Technology, Knowledge and Learning
https://doi.org/10.1007/s10758-024-09751-4

ORIGINAL RESEARCH

Using Online Critical Reflection to Enhance Students' Confidence, Motivation, and Engagement in Higher Education

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Accepted: 5 June 2024

Abstract
This research examines the effect of critical reflection activities in an educational environment that uses active and blended learning experiences for students to develop confidence, motivation, and engagement with their learning. A mixed-methods research approach was adopted on a sample of 137 Communications and Media students, who were involved in a game-based project. Using a validated survey instrument to measure the students' perceptions of their experiences, Pearson Correlation coefficient was used to estimate the relationship between the learning activities and students' perceived confidence, motivation, and engagement. Finally, multiple linear regression was used to determine the effect of the critical reflection activities. This study identifies several variables that significantly contribute to student confidence, motivation, and engagement with learning. Yet, some variables were identified that also diminish students' confidence, motivation, and engagement. Learning activities that show statistically weak and strong significant relationships were also identified. Some factors that significantly impacted students' confidence, motivation, and engagement include better understanding of course topics; direct relevance of an online critical reflection; students' motivation to learn more about the subject; clear, timely, and in-depth feedback; and the use of some pedagogical triggers.

Keywords Blended learning · Critical reflection · Confidence · Motivation · Engagement · Teamwork · Groupwork · Active learning · Students learning experience

1 Introduction

In higher education delivery, the relevant role played by student confidence, motivation, and engagement (CME) in shaping their learning process cannot be overstated. These attributes together not only strengthen students' acquisition of competencies but also encourage proactive behaviour, persistence, and work harder toward achieving their

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Published online: 09 August 2024

learning objectives (Barkley & Major, 2020; Jayalath & Esichaikul, 2020; Wong et al., 2022). Conversely, students who lack confidence often struggle with doubts regarding their problem-solving abilities, leading to diminished self-esteem and waning motivation and engagement (Rush & Balamoutsou, 2006).

Despite the acknowledged significance of CME in higher education delivery, a notable gap persists in understanding how specific pedagogical interventions, particularly online critical reflection activities embedded within active and blended learning experiences (ABLE), impact students' CME. While prior research has explored the relationship between the various teaching methodologies and students' outcomes, there remain inadequate empirical studies that focus on the nuanced effects of online critical reflection on CME within the context of contemporary educational paradigms. Furthermore, existing literature is scarce on the interplay between online critical reflection practices and students' perceptions of their own learning experiences, leaving an opportunity to delve deeper into this pedagogical approach. Critical reflection (CR) stands out as a recognized pedagogical approach (Harvey, 2016), considered for its ability to deepen students' knowledge and understanding (Cossu et al., 2024). While online reflection activities within learning modules hold promise for focusing students on their learning objectives and encouraging motivation and engagement (Barkley & Major, 2020), students often find CR daunting and fail to perceive its connection to their CME (Watson & Kenny, 2014).

Contemporary pedagogy advocates for active and blended learning experiences (ABLE), emphasising the need for innovative approaches to enhance student learning outcomes. Thus, this study seeks to explore the influence of students' online reflections on their learning experiences on their CME. Specifically, it aims to assess students' perceptions of an online critical reflection activity embedded within an ABLE. The overarching research question guiding this study is: "What impact do online critical reflections have on students' confidence, motivation, and engagement to learn?" Within this study, the focus is on the learning activities that significantly affect the students' CME.

The dependent variables under study are (a) student confidence, (b) motivation, and (c) engagement (CME), while the predictor variables comprise the critical reflection activities integrated into the course-redesigned learning activities. This study intends to highlight on the relevant variables within teaching and learning innovations that shape students' learning experiences. Studying such factors that enhance students' CME can help educators effectively integrate online critical reflection activities, and encourage students to develop self-confidence, motivation, and engagement with their learning. This, in turn, can lead to improvements in the students' knowledge, understanding, and problem-solving skills.

Additionally, although the triad of confidence, motivation, and engagement is well-established in the educational psychology literature (Bong & Skaalvik, 2003), there are several reasons for specifically focusing on these dependent variables together. Firstly, these variables collectively form the core pillars of effective learning experiences, influencing students' cognitive, affective, and behavioural dimensions (Bandura, Freeman & Richard, 1999). Secondly, empirical evidence suggests that enhancing students' confidence, motivation, and engagement leads to tangible improvements in learning outcomes, including knowledge acquisition and problem-solving abilities (Sheldrake, 2016; Hellín et al., 2023). Lastly, by focusing on these specific variables, this study seeks to provide educators with actionable insights for optimising teaching and learning environments to better support student success in higher education. It is anticipated that the findings of this study may provide an understanding of the significant variables within teaching and learning innovations that affect students' learning experiences.

2 Literature Review

Active and Blended Learning Experiences (ABLE) can be conducive to students' engagement with their own learning, as they collaborate with their peers and teachers (Bonwell & Eison, 1991; Hodges, 2020). Larson et al's (2018) study found that when people work in groups they put greater effort into the activity. Thus, in such a learning environment, interactive and collaborative work can; enhance higher-order cognitive activity and learning (Baepler et al., 2014; Beichner, 2008); help students develop confidence (Awidi, 2019; Baepler et al., 2014; Hoic-Bozic et al., 2009); and enhance critical thinking skills (Akyüz & Samsa, 2009; Alotaibi, 2013).

2.1 Critical Reflections on Active and Blended Learning Experiences (ABLE)

ABLE is a pedagogical approach often incorporating elements of authentic learning which can be done both on- and offline. This approach is useful to student learning when the chosen learning activities are aligned with the intended learning outcomes of the university topic/course/unit (Biggs & Tan, 2012). Students learn through activities that are intentionally developed to deepen their knowledge and understanding of the subject. The act of reflection allows students to synthesize knowledge and understanding through the sharing of ideas, participation in discussion, and through engagement with project activities, experiments, and group activities (Awidi & Paynter, 2016, 2024; Cavilla, 2017). This aligns with Gibbs (1988) reflective model which emphasises the cyclical process of reflection, where students observe, reflect, and then take action to improve their learning experience.

Yancey asserts in Cavilla (2017), that reflection must be integrated and embraced within the classroom to effectively transition students from external to intrinsic motivation. Cavilla (2017) maintains that, while reflection does not need to take the place of assessment, it can be infused as part of an activity to enhance student performance. Feedback enables students to improve their learning through reflection on activities, which enables the development of problem-solving skills (Cossu et al., 2024), and enhances professional practice experience, as they become aware of linkages between theory and what they know and believe (Whitaker & Reimer, 2017, 2021). However, this feedback and reflection must be intentional and well-planned for students to benefit from the experience, by asking them questions and helping them to organise, express and think through their actions or knowledge (Knoth et al., 2020).

Activities within an ABLE must be structured in a way that students take responsibility for their own learning, feel motivated to engage with it (Barkley & Major, 2020; Capone & Lepore, 2021) and be confident to solve problems using the knowledge acquired. In a 'flipped' classroom approach this can be achieved when learning activities occur either pre-class, in-class or post-class in sessions supported by online technologies (Awidi & Paynter, 2019a, 2019b).

Critical Reflection (CR) is the process by which students identify the central historical and cultural assumptions that underly their actions and question the meaning of these assumptions. According to McCormick et al. (2013), students who critically reflect on their learning, tend to be more highly engaged with their learning which is reflected in their performance. By challenging their prevailing social, political, cultural or professional norms (Brookfield, 2016; Shandomo, 2010) students can develop alternative ways of acting. Thus, CR is the independent interrogation of a student's overall worldview of prior knowledge

and understanding as related to their actions. Through this interrogation students come to interpret and create new knowledge which may affect attitudes or behavioural changes as they gain insights (Matsuo, 2019; Shandomo, 2010). Using reflective journals and undertaking activities, students can explore their thinking and understanding by comparing their new and existing (prior) knowledge. It is an opportunity for the students to remember, recall, reconstruct, recreate, and represent what they have learnt (Shandomo, 2010; Zuckerman, 2012). CR thus leads to growth in their learning experience, as they become more curious, enquiring, and exploratory.

Zuckerman (2012) asserts that critical to effective educational growth and learning is the notion of students reflectively considering the goals and means of their own actions and thoughts as well as a willingness and consideration to take on the views of others. This can extend the zone of proximal development as postulated by Vygotsky (Cavilla, 2017) because "the wider the students' zone of proximal development, the greater the amount of learning that can take place independently once it has been properly scaffolded" (Cavilla, 2017). This implies that students can more confidently engage in problem-solving activities independently by drawing on the knowledge gained from their learning. Studies have shown that CR activities improve students' critical thinking skills, helps them develop self-knowledge, and helps change students' perceptions of their own efforts, motivations and abilities to complete set tasks; and helps them develop a realistic sense of efficacy and motivation (Cavilla, 2017; Colley et al., 2012; Rusche & Jason, 2011). Rusche and Jason (2011) noted that by encouraging students to keep journals in which they document their experiences, students can significantly deepen their grasp of course material, even when they do not like it or agree with it (Rusche & Jason, 2011, p.346). Thus, as Watson and Kenny (2014) found, by gaining experiences through the reflective processes' students are able to make better choices that enhance their overall effectiveness.

Awidi & Paynter (2019a, 2019b) measured the impact of a 'flipped' classroom model on student learning experiences and found a positive correlation to CME. However, their study did not examine the extent to which variables that determine the student experiences affect their CME or the quality of teaching they experienced. Delialioğlu (2012) has asserted that a problem-based learning environment has the power to engage students with meaningful learning activities. This is supported by Forndran and Zacharia's (2019) study which used a game-based approach—a reward system whereby students earned virtual coins which could be converted into benefits, such as extra time for final examinations.

2.2 Confidence, Motivation and Engagement with Learning

Student confidence to engage with learning has previously been attributed to intentional course designs that are activity based. For example, Khan and Madden (2018) employed active learning strategies over three semesters to investigate whether the activities both enhanced student confidence and reduced test anxiety. Their findings indicate that different types of learning activities correlate to student engagement. Where students were paired to solve problems, the activities induced the students to learn the content without realising it. Overall, the activities were perceived to be a less stressful mechanism for testing and enhanced confidence, motivation and engagement with learning materials, which in turn improved the students' learning outcomes as well as better prepared them for the final examination. Such experiences provide students with a self-perceived ability to learn, implement and perform specific tasks (Bandura, 1997). Conversely, lack of confidence is

marked by feelings of anxiety and fear, resulting in low expectations, excessive worry over evaluation and low self-worth (Hembree, 1988; Khan & Madden, 2018) which can thus impact performance.

Ampountolas et al. (2019) compared the ability of undergraduate and postgraduate students to make decisions. Their study demonstrated that learning activities involving simulations—such as those used in a game-based approach—can improve student self-confidence and help develop their decision-making skills. Overall, the confidence and decision-making skills of undergraduate students who engaged in daily operational activities, was demonstrably improved compared with the cohort of postgraduate students who were not required to engage in these daily operational activities.

Khan and Madden (2018) also demonstrate that when students gain confidence in their knowledge and ability to perform tasks, deep learning occurs. Both Smith et al. (2018) and Franz et al. (2020) have also shown that student confidence in solving problems is linked to active learning strategies. Franz and et al, (2020) observed that improvements in the student learning experience in relation to their confidence was mirrored in the scores they obtained during practice laboratory simulations, as well as the practice scenarios they encountered.

The intrinsic or extrinsic motivation to learn is well linked to engagement in learning activities that build student confidence (Armbruster et al., 2009). According to Cavanagh (2011), the benefits of active learning are reflected in students' motivation toward their study, their attitudes toward their learning, their improvements in critical thinking skills, and their propensity for self-directed learning. However, not all active learning strategies result in students' motivation to learn (Wilke, 2003).

Engagement occurs when students demonstrate that they are emotionally and cognitively involved in their teaching and learning experiences (Thijs & Verkuyten, 2009) Capone & Lepore, 2021). The effectiveness of an ABLE in promoting engagement and motivation is evident when authentic problem-solving activities are incorporated into the experiences that enable students to interact with and apply knowledge to other contexts (Capone & Lepore, 2021; Delialioğlu, 2012). Although authentic interactions have been argued to make students more confident in applying their skills (Wu et al., 2011), they must be well aligned with the learning outcomes (Biggs, 2012), and they must be structured in a way that students are able to reflect and make meaning of their own learning.

Lumpkin et al.'s (2015) investigation of students' perceptions of the impact of learning activities on their engagement, found that students valued participating and engaging with the learning activities and affirmed that their active engagement positively impacted their learning. Barkley and Major (2020) have asserted that student engagement is a product of motivation and active learning, and efforts towards motivation can improve engagement and student learning outcomes.

2.3 Focus of the Study

Based on the literature, this study presumed that students engaged in teams or groups for activities and assignments would enjoy their learning more, acquire valuable groupwork skills, and deepen their subject knowledge and understanding. Effective student learning, as reflected by performance, occurs when activities instil confidence, motivation, and engagement, both online and offline in a 'flipped' classroom approach. Drawing from Cavilla (2017) and Yancey (1998), this study suggests that Critical Reflection (CR) activities enhance students' confidence, motivation, and engagement. Understanding the variables

relevant to stimulating confidence, motivation and engagement (CME) among students is important. Integrating CR activities into the learning process, along with formative assessment and feedback, should motivate students and encourage confidence in solving problem.

This study aims to demonstrate that 'constructively aligned' ABLEs, with activities, resources, and assessments aligned with learning outcomes (Biggs, 2012), and meeting student learning needs, would enhance student CME. Hence, by identifying activities in the redesigned course that contribute to students' confidence, motivation, and engagement in learning, would be significant in meeting the objectives of this study. Students' perceptions of what affects their CME when they engage in online reflections would be captured.

3 Methodology

3.1 Background and Rationale

This study is about a third-year undergraduate Communication and Media Studies course, at a Western Australian University, with a specific focus on Design, Play, and Culture. Before the intervention and study, the course was conventionally instructor-led with digital resources, which allowed students to attend lectures and/or study online. However, it was observed that the students needed to actively engage with the learning resources, which was reflected in the end-of-semester performance. End of semester Student feedback from the unit suggests that they found the course difficult and either "loved it or hated it". The problem was that students struggled to participate and engage effectively in group project activities and had difficulty demonstrating they understood the learning outcomes and how games relate to understanding interactive systems. They also found it difficult to apply the knowledge they gained from the course to their experiences and ultimately relate them to workplace situations. With these observed problems, a decision was made between the Unit Coordinator, Learning Designer, and Educational Researcher to redesign the course and evaluate the impact of the innovation on the students learning. In the redesign online critical reflection exercises were embedded in active and blended learning activities. It was anticipated that as they engage, the online reflections will deepen their understanding, enhance their confidence, and motivate them to learn more by engaging. In implementing this, the course redesign and the outcome were monitored over eight weeks.

3.1.1 Multi-design Process

The Unit was redesigned in collaboration with the Unit Coordinator (UC) in a workshop. A flipped classroom approach was implemented, integrating active and blended learning activities with CR to enhance the students' learning experience. This approach aimed to improve students' motivation and confidence in problem-solving. Prior to in-person sessions, students engaged with short video clips, readings, and project exercises. During class time, the UC facilitated discussions as students participated actively. After class, students continued learning through online readings, videos, and group projects. These projects were designed to be experiential, collaborative, and problem-solving, incorporating game-based activities throughout the semester. Within group projects, simulations and game-based activities were paired with CR, using an online peer assessment tool (SPARK) to ensure engagement and fairness. SPARK was specifically designed to develop team skills,

enhance team experiences, improve learning from team assessment tasks, and ensure fair assessments for all students. See Fig. 1 below.

3.1.2 Structure of Learning Activities

During the first half of the course, students were taught and provided with essential content, while the second half focused on project-based activities. The aim was for students to grasp concepts through relevant learning tasks, related relevant information, and resources linked to their learning objectives. For the first seven weeks, students attended a one-hour lecture and two-hour tutorial/workshop that involved interactive game simulations and role-playing exercises. Additionally, from weeks three to eight, students had the option to participate in game design studio activities, encouraging collaboration and exploration of various game systems and mechanics. Following week seven, two lectures were held, one focusing on technical writing. Weeks 10 to 12 were dedicated to workshops and tutorials for students to finalise their game design projects and test their peers' designs. In week 12, students received formative feedback on their projects from the Unit Coordinator, in addition to feedback provided during tutorial sessions. To deepen reflection, students were encouraged to maintain reflective journals and conduct summative reflections toward the semester's end. This involved reviewing lessons, topics, exercises, and assessments, composing journal reflections, and receiving feedback from peers and the Unit Coordinator. By doing all these the study aims to explore the aspects of these activities that, upon critical reflection by students, would enhance their confidence, motivation, and engagement with their learning.

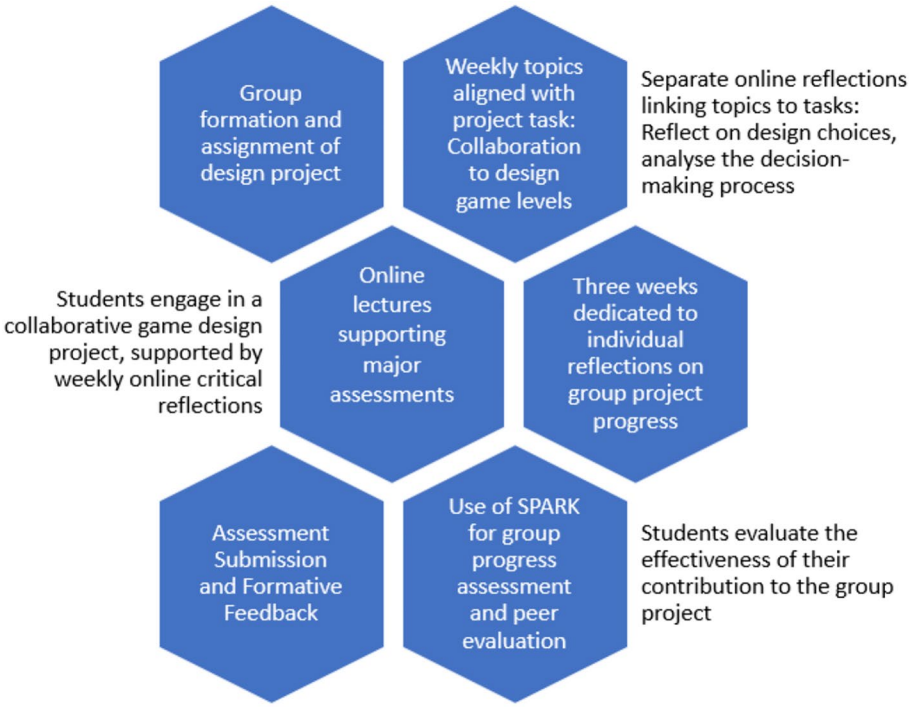

Fig. 1 Students Learning Activities: Collaborative Game Design Project

3.2 Research Design and Instrument

3.2.1 Research Design

To examine students' perceptions of online critical reflections in ABLEs, and assess their CME with learning, a mixed-method approach was adopted. This approach combines both quantitative and qualitative approaches to gain a comprehensive understanding of students' perceptions and experiences. The approach was considered appropriate to explain the study focus of examining the impact of online critical reflections on students' confidence, motivation, and engagement (CME), and identify learning activities that significantly impact these attributes within Higher Education.

3.2.2 Research Instrument

A structured survey with 42 questions using a 5-point Likert scale to understand how confident, motivated, and engaged students felt in different parts of their learning like design projects, group work, online critical reflection, and assessment and feedback. The survey questions were developed collaboratively by the research team and the UC. This was done to ensure content validity and alignment with the research objectives, and the course context-specific evaluation of how the various learning activities and online critical reflection impact on the students' CME. The survey had 40 close-ended questions and six open-ended ones, which allowed students to provide feedback on how well the new approach helped them learn and to identify any pedagogical issues. Three of the open-ended questions asked students about aspects of the course they enjoyed, any challenges they faced, and suggestions for improvement. Semi-structured interview questions were developed for the Unit Coordinator (UC) to explain why the course was redesigned and what was expected from it. The design of the research instrument was guided by the proposition by Awidi and Paynter (2016) that: when students work in groups to complete authentic project tasks, with all relevant resources, are supported and encouraged to collaborate, and receive feedback through online reflection assessments, their confidence to learn would be enhanced. This approach will also motivate them to engage more in learning and construct knowledge.

The survey questions were pre-tested to ensure clarity and reliability, with any feedback incorporated into the final instrument. To ensure validity, the survey items were adapted from validated scales with established reliability coefficients from 48 to 42 questions. Ethics approval was then obtained from the authors' university Human Research Ethics Committee, ensuring compliance with ethical standards in data collection and analysis.

3.2.3 Instruments Development Process

Critical Reflection: To assess students' engagement in online critical reflection activities, the items of the tool in the survey were adapted from several literature sources (Rolfe et al., 2001; Schön D (1991) The Reflective Practitioner 2nd edn Jossey Bass, San Francisco. Including the "Gibbs Reflective Model". Gibbs model was used to prompt students to describe their experience and how they felt about the experience, evaluate to identify what was good about their experience, analyse to make sense of their experience, conclusion, and an action plan based on their experience (Gibbs, 1988). This allows students to reflect

critically on their learning experiences, with items rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This model has demonstrated strong reliability and validity, making it suitable for capturing the depth and breadth of students' reflective practices.

Confidence: The development of the confidence items in the survey were adapted from Bandura's (1997) self-efficacy theory, and the academic self-efficacy scale (van Zyl et al., 2022). Hence, the scale focuses on students' beliefs in their ability to successfully complete academic tasks and achieve desired learning outcomes. Responses were scored on a Likert scale (1–5), with higher scores indicating greater levels of academic self-efficacy. The ASES has been widely used in educational research and has demonstrated robust psychometric properties across diverse student populations.

Motivation: The students' motivational orientation was evaluated using items adapted from the Motivated Strategies for Learning Questionnaire (MSLQ), a comprehensive instrument developed by Pintrich and De Groot (1990), which has been extensively validated and used in educational research settings. The MSLQ assesses students' motivation and use of various cognitive and metacognitive strategies in academic contexts. It comprises subscales measuring intrinsic motivation, extrinsic motivation, task value, and self-regulated learning strategies. The higher scores on the Likert scale indicate greater levels of motivation and strategic learning behaviours.

Engagement: Student engagement was assessed using items adapted from the Student Engagement Instrument (SEI), developed by Fredricks et al. (2004), which has strong psychometric properties and has been validated across various educational research. The SEI captures three dimensions of student engagement: behavioural engagement, emotional engagement, and cognitive engagement. The instrument consists of items that gauge students' involvement in classroom activities, their emotional investment in learning, and their cognitive effort expended during academic tasks. Higher scores on the Likert scale indicate greater levels of student engagement.

3.3 Data Collection

The final survey questions were deployed in Qualtrics, an online data collection management tool. Students enrolled in the unit were invited to participate in the study through an announcement on the course's online learning website (Blackboard) and through email invitation. Of the 137 students enrolled in the course 101 survey responses were received, of which 2 were omitted because they were incomplete. The open-ended questions were completed either fully or partially by 32 students. All responses were received during the last week of the semester normally allocated for exam study and revision. On completion of the UC interview, the recording was transcribed and synthesised to identify common themes that align with the objectives and expectations of the course innovation, which also map to the research objectives. This process of data reduction, organization, and interpretation for the open-ended items was achieved through the use of Terry et al.'s (2017) six-stage process to arrive at the broad themes. Survey data collected through Qualtrics was exported to SPSS Version 23 and put through a cleaning process to remove anomalies and ensure there were no outliers that would influence the results.

3.4 Instrument Quality

Using Cronbach's alpha as a measure of internal consistency, a reliability test was then conducted to further ensure that the instrument measured what it was intended to measure and the analysis procedure was consistent with the findings, thus assessing the consistency of the results obtained or the given construct (Saunders et al., 2009). For the consistency of the given construct measured to be considered credible or reliable, the alpha coefficient value should be at least 0.70 (Whiteside et al., 2010). For this study, the overall Cronbach's alpha for the 42 items was 0.933, greater than the minimum accepted value. For the individual items, Cronbach's alpha values ranged between 0.930 and 0.949. The Corrected item-total correlation, a measure used to assess the relationship between individual items and the total score of the scale after accounting for the overlaps with each other ranged between 0.012 and 0.706. For reliability, the corrected item-total correlations must be above 0.3 to indicate that the items are adequately measuring the same underlying construct (Ferketich, 1991). Three (3) items were below 0.3 and were therefore considered not reliable for the study.

Reliability statistics were calculated for different sets of items using Cronbach's Alpha. For the 23 CR items, the Cronbach's Alpha coefficients were 0.930 and 0.931 when standardized. Similarly, for the 24 confidence items, the Cronbach's Alpha coefficients were 0.918 and 0.921 when standardized (See Appendix Table 10). Furthermore, the reliability statistics for the 25 motivation items yielded Cronbach's Alpha coefficients of 0.934 and 0.936 when standardized. Finally, for the 22 engagement items, Cronbach's Alpha coefficients were 0.929 and 0.931 when standardized. The corrected item-total correlation for each of the constructs was greater than 0.30. Confidence had one item with a value less than 0.30 and was taken out. Using the Factor Analysis, variables with extraction communalities greater than 0.7 were included because they indicate that the factors extracted explain a substantial portion of the variance in the original variable, their theoretical relevance to the research question and constructs of the measure of interest, and the specific context of the research and the practical implications of using the variables, as they provide valuable information to the study. The corrected inter-item correlation of above 0.3, was considered for questions to use in the analysis (Appendix Table 10).

3.5 Statistical Analysis: Process Rationale

Close-ended questions were quantitatively analysed, using descriptive and inference statistics, while open-ended responses were used to provide some insight into the quantitative data. The quantitative and qualitative data were triangulated to provide a comprehensive understanding of the research questions, with the qualitative insights enriching the interpretation of quantitative findings with quotes in the discussions section. Outcomes of the qualitative data were used to explain and contextualise the qualitative findings, offering deeper insights into the students' perceptions and experiences. The researchers decided that if at least three students independently mentioned the same problem, they would consider the response as critical. All questions in the survey were mapped to students' confidence, motivation, and engagement.

In this study, the Pearson correlation and linear regression model were used, because the initial data distribution showed characteristics consistent with the assumption of normality ($p > 0.005$). Adherence to the normality allows for the application of these parametric tests which rely on this assumption for robustness and accuracy. In addition, the interpretability of

results derived from these statistics would enhance the clarity and accessibility of the findings. The linear regression would be valuable in quantifying the strength and direction of relationships between the variables, providing valuable insights into the predictive capacity of the independent variables on the dependent variables of interest. Similarly, the Pearson correlation would be valuable in assessing the degree and direction of association between the variables.

To establish the effect of the predictor variables on the independent variables, the strength of the relationship between the variables was examined. The correlation analysis showed that whereas most of the variables indicated a positive and statistically significant correlation between the learning innovation activities and student CME, a few indicated a negative correlation as shown in Tables 1 and 2. Overall, design and group projects, assessments, and peer assessments showed statistically significant weak ($0.30 \leq r \leq 0.49$) but positive correlation with student CME, while CR activities showed statistically strong with high positive correlation with student CME ($0.70 \leq r \leq 0.90$). In addition, multiple linear regression was used to identify the predictor variables of the instrument items that impacted student CME. Below is the summary of the dependent variables and predictor variables showing the correlations between them, forming the basis of the degree of relationship and further analysis (Table 1 and 2).

The Pearson correlation coefficient was used to quantify the linear relationship between the variables. Although commonly used for interval or ratio data, it is applied to the ordinate data in this study under the condition that it is approximately normally distributed, and the sample size (100 respondents) was considered large for a program with 165 enrolled students. This statistic is considered for its efficiency and sensitivity in detecting linear relationships between variables and providing valuable insights into the strength and direction of the relationships. It is also easily interpretable, with coefficients ranging from -1 (strong negative linear relationship) to 1 (positive linear relationship). Spearman or Kendall correlation measures were not considered because although they do not rely on the assumptions of linearity, they do assume monotonicity (as one variable increases, the other either consistently increases or decreases). If the relationship between the ordinal variables is linear rather than monotonic, Spearman or Kendall correlation may not accurately capture this relationship. They only consider the ranks of the data, disregarding any information about the magnitude of differences between the ranks, which may result in loss of information, particularly if there are large differences in the magnitude of the ordinal categories. In contrast, Pearson correlation takes into account both the ranks and the magnitude of differences between data points, providing a more nuanced assessment of the relationship between the variables.

On the rationale for choosing a one-tailed test over a two-tailed test, this study focuses on examining the impact of online critical reflection on students' CME. The Hypothesis posits that online critical reflections will increase students' CME or have a positive effect on these attributes, which makes the one-tailed test appropriate. This is because the research hypothesis is directional, predicting a specific increase as a result of participating in online critical reflections. By using the one-tailed test, the analysis focuses on detecting the specific directional effect, such as an increase in CME. This targeted approach can increase statistical power by concentrating the analysis on one side of the distribution, making it easier to detect significant differences or effects if they exist. Given the importance of identifying any positive impact of online critical reflections on CME, maximising statistical power through a one-tailed test can be advantageous.

Table 1 Pearson correlation of students' active and blended learning experience

Code	Active and Blended Learning Experience (ABLE)	Confidence		Motivation		Engagement	
		Corr. Coeff.	Sig. 1-tail	Corr. Coeff.	Sig. 1-tail	Corr. Coeff.	Sig. 1-tail
SABLE	Confidence/motivation/engagement	1.000		1.000		1.000	
Q1.1	The design project is a necessary and important element in a unit such as this	0.255	0.005	0.334	0.000	0.331	0.000
Q1.2	The design project helps me understand how interactive systems work	0.386	0.000	0.494	0.000	0.471	0.000
Q1.3	The design project demands strong teamwork, communication, and project management skills	0.367	0.000	0.368	0.000	0.488	0.000
Q1.4	The amount of time I have had to spend on the design project so far is unreasonable	0.048	0.318	0.074	0.235	0.142	0.081
Q1.5	Distributing the 45% weighting for the design project between design product (30%) and design process (15%) is fair	0.313	0.001	0.377	0.000	0.358	0.000
Q1.6	A 45% overall weighting for the design project is reasonable	0.308	0.001	0.384	0.000	0.341	0.000
Q1.7	It is helpful that after week 7 the focus of the unit is almost solely on the design project	0.473	0.000	0.427	0.000	0.352	0.000
Q1.8	The design project helped me understand how rules in systems can interact to produce different forms of behaviour	0.379	0.000	0.413	0.000	0.445	0.000
Q1.9	The design project helps me understand how different rules in systems can function to generate forms of interactivity	0.421	0.000	0.465	0.000	0.508	0.000
Q1.10	Using physical games such as board games helps me understand more easily how interactive systems work	0.479	0.000	0.451	0.000	0.373	0.000
Q2.1	The group work developed my ability to work with others	0.188	0.031	0.275	0.003	0.261	0.005
Q2.2	The group work developed my ability to defend and articulate clearly a point of view	0.349	0.000	0.318	0.001	0.358	0.000
Q2.3	The group work developed my ability to defend a point of view in a respectful way	0.284	0.002	0.284	0.002	0.299	0.001
Q2.4	The group work created opportunities for me to consider different points of view	0.415	0.000	0.364	0.000	0.431	0.000
Q3.1	SPARK enabled me to understand how my contribution to group work has been assessed by the rest of my group	0.318	0.001	0.304	0.001	0.301	0.001
Q3.2	Using SPARK encouraged discussion about teamwork and project management within my group	0.336	0.000	0.345	0.000	0.342	0.000
Q3.3	SPARK helped my group to effectively manage members' workloads	0.329	0.000	0.423	0.000	0.251	0.006
Q3.4	Compared with other experiences of group work at University, the SPARK process made group work fairer	0.216	0.016	0.282	0.002	0.230	0.011
Q3.5	Happy to continue working with SPARK in the future	0.316	0.001	0.349	0.000	0.367	0.000

There is statistically significant relationship between the CR in design project activities, groupwork, online resource (SPARK) and students' confidence, motivation and engagement. However, the relationships range from low to moderate

Table 2 Pearson Correlation of Students Active and Blended Learning Experience

Code	ABLE	Confidence		Motivation		Engagement	
		Corr. Coeff.	Sig. 1-tail	Corr. Coeff.	Sig. 1-tail	Corr. Coeff.	Sig. 1-tail
SABLE	Confidence/motivation/engagement	1.000		1.000		1.000	
Q5.1	What I was required to do in the online critical reflection (CR) was so clear	0.697	0.000	0.570	0.000	0.470	0.000
Q5.2	I understand the topics better by participating in the online CR exercises	0.854	0.000	0.714	0.000	0.490	0.000
Q5.3	What the online CRs ask me to do is directly relevant to what I am learning in the unit	0.797	0.000	0.666	0.000	0.570	0.000
Q5.4	A 20% weighting for the online CRs is reasonable	0.692	0.000	0.612	0.000	0.409	0.000
Q5.5	Feels more confident with my learning experience as a result of participating in the online CRs			0.772	0.000	0.574	0.000
Q5.6	Feels motivated to learn more about the subject as a result of participating in the online CRs	0.772	0.000			0.676	0.000
Q5.7	Feels my learning experience is more engaging than it would have been if I didn't participate in the online CRs	0.574	0.000	0.676	0.000		
Q7.1	The optional online topics and the associated online lectures are a useful resource	0.230	0.011	0.238	0.009	0.213	0.017
Q7.2	Never looked at the optional topics and associated online lectures	0.244	0.008	0.114	0.130	0.046	0.325
Q7.3	Would rather access all lectures in the unit online than go to a lecture theatre	−0.040	0.348	−0.013	0.450	0.028	0.393
Q7.4	Feels disappointed that there were not more topics and lectures in the unit after week 7	0.159	0.058	0.013	0.448	0.022	0.415
Q7.5	Provided with the necessary resources relevant to successfully complete the unit	0.503	0.000	0.382	0.000	0.451	0.000
Q7.6	The LMS for this unit is set up in a clear and useful manner	0.380	0.000	0.316	0.001	0.360	0.000
Q7.7	Having the optional topics for the essay is a good idea	0.008	0.467	0.147	0.073	0.216	0.016
Q7.8	Understands why the unit covers most of the content prior to week 8	0.521	0.000	0.350	0.000	0.350	0.000
Q8.1	Feedbacks (FB) I receive on the online critical reflections (CR) is clear	0.582	0.000	0.478	0.000	0.358	0.000
Q8.2	FB I received on the online CRs helps me improve my learning in this unit	0.613	0.000	0.553	0.000	0.414	0.000
Q8.3	FB for the CRs was returned within a reasonable time	0.405	0.000	0.445	0.000	0.419	0.000
Q8.4	FB I received on the essay is clear	0.353	0.000	0.307	0.001	0.399	0.000
Q8.5	FB I received on the essay helps me improve my learning and writing	0.359	0.000	0.413	0.000	0.423	0.000
Q8.6	FB for the essay was returned within a reasonable time	0.351	0.000	0.302	0.001	0.332	0.000
Q8.7	FB received on the essay was detailed enough to help me understand my strengths and weaknesses (essay)	0.348	0.000	0.352	0.000	0.364	0.000

There is statistically significant relationship between CR exercises, assessment activities, online exercises; access to content, feedback, and students' confidence, motivation and engagement. However, relationships range from low to high

4 Results

All of the student activities within the active and blended learning experiences (ABLEs), including the design project and groupwork were designed to provide students with a deeper understanding of the subject and fed into the online critical reflection (CR) activities. In evaluating the effectiveness of the innovation regression analysis was used to measure how the various activities affected student confidence, motivation and engagement (CME). The multiple linear regression model was used to investigate the relationship between CR and CME. Table 3 shows the model summary and ANOVA results of the overall effect of the students experience on their CME. Adjusted R square was also used to show the variability within the model. Computed ANOVA of the data indicated that all of the ABLE variables considered in the study significantly influenced student CME.

Table 4 below shows the predictor variables describing the effect of ABLE activities on CME. It indicates that the one variable that influenced both student confidence and motivation was the variable associated with Q1.2. Two of the predictor variables—Q2.2 and Q8.4—influenced both student motivation and engagement, and the predictor variables for Q5.2, Q5.3 and Q5.6 influenced both student confidence and engagement. It was also observed that no single variable influenced confidence, motivation and engagement together. The predictor variables showing negative co-efficient values resulted from the fact that not all students felt satisfied with that activity, hence the variant effect which must be interpreted with care.

4.1 Confidence in the Learning Experience

While investigating the student confidences through their participation in the online CR exercise, it was observed that all the ABLE variables positively correlated with the students' feelings of confidence, except for Q7.3, which was significantly negatively correlated ($r = -0.040$, sig. 0.000) as indicated in Table 2. This suggests that students would rather attend a lecture (at least occasionally) than access all lectures online. It was noted that all the CR activities (Q5.1, Q5.2, Q5.3, Q5.4, Q5.6, Q5.7), including those related to Q7.5, Q7.8, Q8.1, and Q8.2 (online activities and feedback) strongly and significantly correlated with a sense of confidence (see Tables 1 and 2). However, correlations between questions Q1.4, Q7.3, Q7.4, and Q7.7 were not statistically significant, which indicates that they may not have contributed to the students' confidence to learn.

Table 3 ANOVA results of ABLE on confidence, motivation, and engagement in learning

Model		Sum of squares	Df	Mean square	F	Sig.	Adjusted R square
Confidence	Regression	83.089	9	9.232	58.925	.000[b]	0.842
	Residual	13.944	89	0.157			
Motivation	Regression	85.082	9	9.454	33.708	.000[b]	0.750
	Residual	24.961	89	0.280			
Engagement	Regression	68.043	8	8.505	16.269	.000[b]	0.555
	Residual	47.051	90	0.523			
Student learning experience	Regression	16453.113	5	3290.623	38.680	.000[b]	0.658
	Residual	7911.765	93	85.073			

Table 4 Summary of coefficient of multiple regression results – ABLE effect on confidence, motivation and engagement with learning

SLE	Confidence			Motivation			Engagement		
	B	t	Sig.	B	t	Sig.	B	t	Sig.
(Constant)	−0.091	−0.316	0.753	−0.570	−1.697	0.093	−0.778	−1.427	0.157
Q1.2	−0.098	−1.931	0.057	0.210	2.297	0.024	–	–	–
Q1.3	–	–	–	–	–	–	0.341	2.353	0.021
Q1.7	−0.137	−2.097	0.039	–	–	–	–	–	–
Q1.10	–	–	–	–	–	–	−0.193	−1.700	0.093
Q2.1	–	–	–	0.247	2.413	0.018	–	–	–
Q2.2	–	–	–	−0.433	−3.640	0.000	0.233	2.023	0.046
Q3.2	0.108	2.541	0.013	–	–	–	–	–	–
Q3.3	–	–	–	0.131	2.342	0.021	–	–	–
Q5.2	0.479	6.117	0.000	–	–	–	−0.280	−1.980	0.051
Q5.3	0.193	2.405	0.018	–	–	–	0.381	2.634	0.010
Q5.4	–	–	–	0.172	2.215	0.029	–	–	–
Q5.5	–	–	–	0.498	5.752	0.000	–	–	–
Q5.6	0.269	4.558	0.000				0.593	5.751	0.000
Q5.7	–	–	–	0.292	4.493	0.000	–	–	–
Q7.8	0.289	4.538	0.000	–	–	–	–	–	–
Q8.2	0.136	2.113	0.037	–	–	–	–	–	–
Q8.3	−0.210	−3.059	0.003	–	–	–	–	–	–
Q8.4	–	–	–	−0.330	−3.197	0.002	0.429	2.749	0.007
Q8.5	–	–	–	0.295	2.619	0.010	–	–	–
Q8.7	–	–	–	–	–	–	−0.350	−2.177	0.032

In using the regression model (with an R^2 of 81%) to estimate the ABLE variables that influenced students' confidence, a significant contribution ($F(40,58) = 11.39$; $p = 0.000$), with an unstandardized Beta constant value of $\beta = 0.469$ was found. However, most of the individual contributions were not statistically significant. For example, the design project and part of the groupwork activities were not statistically significant, with negative Beta values, which suggests that their overall contribution was not strong enough to have any significant effect on students' confidence to learn.

Of the 42 predictors in the model, only those related to questions Q5.2, Q5.6, and Q7.8 significantly contributed to student confidence as a result of participating in the online CR. This indicates that the online CR enhanced both their understanding of the subject matter and their motivation to learn about it; and that the students understood that the unit covered most of the content prior to week eight. By eliminating those variables which did not significantly contribute to ABLEs, it was observed that 9 of the 42 predictors significantly contributed to the students' feelings of confidence, as shown in Table 4 above. The compounding effects of the other variables on the nine (9) items were so strong that the unstandardized Beta constant value reduced to $\beta = -0.091$; therefore, the other significant variables with negative coefficients in the equation were left out. With these nine predictors, a unit increase in the significant predictor variables gave an overall positive increase in student confidence. Thus, with an increase in the effects that improve students' confidence,

Table 5 Predictors of students' confidence to learn

Code	ABLE
Q1.2	The design project helped students' understanding of how interactive systems work
Q1.7	Students found it helpful that after week 7 the focus of the unit was almost solely on the design project
Q3.2	The online resource (SPARK) encouraged discussion about teamwork and project management within their group
Q5.2	Students understood the topics better by participating in the online critical reflection exercises
Q5.3	The online CR exercises were directly relevant to what they were learning in the unit
Q5.6	Students felt motivated to learn more about the subject as a result of participating in the online CR exercises
Q7.8	Students understood why the unit covered most of the content prior to week 8
Q8.2	Feedback on the online CRs helped improve learning in the unit
Q8.3	The feedback for the CRs was returned within a reasonable time

there will be an overall positive increase in students' confidence (an increase that is equivalent to the increase in the predictor variables) (Table 4).

Hence the equation for student confidence can be written as: Y_1_SC = − 0.091–0.098_**Q1.2**–0.137_**Q1.7** + 0.108_**Q3.2** + 0.479_**Q5.2** + 0.193_**Q5.3** + 0.269_**Q5.6** + 0.289_**Q7.8** + 0.136_**Q8.2**–0.210_**Q8.3**.

As shown in Table 5, the following predictors contribute to student perceptions of their confidence.

Although collectively the variables significantly predicted student confidence, analysis revealed that the unstandardized beta values of Q1.2, Q1.7 and Q8.3 had negative effects and in-fact minimised the level of significance. The results further showed that student confidence is a significant predictor of student motivation, but not of their engagement with learning.

4.2 Motivation to Learn and ABLE

One of the propositions for this study is that students are more likely to be motivated to engage in learning when they find relevant materials and resources, receive support for participation, and have access to formative assessment and feedback, enabling reflective learning and new knowledge construction. The Pearson correlation coefficient results in Tables 1 and 2 above show that student motivation arising out of their participation in the online CR positively correlated with all the ABLE variables considered by this study, except Q7.3 which correlated negatively. The correlation coefficient further suggests that accessing all learning activities online, including lectures, rather than attending on-site, does not motivate students. Therefore, having all the activities and lectures online, without any face-to-face interaction, does not provide an enhanced learning experience. Most of the activity items weakly or moderately correlated with motivation, as shown in Tables 1 and 2. The questions relating to the online CR activities (Q5.1, Q5.2, Q5.3, Q5.4, Q5.5, Q5.7), and the effect of feedback received, were statistically significant and strongly correlated ($r > 0.5$) to student motivation. It was observed that weak correlations (Q1.4, Q7.2, Q7.3, Q7.4, Q7.7) were not statistically significant indicating that they may not have contributed to the students' motivation to learn.

The ANOVA results, with an R^2 of 70%, as shown in Table 3, indicate that the variables significantly contributed to student motivation as a result of participating in the online CR. The unstandardized Beta had a constant value $\beta = 0.127$, with only 3 out of 41 of the predictor items showing statistically significant effects (Q5.5; Q5.7 and Q8.4), and another two showing marginal significance (Q2.1 and Q2.2). Thus, the coefficient of the ABLE model revealed that most of the variables did not significantly contribute to student motivation. Again, a strong compounding effect of some of the predictor variables was observed, and by eliminating the variables that did not significantly contribute, the revised count of predictors that made statistically significant contributions to student motivation was 9 out of 42. The compounding effects of the non-significant contributing predictors resulted in an unstandardized Beta value of $\beta = -0.570$.

Hence, the equation that describes student motivation can be written as: $Y_1\_SM = -0.570 + 0.210\_\mathbf{Q1.2} + 0.247\_\mathbf{Q2.1} - 0.433\_\mathbf{Q2.2} + 0.131\_\mathbf{Q3.3} + 0.172\_\mathbf{Q5.4} + 0.498\_\mathbf{Q5.5} + 0.292\_\mathbf{Q5.7} - 0.330\_\mathbf{Q8.4} + 0.295\_\mathbf{Q8.5}$. It can therefore be conclude that the following predictors contribute to student motivation in ABLEs (see Table 6).

Although the predictor variables overall indicate a significant contribution to student motivation, the questions: *Group work developed students' ability to defend and articulate clearly their point of view* (Q2.2); and *the feedback on the essay was clear* (Q8.4), had negative Beta values, which suggests that these predictors diminished student motivation. Finally, the data showed that student motivation was a statistically significant predictor of student confidence and their engagement with learning.

4.3 Engagement with the Learning Experience

The use of Pearson's correlation revealed that student engagement positively correlated with all of the ABLE variables shown in Tables 1 and 2. However, most of the correlation coefficients showed only weak or moderate ($r < 0.5$) correlation between the predictor items and student engagement. It was observed that four of the variables (Q1.9; Q5.3, Q5.5 and Q5.6) strongly correlated ($r > 050$) with activities in ABLEs, whereas the ABLE predictors Q7.2, Q7.3 and Q7.4 were very weakly correlated ($r < 0.05$) and were not statistically significant. Thus, the following statements in the survey: *optional topics and associated online lectures* (Q7.2), *access to all lectures in the unit online rather than lecture theatre* (Q7.3), and *student disappointment that there were not more topics and lectures in the unit after week 7* (Q7.4), were not significantly correlated to student engagement.

Table 6 Predictors of student motivation to learn

Code	ABLE
Q1.2	The design of a project helps students to understand how interactive systems work
Q2.1	Group work develops students' ability to work with others
Q2.2	The group work develops students' ability to defend and clearly articulate a point of view
Q3.3	Using the online resource (SPARK) helps the group to effectively manage members' workloads
Q5.4	The weighting (20%) for the online critical reflections is reasonable
Q5.5	Students feel confident with their learning experience as they participate in the online CR
Q5.7	Students feel their learning experience is more engaging by participating in the online CR
Q8.4	The feedback they receive on the essay is clear
Q8.5	The feedback they receive on the essay helps them improve their learning and writing

The ANOVA results of the multiple linear regression model summary, with an R2 of 48%, indicated that the variables together significantly contributed to student engagement (F (40, 58) = 3.281; p = 000) as previously shown in Table 3. However, the coefficient indicated that most of the ABLE variables did not significantly contribute to students' perceptions about their learning experience as being more engaging than it would have been if they had not participated in the online CR. Although most of the ABLE variables showed negative contributions to student engagement, on the positive side, it was observed that the following statements: *Online CR was relevant to their learning* (Q5.3); and *I felt motivated to learn more about the subject by participating in the online CR* (Q5.6) were statistically significant contributors to student engagement. However, overall, the unstandardized coefficient of Beta was $\beta = -1.340$. Although the Beta values of significant variables were positive (0.494 and 0.432), a unit increase in the predictor variables would result in a marginal decrease in student engagement. This means that if all the predictor variables were increased, students would be less engaged with their learning. Hence, it is important to specifically identify the contribution of individual variables to students' engagement.

By eliminating the variables that were not significantly contributing to students' perceptions of engagement, including those that were compounding the significance of other variables, 8 ABLE variables were identified that contributed significantly to students' perceptions of an engaging learning experience. These variables are identified as: Q1.3, Q1.10, Q2.2, Q5.2, Q5.3, Q6.5, Q8.4, and Q8.7. It was also noted that although the unstandardized coefficient of Beta had a value of $\beta = -0.778$, a unit increase in the ABLE significant variables would result in a positive increase (0.376) in student engagement. Thus, the nature of CR and how it relates to activities needs to be carefully considered when determining student engagement with their learning.

The engagement equation can therefore be written as: $Y_1\_SE = -0.778 + 0.341\_\mathbf{Q1.3} - 0.193\_\mathbf{Q1.10} + 0.233\_\mathbf{Q2.2} - 0.280\_\mathbf{Q5.2} + 0.382\_\mathbf{Q5.3} + 0.593\_\mathbf{Q5.6} + 0.429\_\mathbf{Q8.4} - 0.350\_\mathbf{Q8.5}$. It can therefore be concluded (as listed in Table 7) that the following predictors contribute to students' perceptions of an engaging learning experience in ABLEs.

The study further revealed that the statements: *The design project demanded strong teamwork, communication, and project management skills?* (Q1.10); *They understood the topics better by participating in the online CR exercises* (Q5.2); and *The feedback received on the essay was clear* (Q8.5), had negative Beta values. Although statistically significant,

Table 7 Predictors of student engagement with learning

Code	ABLE
Q1.3	The design project demanded strong teamwork, communication, and project management skills
Q1.10	Using physical games such as board games helped them understand more easily how interactive systems work
Q2.2	The group work developed their ability to defend and clearly articulate a point of view
Q5.2	They understood topics better by participating in online critical reflection exercises
Q5.3	What the online critical reflections asked them to do was directly relevant to what they learned in the unit
Q5.6	They felt motivated to learn more about the subject as they participate in the online critical reflections
Q8.4	The feedback they received on the essay was clear
Q8.7	The feedback they received on the essay was detailed enough to help them understand the strengths and weaknesses of their essay

this indicates that individual student contributions diminish their engagement. Hence, if there is an overemphasis on the use of activities without checking if students are satisfied with them, it may diminish the expected positive effect. Overall, positive contributions were influenced by the other predictor variables in the equation above. In addition, engagement with learning has been shown to be a significant predictor of motivation to learn but not of confidence to learn.

5 Discussion

The purpose of this study was to evaluate the effects of Critical Reflections (CR) on student confidence, motivation, and engagement (CME) in an active and blended learning experience (ABLE). Findings suggest that in ABLEs, CR is an effective pedagogical approach that enhances student CME. The activities encouraged groupwork, and project work, and utilized a game-based approach. Together with periodic sessions with the UC this allowed students to discuss any concerns with the feedback and encouraged them to own their learning experience. It was clear that when students were able to reflect on the feedback provided to them, they were able to identify gaps in their learning, which in turn helped them clarify their knowledge and understanding and improve their work. This is supported by Cavilla (2017) who posits that CR helps students develop metacognitive skills, obtain a deeper understanding of concepts and topics, and can stimulate their ability to recall and apply difficult constructs to solving problems.

Using reflective journals, the students were able to keep records of their experience and noted any issues they found interesting, those that were difficult to resolve and how they were resolved, and the application of different theories to learning activities. As a result, the study presumption that student participation in online CR within ABLEs would impact their CME, was confirmed. Commenting on how reflection on the activities supported their learning process a student remarked:

> *"I prefer CR to tutorials since I better work in an environment where I can plan and manage my responses. I feel they do help me understand the unit content better and usually, the reflections I do well in are the topics that I'd cover for my essay since they help assure, I understand the topics" (Student S1).*

It can be argued from such comments that the effectiveness of the innovation can be validated by using reflective activities to plan and manage student responses. The analysis indicates that as a result of online participation in CR, several ABLE activity factors influence student CME and the overall learning experience. These include:

1. Improved understanding of the topic;
2. Relevance of the online CR exercises to learning in the unit; and
3. The feeling of motivation to learn more about the subject.

These students' experiences confirm the suggestion that, when learning activities allow students to take responsibility for their learning, they feel motivated and engaged with their learning (Barkley & Major, 2020; Capone & Lepore, 2021). This shows that relevant CR activities can improve student knowledge and understanding, and their motivation. Although the results show weak to moderate positive correlations (as shown in Tables 1 and 2), confidence and motivation were influenced by the design project activities

that help students understand how interactive systems work together. Motivation to learn and engagement were influenced by groupwork experiences that developed their ability to defend and articulate their own point of view, and the clarity of feedback that helped them improve on their work.

It is evident from these findings that groupwork activities that allow students to be innovative and creative in their approach to solving problems, and that are guided by CR and feedback from the UC can enhance not just knowledge and understanding of the subject and its application to real-life situations but also the confidence to engage with learning.

What was found helpful was that allowing students to journal their contributions, reflect and share these within their groups, helped them to clearly defend their argument supporting their contribution. These factors support the relevance of allowing the use of CR for, recording and sharing ideas; raising concerns and asking questions; and also making constructive contributions (Cavilla, 2017).

5.1 Online CR Impact Variables on Students' CME

The nine (9) identified predictor variables that influence confidence and motivation, and 8 identified predictor variables that influence engagement are detailed below. This study argues that, these statistically significant predictors are relevant to the design of CR activities in the ABLEs study and that their contribution to student confidence, motivation, and engagement must be intentionally considered. Levels of engagement are affected by the way such activities are structured and presented to the students and observations from the findings also show that in the design of ABLEs, the removal of learning activities that are ineffective encourages greater student engagement. Thus, while some activities provided a statistically significant contribution to CME and the overall student learning experience, they negatively influenced the extent of this impact, particularly with students who don't enjoy the learning process. This is supported by a student who claimed, "*I just personally think a lot of students struggle with the content of this unit and only have to do it because it's compulsory*" (Student-S26). It can be argued from the work of Cavilla (2017) that, when reflections are integrated into learning activities but not embraced by the students, there may not be external to internal motivation.

5.1.1 Students' Confidence

The findings revealed that three of the nine predictor variables had diminishing effects on student confidence (Table 4). Such diminishing effects could firstly be attributed to those students who understood the structure of the design project activities and how it was meant to help their understanding of how interactive systems work. Three of the students in the study felt disappointed because they were not interested in games and did not understand why a third-year course would have games embedded in it. In contrast, another three students felt they had put in much more time than expected and suffered from the lack of willingness of some project group members to make contributions. Secondly, the diminishing effects could be explained by the views of some students who did not think it helpful to have a whole unit (week 7) focused solely on design project activities and feedback; and thirdly, there was a complaint that although the feedback was timely, it was at-times unclear on how it could be used to improve their learning. As one student claimed: "*Their… feedbacks were only like two sentences that actually responded to my essay directly.*" Such experiences may result in low self-efficacy,

thereby affecting their motivation to engage (Bandura, 1997), particularly if the students do not find the learning activities important (Bong & Skaalvik, 2003).

It can therefore be argued that, although students may have expressed overall satisfaction with activities and their subsequent learning experience, some activities could negatively influence their confidence. Also, the timeliness and value of feedback are critical to student improvement of their learning and subsequently their confidence. Such experiences could result in anxiety (Bandura, 1997; Sheldrake, 2016). Students were also of the view that the emphasis placed on online lectures and assessments, without any interaction with the UC and peers may also result in a diminishing effect on their confidence, as shown by the weak and negative correlation result of Q7.3 in Table 2.

They considered working in teams on their project as valuable with the inherent meetings and interactions with peers and the UC as part of this. This can be compared to findings from simulation learning described by Ampountolas et al. (2019) where improvement in student confidence and decision-making skills were associated with teamwork activities involving simulations. Hence, the structure of activities in the student learning experience plays a significant role in developing their confidence to learn. The significant effect of the design project activities on student confidence was also consistent with the findings of McKenna et al. (2005) and Cabrera et al. (2001), who all found a positive relationship between group project activities and student confidence. It is therefore recommended that project activities incorporating student reflection should be intentionally thought of in the implementation of ABLEs. These project activities and critical reflections should be structured and scaffolded in a way that, from the beginning to the end of the semester, students can produce tangible evidence of accomplishments.

These findings show that having specific times for project activities and CR is helpful because it allows students to practice and review what they are learning. Online resources that are considered useful and are perceived to contribute to student confidence, encourage teamwork and the use of project management procedures and discussion in the groups. The relationship established between the activities in the ABLEs which led to a better understanding of the topics and confidence in the material was linked to the flexibility in the engagement approaches within project groups, peer interaction, and the UC's feedback, the aim of which was to motivate students to engage with their learning, anytime, anywhere. Hence, it can be argued that CR embedded in ABLE should have elements that intentionally target the development of student confidence to solve problems, as these are more likely to lead to an enhanced understanding of the topic (see Tables 3 and 4). This alignment of learning outcomes with activities and assessments in the unit complies with the constructivist principle asserted by Biggs and Tang (2011). Furthermore, the significant relationship that was established between CR, motivation, and confidence is also supported by other findings (Dunn & Kennedy, 2019; Lin et al., 2018; Zainuddin, 2018).

By covering most of the course content prior to week 8 students were able to put together and appreciate the essence of the work they were doing and how it could be applied in a real-world context, and this was enhanced when feedback was clear, concise and informative. The response from students confirms that the reflection and group work were indeed critical in enhancing their knowledge and understanding of what they have learned and reinforced the notion that providing formative feedback helps improve students learning (Balta & Tzafilkou, 2019; Fluckiger et al., 2010; Peters et al., 2018). However, timely CR feedback significantly boosted their confidence, supporting the argument that motivation to persist and engage with learning is critical to the students learning process, as also argued by Barkley and Major (2020).

5.1.2 Students' Motivation

The results in Table 4 reveal that two of the nine predictor variables for motivation had diminishing effects on their learning. Firstly, the diminishing effects of Q2.2 can be attributed to frustration or the unwillingness of some students to make contributions to the group project, and the challenge of fake reporting and scoring as group members tended to avoid arguments within the groups. This coupled with the fact that some students considered the feedback they had received negatively rather than constructively, affected their ability to clearly articulate their point of view. Secondly, the diminishing effect of Q8.4 can be attributed to the views of some students that the feedback they received was unclear and did not help them improve their learning. These experiences of negative effects of poor feedback on both motivation and confidence are supported by Awidi and Paynter (2019a, 2019b) and Fong et al., (2019).

Although the online lectures did not offer students any opportunity to physically interact and engage in peer discussions, the results especially in Table 4 show that motivation, like confidence, may be driven partly by active interactions with peers. Hence, while they are satisfied with the online lectures and CR activities, there is a need to encourage students to interact with peers offline. This is important due to the motivational gains associated with working in groups (Larson et al., 2018). Similarly, as with confidence, student motivation was enhanced by their active engagement with the learning process which helped them to better understand the subject.

This study did not focus on the effect of different grouping levels on motivation to learn, however, it did establish that working in groups helps improve student achievement (Saleh et al., 2007). Furthermore, contributions made to the group project helped students develop skills for articulating their point of view, even though the challenges of groupwork can be frustrating, particularly when peers are perceived not to be contributing to the group project activities. Other studies have attributed this to common problems like poor communication, personal issues, unequal contribution, lack of focus, and missing deadlines (Barkley et al., 2014; Thompson & McGregor, 2005), all of which were observed in this present study.

The significant effect of online resources on student motivation (Q3.3), is supported by the hypothesis that student motivation is more likely to be enhanced if they value the online resources. It was also significant to note that, motivation was enhanced by the 20% weighting for online CR activities, which students considered fair and reasonable. These findings agree with Stan's (2012) assertion that a significant relationship exists between grades and student motivation.

This study therefore argues that CR in ABLEs significantly improves student confidence during online assessments and is more likely to motivate them to learn (see Table 4). Thus, when students feel confident that their engagement is improving their learning experience, and actively participate in online CR activities, they are more likely to be motivated to learn more about the subject (Wu et al., 2013). Thus, the findings here demonstrate that using effective engagement strategies to build student confidence through CR motivates them to learn more: the process of reflection helps them to make sense of what they are learning. They are then in turn motivated to learn more when CR activities help them relate what they are learning to their chosen career development. Finally, when the feedback students receive is clear and relevant to their learning, they feel more motivated (Scott, 2017; Shute, 2008).

5.1.3 Students' Engagement with Learning

The diminishing effect of three out of eight predictor variables for CR activities in ABLEs that impact student engagement demonstrates that learning activities can either positively or negatively affect the student learning experience. Firstly, the diminishing effect noted in Q1.10 has been attributed to three student responses indicating that they were not interested in the 'Introduction to Games' and felt frustrated because a) they had to compulsorily take the unit, and b) due to the lack of cooperation of other team members. Secondly, the diminishing effect observed in Q5.2 can be attributed to students feeling that the CR activities were a low priority coupled with the expected word count, a student remarking, "*sometimes the readings for the unit were somewhat lengthy*" (Student, S21). Thirdly, the negative effect observed in Q8.7 can be explained by the lack of clarity in the feedback they received. While it is acknowledged that not all students will be interested in the activities in a course, it is worth noting that a lack of interest, other priorities, teamwork dynamics, structure of activities and feedback issues can affect student engagement. When students become less motivated, they will more likely not engage effectively with their learning (Dunn & Kennedy, 2019).

The strong relationship between student engagement and groupwork, communication and project management skills, confirms the proposition that when students solve problems as part of a team, engagement with their learning will be enhanced (Delialioğlu, 2012). Within the context of this study, it was observed that the design project and group work made students engage more with their learning and that the online assessment and feedback on their CR was a motivator for engagement. Through their engagement students were able to learn that working on a design project in groups demands teamwork, communication, and project management skills.

These findings reinforced the benefits of game-based approaches in learning, as demonstrated by Fonteijn and Dolmans (2019) and Gil-Doménech and Berbegal-Mirabent (2019). It is therefore argued that using a game-based approach to student learning reinforces their understanding of the subject matter. By actively engaging in the gaming activities, students were able to develop abilities that helped them defend and articulate clearly what they were doing and why they were doing it. Although not all engagement resulted in students developing assertive skills, by sharing tasks, students were able to explain their contribution to their group, providing a deeper understanding of what they had learned.

Reflecting on their learning in an online context, enhanced student understanding, and enabled them to engage more with their learning. Thus, this study argues that within ABLEs, online activities must reinforce what the students are learning for them to engage fully. On the relevance of the online CR activities to what they were learning, a student remarked "*The critical reflection was a good way to measure our engagement with the reading materials and lectures. They were interesting questions that encouraged me to think about the reading/lecture materials in more depth.*" Therefore, the results confirm that when reflection motivates them to learn, student engagement is enhanced. Finally, as shown in Table 7 engagement is further enhanced by formative feedback, and when this clearly indicated their strengths and weaknesses it helped students to engage more with the learning.

6 Limitations

The study's limitations include the possibility of additional variables influencing the outcomes beyond those observed. Further research, especially with access to longitudinal data and more variables, would strengthen arguments. However, despite these limitations, evidence suggests that the introduction of CR in ABLEs significantly impacted student CME. Future studies could explore different group formations' effects on student CME or investigate how non-significant contributing items compound to influence overall student CME.

7 Conclusion

The findings of this study highlight the effectiveness of online Critical Reflection (CR) as a pedagogical approach within the context of Active and Blended Learning Experiences (ABLEs), particularly in enhancing student Confidence, Motivation, and Engagement (CME) to learn. Through various activities such as group work, project work, and game-based approaches, students were provided with opportunities to reflect on their learning experiences, identify gaps in their understanding, and clarify their knowledge.

The incorporation of reflective journals allowed students to document their experiences, note challenges, and articulate the application of theoretical concepts to learning activities. These reflective practices not only validated the hypothesis that student participation in online CR positively impacts CME but also highlighted the importance of intentional design and scaffolding of CR activities within ABLEs. Furthermore, the analysis revealed several factors influencing student CME and overall learning experience, including improved understanding of topics, relevance of CR exercises, and motivation to learn more. It became evident that effective engagement strategies, such as group work and clear feedback, significantly influenced student confidence, motivation, and engagement with learning materials. Despite some challenges observed, such as negative feedback experiences and issues with group dynamics, the study emphasizes the critical role of timely and constructive feedback, as well as active peer interactions, in encouraging student confidence and motivation. Additionally, the integration of game-based approaches and structured reflection activities contributed to enhancing student engagement and understanding of the subject matter.

This study overall, advocates for the intentional incorporation of CR activities in ABLEs to promote student confidence, motivation, and engagement with learning. By aligning learning outcomes with activities and assessments, educators can encourage a constructivist learning environment that empowers students to take ownership of their learning and apply acquired knowledge in real-life contexts.

Appendix

Instrument Validation Data Using Factor Analysis and Cronbach Alpha

See Tables 8, 9 and 10.

Table 8 Factor analysis—communalities

Item	Item statement	Initial	Extraction
Q1_1	I agree that the design project is a necessary and important element in a unit such as this	0.750	0.609
Q1_2	The design project helps me understand how interactive systems work	0.852	0.807
Q1_3	The design project demands strong teamwork, communication, and project management skills	0.680	0.544
Q1_4	The amount of time I have had to spend on the design project so far is unreasonable	0.511	0.596
Q1_5	Distributing the 45% weighting for the design project between the design product (30%) and the design process (15%) is fair	0.783	0.861
Q1_6	A 45% overall weighting for the design project is reasonable	0.695	0.509
Q1_7	It is helpful that after week 7 the focus of the unit is almost solely on the design project	0.704	0.634
Q1_8	The design project helps me understand how rules in systems can interact to produce different forms of behaviour	0.930	0.896
Q1_9	The design project helps me understand how different rules in systems can function to generate forms of interactivity	0.939	0.919
Q1_10	Using physical games such as board games helps me understand more easily how interactive systems work	0.780	0.595
Q2_1	The group work developed my ability to work with others	0.784	0.667

Table 8 (continued)

Item	Item statement	Initial	Extraction
Q2_2	The group work developed my ability to defend and articulate clearly a point of view	0.892	0.883
Q2_3	The group work developed my ability to defend a point of view respectfully	0.905	0.901
Q2_4	The group work created opportunities for me to consider different points of view	0.816	0.773
Q3_1	SPARK has enabled me to understand how my contribution to group work has been assessed by the rest of my group	0.777	0.730
Q3_2	Using SPARK has encouraged discussion about teamwork and project management within my group	0.729	0.624
Q3_3	SPARK has helped my group to manage member's workloads effectively	0.758	0.704
Q3_4	Compared with other group work experiences at the University, the SPARK process has made group work fairer	0.763	0.749
Q3_5	I am happy to continue working with SPARK in the future	0.761	0.739
Q5_1	It is clear what I was required to do in the online critical reflections so far	0.737	0.647
Q5_2	I understand the topics better by participating in the online critical reflection exercises	0.909	0.909
Q5_3	What the online critical reflections ask me to do is directly relevant to what I am learning in the unit	0.831	0.763

Table 8 (continued)

Item	Item statement	Initial	Extraction
Q5_4	A 20% weighting for the online critical reflections is reasonable	0.730	0.661
Q5_5	I feel more confident with my learning experience as a result of participating in the online critical reflections	0.873	0.853
Q5_6	I feel motivated to learn more about the subject as a result of participating in the online critical reflections	0.776	0.668
Q5_7	I feel my learning experience is more engaging than it would have been if I didn't participate in the online critical reflections	0.684	0.518
Q7_1	The optional online topics and the associated online lectures are a useful resource	0.608	0.635
Q7_2	I never looked at the optional topics and associated online lectures	0.615	0.652
Q7_3	I would rather access all lectures in the unit online than go to a lecture theatre	0.463	0.246
Q7_4	I am disappointed that there are no more topics and lectures in the unit after week 7	0.668	0.729
Q7_5	I am provided with the necessary resources relevant to complete the unit successfully	0.687	0.509
Q7_6	The LMS for this unit is set up in a clear and useful manner	0.692	0.501
Q7_7	Having the optional topics for the essay is a good idea	0.589	0.527

Table 8 (continued)

Item	Item statement	Initial	Extraction
Q7_8	I understand why the unit covers most of the content prior to week 8	0.714	0.569
Q8_1	The feedback I receive on the online critical reflections is clear	0.879	0.881
Q8_2	The feedback I receive on the online critical reflections helps me improve my learning in this unit	0.891	0.917
Q8_3	The feedback for the critical reflections is returned within a reasonable time	0.676	0.549
Q8_4	The feedback I received on the essay is clear	0.872	0.816
Q8_5	The feedback I received on the essay helped me improve my learning and writing	0.878	0.898
Q8_6	The feedback for the essay was returned within a reasonable time	0.685	0.523
Q8_7	The feedback I received on the essay was detailed enough to help me understand the strengths and weaknesses of my essay	0.907	0.898

Extraction method: unweighted least squares

Table 9 Factor matrix*

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
Q1_1	0.621	0.286	0.197	0.104	0.259	0.040	0.022	0.053	0.121	0.079
Q1_2	0.745	0.333	0.224	0.002	0.211	0.095	0.172	0.023	0.050	0.062
Q1_3	0.626	0.136	0.258	0.142	0.121	0.004	0.041	0.111	0.047	0.127
Q1_4	0.130	0.135	0.181	0.075	0.150	0.437	0.037	0.055	0.112	0.541
Q1_5	0.589	0.141	0.116	0.343	0.341	0.113	0.072	0.152	0.323	0.319
Q1_6	0.508	0.006	0.090	0.155	0.200	0.084	0.130	0.013	0.391	0.038
Q1_7	0.521	0.383	0.167	0.192	0.039	0.093	0.040	0.372	0.003	0.021
Q1_8	0.715	0.299	0.270	0.001	0.339	0.187	0.187	0.012	0.100	0.163
Q1_9	0.750	0.274	0.188	0.061	0.335	0.219	0.151	0.122	0.169	0.128
Q1_10	0.697	0.240	0.036	0.013	0.143	0.027	0.126	0.061	0.095	0.013
Q2_1	0.569	0.356	0.084	0.384	0.095	0.087	0.153	0.055	0.139	0.000
Q2_2	0.696	0.283	0.023	0.475	0.023	0.058	0.082	0.134	0.252	0.002
Q2_3	0.640	0.365	0.057	0.484	0.123	0.034	0.064	0.188	0.253	0.032
Q2_4	0.681	0.207	0.038	0.445	0.013	0.064	0.088	0.141	0.185	0.024
Q3_1	0.575	0.484	0.210	0.217	0.110	0.044	0.086	0.156	0.159	0.046
Q3_2	0.477	0.447	0.321	0.227	0.079	0.056	0.117	0.081	0.105	0.048
Q3_3	0.462	0.389	0.441	0.186	0.229	0.125	0.133	0.005	0.141	0.067
Q3_4	0.424	0.529	0.421	0.149	0.107	0.145	0.121	0.204	0.004	0.008
Q3_5	0.462	0.427	0.425	0.256	0.080	0.087	0.049	0.267	0.046	0.090
Q5_1	0.593	0.441	0.135	0.066	0.212	0.016	0.133	0.028	0.108	0.057
Q5_2	0.701	0.441	0.258	0.058	0.173	0.093	0.311	0.042	0.095	0.083
Q5_3	0.706	0.417	0.140	0.012	0.087	0.003	0.233	0.013	0.074	0.054
Q5_4	0.574	0.480	0.198	0.083	0.151	0.036	0.159	0.036	0.029	0.057
Q5_5	0.725	0.269	0.301	0.224	0.142	0.107	0.270	0.072	0.011	0.058
Q5_6	0.666	0.265	0.161	0.046	0.198	0.123	0.238	0.074	0.102	0.003

Table 9 (continued)

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
Q5_7	0.651	0.033	0.041	0.191	0.088	0.017	0.128	0.044	0.120	0.122
Q7_1	0.390	0.028	0.259	0.158	0.460	0.329	0.027	0.102	0.001	0.242
Q7_2	0.108	0.167	0.294	0.136	0.528	0.439	0.106	0.108	0.010	0.116
Q7_3	0.012	0.129	0.206	0.205	0.042	0.086	0.300	0.157	0.071	0.126
Q7_4	0.131	0.502	0.076	0.308	0.141	0.210	0.181	0.493	0.127	0.058
Q7_5	0.585	0.305	0.093	0.148	0.007	0.090	0.101	0.063	0.142	0.034
Q7_6	0.570	0.128	0.124	0.203	0.100	0.106	0.240	0.009	0.109	0.110
Q7_7	0.246	0.036	0.268	0.167	0.424	0.363	0.105	0.118	0.004	0.174
Q7_8	0.506	0.454	0.022	0.186	0.112	0.042	0.204	0.066	0.054	0.094
Q8_1	0.593	0.299	0.248	0.297	0.209	0.203	0.332	0.286	0.095	0.068
Q8_2	0.644	0.239	0.237	0.375	0.143	0.152	0.294	0.344	0.015	0.002
Q8_3	0.555	0.035	0.179	0.304	0.084	0.239	0.174	0.143	0.002	0.007
Q8_4	0.522	0.190	0.526	0.260	0.131	0.322	0.141	0.117	0.093	0.020
Q8_5	0.575	0.044	0.446	0.503	0.109	0.269	0.073	0.119	0.087	0.037
Q8_6	0.575	0.015	0.356	0.214	0.087	0.037	0.002	0.006	0.072	0.076
Q8_7	0.538	0.205	0.573	0.269	0.123	0.331	0.153	0.042	0.124	0.005

Extraction method: unweighted least squares. *10 factors extracted. 12 iterations required

Table 10 Reliability Statistics: Item-Total Statistics

Items = 41	Cronbach's alpha = 0.933		Cronbach's alpha based on standardized items = 0.938	
Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
Q1_1	148.86	396.195	0.594	0.931
Q1_2	148.72	395.075	0.706	0.930
Q1_3	148.19	408.548	0.576	0.931
Q1_4	149.79	426.434	0.582	0.937
Q1_5	148.91	403.675	0.551	0.931
Q1_6	148.92	402.127	0.491	0.932
Q1_7	148.26	408.250	0.463	0.932
Q1_8	148.65	397.918	0.664	0.930
Q1_9	148.61	396.978	0.699	0.930
Q1_10	148.84	396.150	0.681	0.930
Q2_1	148.80	403.727	0.544	0.931
Q2_2	148.78	401.369	0.656	0.930
Q2_3	148.77	403.503	0.604	0.931
Q2_4	148.61	402.722	0.633	0.931
Q3_1	148.69	399.861	0.584	0.931
Q3_2	149.12	400.995	0.483	0.932
Q3_3	149.25	400.496	0.492	0.932
Q3_4	149.11	402.019	0.456	0.932
Q3_5	148.74	403.865	0.484	0.932
Q5_1	148.59	403.440	0.551	0.931
Q5_2	148.72	396.295	0.653	0.930
Q5_3	148.64	398.312	0.657	0.930
Q5_4	148.71	401.837	0.535	0.931
Q5_5	148.95	394.539	0.695	0.930
Q5_6	149.18	394.694	0.651	0.930

Table 10 (continued)

Items = 41	Cronbach's alpha = 0.933		Cronbach's alpha based on standardized items = 0.938	
Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
Q5_7	149.00	394.763	0.633	0.930
Q7_1	148.95	411.433	0.357	0.933
Q7_2	149.99	417.567	0.100	0.936
Q7_3	149.35	422.064	0.012	0.937
Q7_4	150.47	427.771	0.611	0.937
Q7_5	148.80	405.958	0.554	0.931
Q7_6	148.66	406.254	0.544	0.931
Q7_7	148.70	416.290	0.214	0.934
Q7_8	148.58	408.837	0.458	0.932
Q8_1	149.42	400.540	0.558	0.931
Q8_2	149.50	399.095	0.618	0.930
Q8_3	149.08	404.195	0.548	0.931
Q8_4	148.87	403.899	0.480	0.932
Q8_5	148.97	401.915	0.543	0.931
Q8_6	148.71	407.762	0.530	0.931
Q8_7	148.88	403.940	0.489	0.932

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10758-024-09751-4.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions. I hereby declare that this project/study/research has received no specific funding from any public, commercial, or not-for-profit funding agencies.

Data Availability The dataset contains student information that the ethics committee did not approve for sharing. All data is stored in the university repository.

Declarations

Conflict of interest The authors have not disclosed any competing interests.

Competing Interests All authors declare that they have no competing interests in relation to the work described in this manuscript.

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