting eye-tracking technology to assess the facial expressions and emotions, reflecting engagement levels. Nevertheless, this technology was expensive, so it could limit the ability to analyse a statistically significant number of students. Moreover, the click counter customised by the researcher was not fully automated. It needed time and effort from the researcher to ensure the accuracy of the numbers because she herself periodically intervened to integrate and collect data. Another added value activity that could enrich the data and improve the triangulation outcomes is the learning journal in which students documents their learning experience per day.

The final data interaction challenge was about integrating the methods to have a consolidated view of the students. i.e. this work did not develop an integrated data interaction system to collect all the data about a learner as the unit of analysis. Several factors hindered the researcher's ability to develop this system further. First, it would have cost more effort in getting ethical approval and acceptance

from students to track each one's interaction data per personally. Second, technologically, it would have cost significantly more time and effort to develop this system, thus exceeding the fund allocated to the present research project.

Regarding the survey, there were four areas for improvement: connecting the two questionnaires, having a longitudinal survey, controlling demographic factors, and improving the measurement scales. Concerning the first of these, the present research adopted two surveys. The first adopted the interpretive paradigm for validating the students' feedback on the interventions as being easy to use, useful, improving the PCA, improving the PLSR and as a motivator for improving the intention to continue to use in the future. The second survey was to test the impacts of perceiving these interventions as easy to use and useful on the LMS PCA, PLSR and CIU.

Although this triangulation enabled in-depth analysis and insightful results, the present research could not connect these two questionnaires so that more relationships could be explored (i.e. the intervention PCA and PLSR and the LMS PCA and PLSR). There were two remedies to this problem. The first would have been to merge the two questionnaires into one – but this would have made the questionnaire too long, risking students' reluctance to complete it, which could have affected the response rate. The second option was to connect the two questionnaires through an ID or email address on the two questionnaires. This option was not a valid offer due to the respondents' concern for privacy, which would have limited the trustworthiness of their responses. For example, some students might have feared that giving negative responses would affect their marks.

The second area of improvement was in having two questionnaires, one when the students saw the intervention, and another at the end of the course. This could have helped to understand the dynamics of PEOU and the PU change over time and the way in which this change affects the results. However, this was not a viable option. It is always challenging to ensure the success of experiments because students are invariably overloaded with questionnaires. Two questionnaires were already scheduled; four of them would have been difficult to administer, especially given the high expected drop rate of completed questionnaires at the end of a semester.

Thus, the present research had one opportunity to run at the end of the semester. To begin with, there was a potential surprise element in starting a technology. At the absolute end, there was a time issue which risked the PEOU being diluted through possible over-familiarity with the features. The third area of improvement for the survey lay in including demographic questions so as to assess the role of gender, age, background, education, together with other country-specific factors. Despite the importance of having these factors in the study, the potential cost of having them could outweigh

their benefits. Indeed, the class has similar students in terms of age, background, education and from relatively the same culture. The data had to come from one topic, one class, one teacher, and one intake. The variation in the demographic factors was thus limited; hence replicated studies should ensure a wider and more diverse group of participants to test inclusivity and therefore, equality. The students may see this as a way of identifying them or asking what could be seen as personal questions. Moreover, the questionnaire was designed to be kept short and straightforward so as to merit a high response rate.

The measurement of the scales in the positivist questionnaire led to some areas for improvement. First, the PLSR was measured using a self-rated questionnaire, as commonly used in the literature. However, it could also be measured by the learners' interactions on the computer (Çebi & Güyer, 2020). Both approaches were used in the literature, but the possibility of triangulating the data could improve the value of the work. Nevertheless, the cost and effort of integrating the algorithms of the data interactions and seeking approval from the students to connect these data with their questionnaire was a key challenge limiting the researcher's ability to consider this option. Second, the PLSR was a perception and not necessarily real; i.e. this research focused on self-perception more than objective practices. Nevertheless, this research adopted rigorous validity and reliability tests to ensure that the scales that were used were helpful and not misleading.

Regarding the PCA, in the literature, some authors used 4-dimensional scales to measure the PCA; each of the dimensions having 4 items. This could be a valid point if the constructs were few in number. Nevertheless, if the present research had included 16 items for measuring the PCA the questionnaire would have been lengthy and the response rate low. The last point to include as a possible area for improvement was the ability to measure the use behaviour of the respondents regarding the interventions. Because there was no possible linkage between the data interaction information and the questionnaire, the only option available was to measure this behaviour through self-rated items. Questions about the behaviour could be doubted or inflated but using second-order questions for measuring this behaviour would give more valid responses. In other words, the questionnaire could ask directly on use level, but this could have elicited misguided answers since the use level was relative and not easily measurable. Meanwhile, the perception of ease of use and usefulness using the Likert scale could give stronger and comparable figures.

7.8. Future Research

7.8.1. Replications and Generalisation

Due to the methodological challenges, replicability and generalisability, this research can be improved by conducting similar research in different contexts and on different modules. A replication of the same study with a larger sample could also improve the reliability of this work. The students who enrolled on this project studied for a computer science degree with the implicit assumption that they did not have a problem with using computers. The results might differ with undergraduates from a different subject background (i.e. Business, Biology, or English).

Tashkent as a context can be perceived as culturally different from Western countries. For instance, the perception of teacher-student power is much higher in this context than in the UK (Hofstede, 2018). This implies that the interaction with teachers over the social media could be different for learners from different backgrounds. People from various cultures could have different attitudes to using social media for help-seeking, as discussed by Hamid et al. (2016). Al Tarawneh et al. (2017) have also reported that cultural differences affect students' behaviour with regard to using social media. Additionally, Telegram is a popular platform in Tashkent (Makarenko, 2019), but it may not be the best platform for the UK. In the UK, Facebook, Instagram, and YouTube are the most popular platforms among UK residents in higher education (Bhardwa, 2017). This suggested that the introduction of Telegram for educational purposes would need to have a valid business basis for adoption in the UK., i.e. the psychological cost of introducing a new SM balanced with the benefits of having privacy in conversation,

7.8.2. CIU and Academic Performance

The ultimate focus of this research was improving the CIU of LMS because in the present research, the CIU is associated with academic performance (Tawafak et al., 2018). Although this is a valid premise, in most of the previous research, it needed to be critically evaluated and analysed before taking it these research findings for granted. There are two examples here that touch this relationship and need to be considered with cautions.

First, herd behaviour was robust and affected the learners' practice of following the herd. This did not mean the best practices were followed nor that the best performance was produced. Instead, it implied the average person's behaviour, which indeed could be a little higher than the middle point of the performance scale (more than 50%). Thus, the herd behaviour pushed the practices to cluster around the average performance which was suitable for the negative outliers (failing students) but

was a weakness for the positive outliers (the best students). Thus, it was necessary to note that herd behaviour was found to play a significant role in improving the CIU. However, to improve the learning performance, it needed further investigation to examine the implicit assumptions underlying the relationship between the use of technology, herd behaviour and academic performance.

Similarly, for VC, although the VC is widely known in the literature, it can be improved. The learners' performance and the relationship between weekly VC and academic performance should be studied before accepting the assumptions as unquestionable. Allocating LOs per semester could improve performance because learners know much about the requirements of the semester, but they take into consideration previous exam papers. This premise is believed to be correct, but, for the present research, having weekly VCs was as important as reinforcing the importance of the topics and making learners believe in them more and more. However, this could affect their ability to follow the teachers' instructions and be guided by the past exam papers. The exam levels may cover only the "remember" aspects, while LOs focus only on "application" practices. In other words, while students may focus on applying these lessons in their practices, this may not necessarily lead to improving academic performance. This relationship needs further study and investigation to ensure a positive association between having VCs and academic performance.

7.8.3. Underpinning factors of accepting the research interventions

According to the data in this research, there were some noticeable variations in accepting the TT, VC and SM. Although all of them were perceived as successful interventions for improving PCA, PLSR and LMS CIU, these variations in acceptance could trigger questions about the underlying factors making this a variation in place. The suggested reasons could be personality, experience, or motivations for using the LMS. For instance, self-regulated learners will seek any technology that could improve their ability to plan. In contrast, low self-regulated learners are distracted and not interested in planning their work. These differences in the attitudes to planning leave space for accepting the TT or VC as empowering technologies for planning.

Similarly, there are some personalities keen to compare themselves with others, especially anxious and conscientious learners, who may intend to use TT more than others which could improve their perceptions of the benefits of the TT. Being open to experience as a personality trait may be associated more with exploring the VC than with students being motivated to see other people's performance (i.e. TT). The conscientious learners may be keener to see others, for example, because they fear missing out or being left behind, than to follow the VC. Some personalities were motivated by goals and believed in planning, while others focused on methods or how to do things. Thus, the

self-determined personality and goal achiever could have more enthusiasm to use VC in their activities and have high aspirations. There is no evidence to overwhelm these arguments, and they need to be examined in depth. Regarding the SM, not all personalities are interested in using it, and not all of them are motivated similarly to use it in education. Thus, it is expected that personality plays a role in explaining the possible perceived benefits from the SM on the PCA and PLSR of the LMS. These research avenues could be explored and investigated by interested enquirers.

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8. Appendixes

8.1. Appendix A - Moodle data collection consent letter

Dear WIUT Students,

We highly appreciate your time and feedback in completing the TAM Moodle experience survey included in this email. By taking part in the survey, you are giving your consent to us for using your feedback. Please read the following as it is essential for you to know.

- You will find some questions that are similar to each other. However, they are not; each question gathers a particular aspect of your point of view towards one of the three Moodle features (Activity completion, Competency, and Telegram). Hence, please spend some time to read each question carefully.

- The three Moodle features (Activity completion, Competency, and Telegram) might have an impact on you. Accordingly, we want to know your feedback and point of view about each one of them.

Please note that all your personal information and your feedback on the current survey compile to the following:
Will be coded/anonymised during the entire research phases.
Will not be accessed by the module leader.
Will not affect your grading by any means.
Will not be shared with any third party.
Will not use for other research purposes.
Will not be used for any other purpose.
Will not be accessed by other than the researcher.
Will only be accessed by the researcher to track a source of inappropriate contents shared on the integrated social media platform.
Will be detached and permanently destroyed from the Moodle activity database as the activity only may be stored for a more extended period to extend the current research into a more extensive study area.

We highly appreciate your time and effort to complete the survey and providing us with your valuable feedback.

You can now start the survey by following this link:

Moreover, if you would like to withdraw your feedback at any time, please contact us at w1273572@my.westminster.ac.uk , and we will withdraw you from the study.

Many thanks for your cooperation

TAM Moodle research team

1. Access the Moodle from Google chrome
2. Access to the Telegram web via Google chrome and sign in
3. Access your course page and join the Telegram group

8.2. Appendix B: Students Moodle enrolment consent and confirmation

Dear Student,

Your enrolment at the TAM Moodle has been successful.

By enrolling into TAM Moodle, you agreed that your activities on the TAM Moodle (such as access file, complete a lesson, participate in a forum, participating on the integrated Twitter platform) is to be stored and analysed for research purpose only and will not affect your grading on the course by any means.

Kindly note that your personal data (name, email address, ID) will not be stored or used on the analysis. All students data will be kept secured and will not be shared with any third party; neither will be used for other purposes. Although the integrated Twitter complies all the data privacy and security code, however, Inappropriate contents will be tracked with its source to maintain a safe online learning environment. Please make the best use of the integrated Twitter for your learning contents and study advice purpose only.

On behalf of the research team of TAM Moodle at the University of Westminster London, we would like to thank you for your consent to use your data (safely and securely as stated above) for our research purpose. However, If you wish to withdraw from the research analysis, please email the TAM Moodle administrator at w1273572@my.westminster.ac.uk, and we will withdraw your record without any further investigation. This does not affect you on using the TAM Moodle for your course contents learning or grading by any means.

Many thanks and kind regards

TAM Moodle research team

8.3. Appendix C: Questionnaire 1 to validate the design (Likert scale 1-5; minimum 1, maximum 5; strongly disagree 1, strongly agree 5)

What is your opinion about the Tracking Technology (completed activities)?	**1**	**2**	**3**	**4**	**5**
Perceived Usefulness					
I believe that the completed activities are useful for my learning					
Viewing the completed activities improved my learning performance					
Viewing the completed activities is useful in improving *my self-motivation* toward learning					
Perceived Ease of Use					
I find it easy to understand the completed activity summary					
I find it clear to follow the completed activity summary					
TT made it easier for me to *track the progress of my learning*					
Perceived Cognitive Absorption					
Time flies when I view the completed activities (Engagement)					
I can block all distractions when I view the completed activities (Focus)					
PLSR					
Viewing the students' completed activities *helped me* to *keep track of my learning progress*					
The completed activities improved my *concentration* on *keeping track of my learning progress*					
Viewing the completed activities makes *it clearer* for me to plan *my learning goals*					
The completed activities view makes *me fully focused* on achieving my *learning goals*					
Viewing the completed activities makes *it easier* for me to self-manage *my learning strategies*					
TT improves my independent learning					
Outcomes - Satisfaction					
I am satisfied with viewing the completed activities because it helps me to fully *concentrate* while learning (focus)					
I am pleased with viewing the completed activities because it helps me to block most distractions when I study (focus)					
I am satisfied with viewing the completed activities because it is practical					
I am pleased with viewing the completed activities because I can effortlessly follow it					
Outcomes – Use					
I follow the completed activities while I study because I find it understandable					
I use the completed activities for my learning because it is simple					
I follow the completed activities when I study because I find it practical					
I use the completed activities because I believe itis useful for my learning					
What is your opinion about the Visualised Competences?					
Perceived Usefulness					
Competency improved my productivity in my study					
Competency is advantageous for my learning					
Perceived Ease of Use					
It is easy to understand how to use the competency on the course page for my learning					
It is easy to implement the competency on the course page for my daily learning					
Perceived Cognitive Absorption					
The visualised competency helps me to remain focused on my study (Focus)					
I become deeply engaged with learning when I follow the visualised Competency (Engagement)					

PLSR					
Using the Competency on the course page *helps me* to extend my thinking on *my knowledge of the course*					
Viewing competency on the course page makes *it easier* to become a *self-directed learner*					
Using the competency on the course page makes me *fully engaged* in *extending my thoughts on the course contents*					
Using the competency on the course page enhances my *concentration* on *achieving my learning goals*					
Outcomes Satisfaction					
I am satisfied with the visualised competency because I found it practical					
I am pleased with the visualised competency *because I was able to use it effortlessly*					
I am satisfied with the visualised Competency because it helps me to focus while learning					
I am pleased with viewing the visualised competency because it increases my attention when I study					
Actual Use					
I read the competency on the course page because I found it easy to follow					
Competency is practical to use in learning					
What is your opinion about the use of Telegram?					
Perceived Usefulness					
I find collaborating on the Telegram group advantageous for my learning					
Collaborating on the Telegram group is useful for my collaborative learning					
Collaborating on the Telegram group is beneficial for my learning					
Perceived Ease of Use					
It is easy for me to collaborate on the Telegram group					
Collaborating on the Telegram group is clear and understandable					
Cognitive Absorption					
The Telegram group helps me to block most distractions					
Time flies when I use The Telegram group					
The Telegram group makes me fully engaged in reflecting my knowledge on the course					
Perceived Learning Self-Regulation					
The Telegram group makes it easier for me to seek help about the course content when needed					
The Telegram group enhances my concentration on seeking help regarding the course content					
The Telegram group makes it easier for me to re-evaluate the knowledge I have compared to my classmates' knowledge					
Outcomes - Satisfaction					
I am satisfied with The Telegram group because it helps me to concentrate on collaborative learning					
I am pleased with The Telegram group because it makes me fully engaged in collaborative learning					
I am pleased with Telegram group because I can effortlessly follow it					
Outcomes – Usage					
I use the Telegram course group because it is easy					
I use the Telegram group because it is simple					

8.4. Appendix D: Questionnaire 2 (To test the framework)

TT-PU	TT-PEOU
What is your perspective toward viewing the completed activities of your classmates on the Moodle	
1. It is useful for my learning	6. It is easy to follow
2. It improves my productivity in my study	7. It is clear and understandable
3. It enhanced my effectiveness in my study	8. It is easy to use
4. It is advantageous for my learning	9. It is effortless to use
5. It is practical to use in learning	10. It is simple to follow
Competency-PU	Competency-PEOU
What is your perspective toward viewing the weekly competency on the Moodle	
11. It is useful for my learning	16. It is easy to follow
12. It improves my productivity in my study	17. It is clear and understandable
13. It enhanced my effectiveness in my study	18. It is easy to use
14. It is advantageous for my learning	19. It is effortless to use
15. It is practical to use in learning	20. It is simple to follow
SM-PU	SM-PEOU
What is your perspective toward using the Telegram group for your module	
21. It is useful for my learning	26. It is easy to follow
22. It improves my productivity in my study	27. It is clear and understandable
23. It enhanced my effectiveness in my study	28. It is easy to use
24. It is advantageous for my learning	29. It is effortless to use
25. It is practical to use in learning	30. It is simple to follow

PCA	PLSR	Continues intention to Use
During my learning on the Moodle		
31. I am fully absorbed with my study	36. I can managee my study time	46.I am intending to use it in the future
32. I can block all distraction from out side	37. I can plan my learning tasks independently	47. I will use the Moodle for learning in another module
33. Time flies when I study	38. I know where to search for missing information	48. I am would like to use the Moodle for learning again
34. I don't feel the time when I use it	39. I can track my learning progress independently	49. I am going to use the Moodle in the future
35. I get fully occupied with it	40. I can evaluate my achievements	50. I have in my mind to use the Moodle again for learning

8.5. Appendix E: Tested Framework Hypothesis confirmation

8.5.1. IS success Model

H1: PSRL affects CIU positively: confirmed** in TT, confirmed** in VC, confirmed** in SM
H2: PCA affects CIU positively: confirmed** in TT, confirmed** in VC model, confirmed in SM
H3: PCA affects PLSR positively: confirmed** in TT, confirmed** in VC model, confirmed** in SM
H4: PCA affects the CIU mediated by PLSR: confirmed** in TT, confirmed** in VC, confirmed** in SM

8.5.2. TT perceived usability

H5a: perceived ease of use of TT affects CIU: rejected
H5b: perceived usefulness of TT affects CIU: rejected
H6a: Perceived Ease of use of tracking technology affects PCA: Confirmed**
H6b: Perceived usefulness of tracking technology affects PCA: Confirmed**
H7a: Perceived Ease of use of TT affects CIU mediated by PCA: rejected
H7b: Perceived usefulness of TT affects CIU mediated by PCA: rejected
H8a: Perceived Ease of use of TT affects PLSR: rejected
H8b: Perceived usefulness of TT affects PLSR: rejected
H9a: Perceived Ease of use of TT affects CIU mediated by PLSR: rejected
H9b: Perceived usefulness of TT affects CIU mediated by PLSR: rejected
H10a: Ease of use of Tracking technology affects PLSR mediated by PCA: confirmed**
H10b: Perceived usefulness of Tracking technology affects PLSR mediated by PCA: Confirmed**
H11a: Ease of use of TT affects CIU mediated by PCA and PLSR: confirmed
H11b: Perceived usefulness of TT affects CIU mediated by PCA and PLSR: confirmed

8.5.3. Visualised competency tool

H12a: perceived ease of use of VC affects CIU: rejected
H12b: perceived usefulness of VC affects CIU: confirmed**
H13a: Perceived ease of use of VC affects PCA: confirmed**
H13b: Perceived usefulness of VC affects PCA: confirmed**
H14a: Perceived ease of use of VC affects CIU mediated by PCA: confirmed
H14b: Perceived usefulness of VC affects CIU mediated by PCA: rejected
H15a: Perceived ease of use of VC affects PLSR: confirmed**
H15b: Perceived usefulness of VC affects PLSR: Rejected
H16a: Perceived Ease of use of VC affects CIU mediated by PLSR: confirmed
H16b: Perceived usefulness of VC affects CIU mediated by PLSR: rejected
H17a: Perceived ease of use of VC affects PLSR mediated by PCA: confirmed**
H17b: Perceived usefulness of VC affects PLSR mediated by PCA: confirmed
H18a: Perceived Ease of use of VC affects CIU mediated by PCA and PLSR: rejected
H18b: Perceived usefulness of VC affects CIU mediated by PCA and PLSR: rejected

8.5.4. Social Media

H19a: Perceived Ease of use of SM affects CIU: rejected
H19b: Perceived usefulness of SM affects CIU: rejected
H20a: perceived ease of use of SM affects PCA: confirmed**
H20b: perceived usefulness of SM affects PCA: confirmed**
H21a: Perceived ease of use of SM affects CIU mediated by PCA: rejected
H21b: Perceived usefulness of SM affects CIU mediated by PCA: confirmed
H22a: Perceived ease of use of SM affects PLSR: confirmed
H22b: Perceived usefulness of SM affects PLSR: rejected
H23a: Perceived ease of use of SM affects CIU mediated by PLSR: confirmed
H23b: Perceived usefulness of SM affects CIU mediated by PLSR: rejected
H24a: Perceived ease of use of SM affects PLSR mediated by PCA: confirmed
H24b: Perceived usefulness of SM affects PLSR mediated by PCA: confirmed**
H25a: Perceived ease of use of SM affects CIU mediated by PCA and PLSR: rejected
H25b: Perceived usefulness of SM affects CIU mediated by PCA and PLSR: confirmed

8.6. Appendix F: Researcher's papers

Accepted Papers

Al-Shaikhli, D. and Courtenage, S. (2018) "A Literature Review of Personalisation, Search, and Navigation Methods in Open e-Learning" International Journal of Information and Education Technology, Vol. 8, No. 1, 62-33

Accepted Conference Papers

Al-Shaikhli, D., Jin, L., Porter, A., Ibragimov, D. Tarczynski, A., and Shpirko, M. 2019. The Impact of Cultural Familiarity on Students' Social Media Usage in Higher Education. *18th European Conference on e-Learning ECEL 2019.* Aalborg University Copenhagen, Denmark 07 - 08 Nov 2019 Academic Conferences and Publishing International Limited.

Papers under review

Al-Shaikhli, D., Jin, L., Porter, A., Tarczynski, A., "The effect of the Tracking Technology on students' perceptions of their continuing intention to use a learning management system" Computers and Education

Al-Shaikhli, D., Jin, L., Porter, A., Tarczynski, A., "When the SM improves the perceptions towards the LMS: A Case study on the use of Telegram" Information Technology and Education

Al-Shaikhli, D., Jin, L., Porter, A., Tarczynski, A., "The role of weekly visualised competences on the use of the LMS: The perspective of cognitive absorption and perceived self-learning regulation" Computer in Human Behavior

8.7. Appendix G: Glossary

Acronym	Name	Definition	Ref
AU	Actual Use	Is a predicted construct to indicate learner's acceptance of using a learning management system. In the original Technology Acceptance Model, actual use depends on the students perceived ease of use of the LMS and on the student perceived usefulness of the system.	(Alraimi et al., 2015).
BT	Bloom Taxonomy	The Bloom taxonomy (Bloom, 1965) provides clearly defined learning outcomes that indicate students' knowledge level. BT is operationalised as a set of standards and indicators to guide and evaluate the design of modules.	(Bloom, 1965)
CIU	Continues Intention to Use	Continues intention to use is a student's perspective used to measure their acceptance of the learning management system. It also measures the strength of that acceptance and whether it leads them to consider re-using the same learning management system in the future.	(Hong et al., 2017)
CBE	Competency Based Education	Competency-based education (CBE), also known as Competency-based learning or Skills-based learning, refers to systems of assessment and grading, where students demonstrate these competencies.	(B. Zheng et al. 2020; Gruppen et al. 2012)
CCC	Cross Curriculum Competency	CCC refers to learners' ability to merge the skills and knowledge learned from different disciplines to construct new knowledge in new field.	(Bridges,, 1993).
HB	Herd Behaviour	It explains people imitation of the herd (i.e. others' interactions), giving it power over perceivers' perceptions, beliefs, and behaviours.	Shiller (1995)
ISS	Information Success Model	ISS model scrutinizes the role of system characteristics (e.g., information quality, system quality, and service quality) in the intention to use an application through improving the users' satisfaction and perceived benefits.	DeLone & McLean (1992)
IB	Intention Behaviour	It is a perception of students' intention to use an application. IB normally is measured via (self-reporting).	(Ouellette & Wood, 1998)
LMS	Learning Management System	is a platform to support blended learning courses. LMS originated from management systems, as a technology for organising and managing learning materials to support learners, and further enable them to build knowledge through performing organisational tasks.	(Cheng & Yuen, 2018).
LAD	Learning Analytic Dashboard	In LMS, LAD is an integrated application that provides a comprehensible visualised summary of the learner's tracked interactions, and further analyses the progress of the learning.	(Park & Jo, 2015)
LO	Learning Outcomes	A set of clear objectives and skills that learners are expected to achieve in relation to a particular subject.	Labarrete (2019)
MIS	Management Information System	Is the application that is used in corporates to manage the digital information, data, and resources. LMS is an MIS with an educational purpose as its customised and used within educational institutions or purposes exclusively.	

SM	Social Media	A social interaction online platform used by wide range of people world-widely. There are different types of SM such as Facebook, Twitter, Instagram, and Telegram.	
SEM	Structure Equation Modelling	is a multivariate statistical analysis technique that is used to analyse **structural** relationships. This technique is the combination of factor analysis and multiple regression analysis, and it is used to analyse the **structural** relationship between measured variables and latent constructs.	(Hair et al., 2011)
PLSR	Perceived learning self-regulation	is learners' perception of their ability to set their learning objectives and plans and to carry out these plans as expected.	(Zimmerman, 2002)
PEOU	Perceived Ease of Use	Is a measured factor (normally via self-reporting) that indicate the students' perception of the perceived ease of use of the LMS.	(Davis et al., 1989)
PU	Perceived Usefulness	Is a measured factor (normally via self-reporting) that indicate the students' perception of the usefulness the LMS.	(Davis et al., 1989)
PCA	Perceived Cognitive Absorption	The perception (self-reported) of the state of flow means the inability to sense time or place while using an application.	Agarwal & Karahanna (2000).
PS	Perceived Satisfaction	The students' perception of pleasure, happiness, satisfaction with using the LMS.	DeLone & McLean (1992)
PLS	Partial Least Square	is a multivariate **technique** used to develop models for LV variables or factors. These variables are calculated to maximize the covariance between the scores of an independent block (X) and the scores of a dependent block (Y) (Lopes et al., 2004).	Hair et al (2014)
RBT	Revised Bloom Taxonomy	RBT is based on the BT (Bloom Taxonomy). In RBT, the BT was improved with the effect of aligning the learning outcomes with the instructional activities which shown to improve teachers' ability to plan the teaching materials.	Krathwohl (2010)
TAM	Technology Acceptance Model	predicts users' acceptance and use of information technology by focusing on the system features that affect users' acceptance.	(Davis et al., 1989)
TT	Tracking Technology or tracking tool	A technological intervention that was developed in this research. TT summarise the class interaction with the resources on the course page. It does not filter high achievers neither it personalises students' progress against the rest of the class.	Research developed
TEI	Technological Educational Intervention	The three developed and suggested technological tools (VC, TT, and SM) to be used in this research in order to intervene the student's perception of their continued intention to use the LMS.	Research developed
VC	Visualised Competency	A technological intervention developed in this research. VC is a group of a learning outcomes and cross-curricula competency that were developed to be displayed (visualised) on the Moodle course page on a weekly based depending on the topic that will be delivered.	Research developed

8.8. Appendix Developing the Visualised Competency – Guidance

The technical implementation of Visualised Competency was in three stages. The first stage was to construct the VC framework builder. The outcomes of this stage were the learning outcomes and cross-curriculum competencies that were agreed for the courses under review. This form allowed the researcher to lay out each parent competency along with its sub-rooted skills in preparation for being visualised according to their agreed time frame and matching learning content. The competency builder was used in the selector form to allow choice of which competency to illustrate. The second stage developed the illustrated competency selector form. This form allowed the competencies that were chosen for visual presentation on the course page to be managed. The third stage implemented the illustration of the selected competency on the course page.

The outcome of this stage displayed the expandable hyperlink tree of the selected competency framework, which allowed students to navigate through it and read the content of each sub root of the illustrated competency tree. The image below shows an example of the competencies as illustrated. The students can navigate through the branched text-structure as shown on the left-hand side of the image. When a student clicks on any node (such as a title or subtitle of the competency), the description of the clicked node (on the right-hand side) is displayed.

8.8.1 List of Learning Outcomes

The weekly LOs, competency measurement, and visualised competency on the Moodle columns were added to allow the LO to be decomposed into visual applicable steps for the students to take; this offered a more precise process for the instructor to advise. The table below presents an example of the module's LO laid out according to the suggested table. The full learning outcomes – guided by the Revised Bloom's Taxonomy – is outlined in Table 4-5.

8.8.2. Cross Curriculum Competency (CCC)

The CCC represents the broad skills which learners can acquire and implement in different situations. The aim of providing competency guidance in the present study is to visualise it in its most straightforward form using tree/branch visualisation. Hence, the definition of competency had to be decomposed into shorter sentences to ensure its clarity and simplicity for the students. Table 4-6 was used as a competency break-down structure to simplify its transference to the visualization phase on the Moodle course page.

The CCC table was developed from a review of the literature discussing transferable skills in computer education. Initially, primary keywords were used to filter the scholarly findings, for example, those on cross-curriculum competency, transferable skills, and key skills. Sixteen skills

relevant to undergraduate computer education were extracted. The extracted list was shared with the participating course instructors and was based on their feedback and experience. Nine transferable skills were selected for use among the CCC in the present study. The CCC definitions were kept as they were; however, collaborative efforts were made to deconstruct each skill into smaller units in the instructions for visualising them. Table 4-6 sets out these competencies and shows how they were deconstructed in order to be incorporated in the visualization tool.

Appendix Table 8.8.2. : Competency planner for learning outcomes

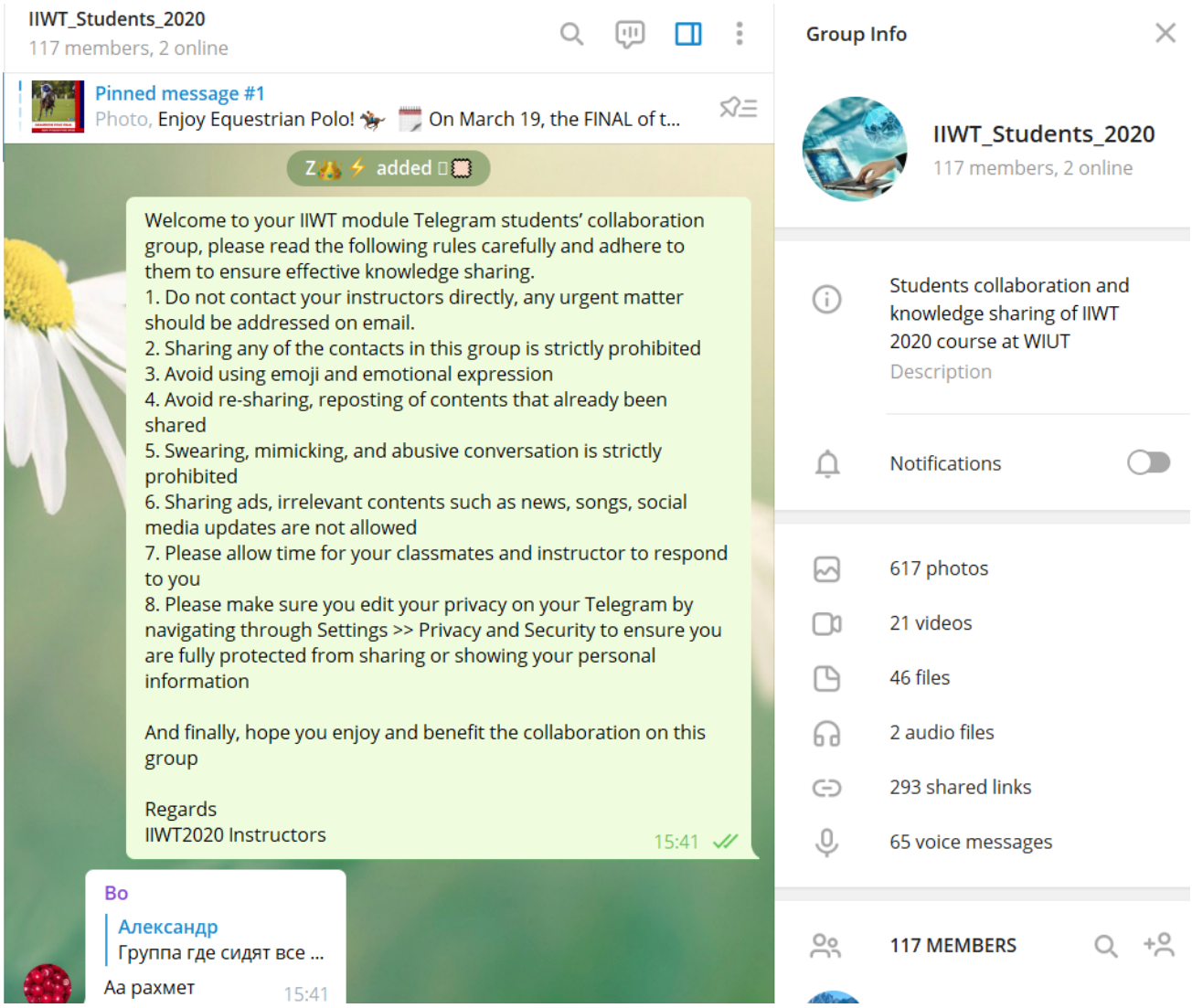
Weekly LO	Bloom's Taxonomy structure	Definition	Measuring tool	Competency measurement	Visualised competency on Moodle
1. Have a theoretical foundation for game development cores and trends	1. Remember	Retrieve relevant knowledge from long-term memory	1.1.Recognising		
			1.2. Recalling		
	2.Understand	Determining the meaning of instructional messages, including oral, written, and graphic communication	2.1. Interpreting	1. Provide examples of selling points to users that you would implement in the proposed game (Exemplifying)	1. Market analysis: identify and analyse market size and competitors, make explicit competitors' analysis in the context of market and proposed game.
			2.2. Exemplifying	2. Compare the competitors in the proposed game (Comparing)	User selling points: discuss features that could attract players and give a competitive advantage in the market. Identify unique features that could be implemented for the proposed game.
			2.3. Classifying	3. Perform the game analysis of the industry and market and summarise the key trends (Summarizing)	
			2.4. Summarizing		
			2.5. Inferring		
			2.6. Comparing		
			2.7. Explaining		
To produce an electronic presentation for personal or professional needs	3.Apply	Carrying out or using the procedure in a given situation	3.1. Executing	IIWT.LO4: Create an organisation's PowerPoint template (with logo, firm style) and use for creating presentations	IIWT.LO4: Organization's PowerPoint template (with logo, firm style, etc.) and corresponding presentation
			3.2. Implementing		

Appendix Table 8.8.3 : Cross-curriculum competency

	Literature-based: Cross-Curricular Competency				
	Parent Competency	Sub Competency 1	Sub Competency 2	Sub Competency 3	Sub Competency 4
1	Learn to learn (Hoskins & Fredriksson, 2008) *Pursue and persist in learning.*	Identify your learning requirements - *Know your learning process and needs*	Identify available opportunities - *Know which resources you can use now to learn*	Be resilient: *Able to overcome come obstacles to learning*	Seek and make use of guidance as an individual and within a group
2	Meta-cognition(Bryony Hoskins and Ulf Fredriksson)	Know your learning: *Know the field you are learning; what the relevant contents are and identify the scope of your learning to avoid wasting time and resources.*	Monitor your progress: *identify milestones for your achievements to visualise your progress*	Effective time Management: *Schedule your tasks based on their priority and basis, on a carefully estimate the task due date, and the length of time required*	Effective information Management: *Identify the most relevant contents to your learning subject*
3	Learning self-regulation: *identify your learning objectives and self-manage the efficient accomplishment of those objectives as the core of what it is to be a self-regulated learner* (Wolters et al., 2006) (Winne & Hadwin, 2008; Zimmerman, 2000)	Set primary and intermediate goals: *Plan how to achieve each one and adhere to it. Write a list and review it daily.*	Prioritisation: Plan your tasks in order, based on which should be completed first, based on their due date, and based on their prerequisites	Help-seeking: ask for clarification, make sure you have shared your classmates' understanding of each concept, approach your teacher or high-achieving students for help	Accept critical feedback positively: Adapt to feedback which you receive regarding your academic progress, and use it positively to improve in your learning (Wolters, C.A., 2010)
4	Problem-solving: "Apprehend the problem situation, think through the processes used to approach the problem and the appropriate solution."((Klieme, 2004)	Identify the nature of the problem: Recognise the problem and formulate its exact nature. Define the desired outcomes: Define the goals as visible accomplished tasks	Break the problem down: Analyse the problem situation, and visualise it (as a table or a diagram)	Solve it stepwise: design the required to solve the problem. What are the inputs and outputs of each step? How will you process it from one step to the next to achieve the desired outcome?	Execute, adjust, and assess: Evaluate each step you apply towards solving the problem and reflect on how you would use it in a different environment
5	Be an active team player: teams perform best when they all communicate, focusing on	Know your role and be committed to it	Know the direction (aim) of the team	Communicate openly and honestly	Team tolerance: Actively listen to your peers and positively

	achieving the desired result (Kauffeld, S., 2006)				accept opposing perspectives
6	Collaborative learning on the Social Media (self-developed)	Content evaluation: carefully read and evaluate the new information in light of the formal resources (trusted websites and not casual forums)	Time Management: Commit to a time frame for your collaboration	Avoid redundancy: do not.	
		Social media relies mainly on users' generating content. Hence, it requires careful evaluation as they might not be valid or based on opinion.		re-explain, re-answer, saturated conversation	
7	Critical and Creative Thinkers: to learn a key concept you need to build it in your mind by a chain of cognitive actions. (Paul & Elder, 2012)	Link and build knowledge: connect new information to earlier knowledge	Evaluate the developed knowledge and how it will benefit you differently	Learn how you can extend your new knowledge	
8	Be a self-directed and self-disciplined learner (Rainwater, 2016)	Be clear and precise: Raise vital questions and problems	Evaluate and elaborate: Gather and assess relevant information (use abstract ideas to interpret it effectively and fairly)	Use standards to measure conclusions: Form use well-reasoned conclusions and	Communicate effectively with others in finding solutions to complex problems
				solutions (test them against relevant criteria and standards)	
				Evaluate your work against previous similar work completed in your field.	
9	Mastery is being able to locate similarities with known situations in new situations, in unfamiliar contexts, and to adopt active, known behaviours. (Safta, 2015)	Commitment means "the active and responsible participation of the student in his or her learning process" (Iglesias-Pradas et al., 2015; Klieme & Others, 2004)			

8.9. Appendix G: Telegram join group welcome message



8.10. Appendix H - Links to research data

1. Survey raw data
2. TT, VC, SM Moodle plugins code and files