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3How do constructivism learning environments generate better motivation and learning strategies? The Design Science Approach

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ABSTRACT

Higher education strongly focuses on shifting from a more traditional teaching approach - "instructivist" to a more student-centered approach – known as "constructivist" to encourage learning imperative key skills in a future turbulent environment. This study examines the application of new learning environment creation, integrated from applying the Design Science approach and Constructivism learning environment, on two critical elements of student evaluation, namely, students' learning motivation and their learning strategy in higher institutions. Quantitative research was adopted for the study. To do so, a new teaching and learning approach was developed and implemented specifically for one cohort. Instead of regularly joining a regular classroom, students can actively attend workshops to gain the skills, knowledge, and action they need to complete the course successfully. Following three months of implementation, 193 questionnaires were collected from all students who took a Project Management course. The data show that a constructivist learning environment encourages intrinsic and extrinsic motivation. Additionally, the student's learning strategy significantly improved in the new learning environment. These findings demonstrate that further attention should be given to constructivist orientation and implementation in the higher education curriculum.

1. Introduction

Design science (DS) has been widely used in information system research [1], engineering, computer science, management science and education. In these studies, DS is used to identify problems and design solutions by creating artifacts. DS has been suggested as a suitable methodology for the design and management of many different fields to produce an effective bridge between theory and practice. In the field of education, the lack of enough connection between theory and practice teaching methods, especially in higher education institutions (HEIs) remains controversial. Therefore, when considering education as one of the research fields that applies DS, this study seeks to blur the boundary between theory and practice in teaching activities, especially in Vietnamese education, where the focus is often on teaching theory-based skills rather than the more practical. It is based on the study of [2]; which suggests that universities should prepare students for the foundation they will need to solve and manage the problems they will face when they undertake work in real life.

Many studies on education often rely on behavioral science to explore and explain phenomena, thereby discovering solutions to those problems. However, DS in education identifies problems, designs artifacts to solve those problems, and finally develops the

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framework to be applied to another course [3]. In particular, DS artifacts can help move learners from passive to active learning, thereby acquiring knowledge more deeply. To apply DS in education, the learning environment is one of the most vital factors. The learning environment has been the subject of extensive research for almost a century, particularly regarding constructivist learning environments from theory through assessment [4,5]. Many nations, such as Vietnam and other Asian countries, use the instruction-based method of learning, which focuses on the lecturer and has the student passively listen to and study before they are required to take a final exam [6]. Alternatively, constructivism theory emphasizes the learner's experience of the natural world, prior knowledge, and beliefs [7]. In other words, students gain knowledge by integrating new information [4] with what they already know [8]. Additionally, practitioners blamed universities for graduates' inability to apply their knowledge and address complex challenges in a real context. They believed that the new learning environment is founded on constructivist theory and claims to create an educational environment to achieve the lifelong learning goal. This method would foster students' exploration of the primary issue and define instruction as a task to promote learning in the future [9]. The learning environment is a crucial factor to consider when developing any course, particularly a project-based course.

According to Social Constructivism theory, students are centered, not instructors. When students actively construct their own understanding through social engagement with their peers, learning outcomes can be effective. They are encouraged to come up with their answers and test new theories. The instructor's responsibility is to facilitate students' learning process on a specific topic. Students should be able to practice their skills in knowledge development through the design and structuring of learning activities done by instructors. There is still a lack of research on learning environments in the business and management field; however, constructivist learning environments research is indeed a hot topic in education [6], similar to mathematics and science [10], or design thinking [11]. The experience of designing and delivering project management courses is discussed in detail in this study by focusing on helping students manage a real project step by step by replicating real-world project management issues.

2. Literature review

2.1. Design science in higher education

Design Science (DS) is a well-known research approach that can be widely applied in academic research to identify problems, design models to tackle the problems and develop greater knowledge by applying problem-solving processes [12]. In educational training and research, the DS approach has been broadly employed to make students more familiar with exploratory research as a technique to determine real-world problems and the strategies to overcome [13]. Specifically, business students are today facing daunting challenges to deal with ever-changing business environments with mounting issues regarding production, supply chain, marketing, and human resources management. As such, educators must also cope with constant pressure to design and create suitable training courses to fit the market demand.

Some previous studies have suggested that DS is an approach to link theory and practice for postgraduate courses [14–16]. Other

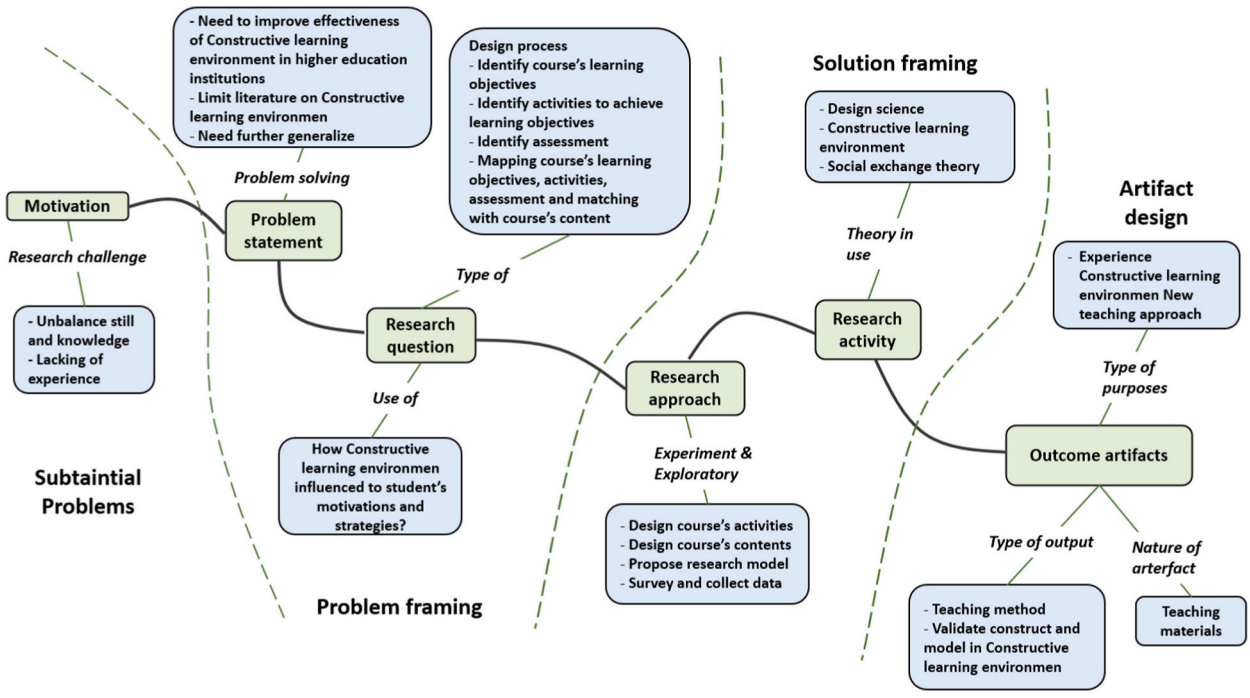

Fig. 1. Analytical framework for course design (Source: Research Team, 2022).

studies have emphasized the application of DS more for undergraduate courses [17,18], while others found that DS is applicable for both undergraduate and postgraduate education [19,20]; and [21]. Most previous studies have considered DS a research tool and taught students to employ it for both scientific research and graduate theses. However, limited studies have applied DS as a pedagogical tool for course design and implementation. There is also a lack of empirical evidence on the knowledge being generated from the new course design. Therefore, for the current study, we adopted the DS approach to re-design the Global Business Project course to engage students better and create stronger motivation for their lifelong learning. We also conducted a follow-up empirical study to evaluate the overall effectiveness of the course.

2.2. An analytical framework for course design

Analytical frameworks provide the basic vocabulary for concepts and terms that may be used to construct the kinds of causal explanations expected of a theory. In addition, framework-based approaches are applied to deal with the complexity that arises in situations involving human interactions with the environment [22]. This analytical framework is based on the "design science" approach; hence, creates a new structure for the course design that is helpful for lecturers to design their courses based on motivation and problem framing.

The analytical framework was developed based on the research of [23]. This framework highlights the four key activities of the class design life cycle with substantial problem solving, problem framing, solution framing, and artifact design (Fig. 1). Therefore, this framework suggests a problem-solving-based format to produce solutions for the course design [1].

2.3. Constructivist learning environments (CLEs)

An effective learning and teaching approach helps students learn and grow actively, but avoids passively injecting knowledge [24] like writing codes for a machine. The traditional teaching – instructivist methodology, where lecturers spend long hours delivering lectures systematically and require students to study in a very organized way, received criticism for its short-term effects [25]. A constructivist learning approach is a more favourable environment that motivates students to nurture both their knowledge and skills for more long-term learning effects [26].

The Constructivist learning method is based on the ideology of [27] where learners can actively facilitate the learning process and accumulate knowledge using their existing realities to reach better learning outcomes. The constructivist scholars firmly believe that people cannot systematically plan and strictly organize what they can learn and how much they can absorb [28]. Instead, learning is an active orientation that can refer to the full participation of learners using a constructive process [29]. All knowledge can be made available for learners to use to fit any unexpected circumstances in a timely manner.

In the study by Ref. [25]; the author proposed new principles to create a constructivist learning environment. The first principle emphasizes students' active role in constructing their own version of knowledge. Students can also learn from different teachers and sources to create a unique understanding created by themselves. The second principle presents the vital role of "authentic products and society". To use it, teachers and instructors create learning outcomes closely linked with real-world circumstances, authentic issues, and personal relevance. Those relevances provoke higher attention by students to reaching consequences. Based on these principles, integrative teaching methods and applications were introduced. In another experimental study by Ref. [24]; authors suggested some specific applications, such as project-based learning (improvising or new idea generation), problem-based learning (team collaboration to solve one issue), scaffold learning (studying from experts or actual practitioners), and flipped learning (pre-learning motivation). In this study, following the signposts of [24,25]; three methods, problem-based, project-based and scaffold, have been adopted for experimenting with this study to develop a successful constructivist environment for university students.

2.4. Underground theories

2.4.1. Constructivism theory

In contrast to how to enter the human brain, many educational psychologists were more interested in what was happening within the brain. Thus, depending on their existing knowledge [27,30], postulated that learners could generate new knowledge actively. The theory of Vygotsky, known as "social constructivism", strongly emphasizes the value of the socio-cultural context in which learning occurs and how the context affects learners. Constructivism theories have been included in many universities' curricula globally. There may be variations in how they are adopted depending on the cultural orientations [31]. The main applications of constructivism theory occur mostly in mathematics, English, psychology, and other courses.

The main goal of this current study is to support creative teaching approaches to business and management education. Particularly in Vietnam, the lecturer transfers knowledge to passive students, who wait like empty vessels to be filled in the classroom [8]. A constructivist learning environment is created by utilizing constructivist theory to enhance the standard of instruction and motivate students to learn more. The teacher is more of a facilitator who helps students expand their understanding and appraise it. The central tenet of constructivist theory is that students actively create their knowledge based on their experiences, language, and culture. Additionally, according to Ref. [32]; a constructivist approach makes learning even more meaningful since it involves the complete person in terms of thought, emotion, and action. The constructivist method has five essential components: (1) learning is social, (2) knowledge is experience-based, (3) knowledge is constructed by learners, (4) all aspects of a person are connected, and (5) learning communities should be both inclusive and equitable.

We, therefore, created constructivist learning environments to identify and establish connections between constructivist learning

theories and business and management courses. The mapping of constructivism learning theory for business and management courses is covered in a limited body of literature. In their 2020 study [33], looked at innovative ways to teach business ethics and sustainability courses. Although constructivist learning theory is frequently explored, there has not been a much-focused study on how that theory relates to business and management courses.

2.4.2. Social exchange theory (SET)

Among the many different theories, this study focuses on the positive transformation of students stimulated by constructivist learning environment courses. This study used the SET framework as a unique conceptual model. It was developed by [34]. Social exchange theory is a comprehensive framework used to explain and anticipate three aspects of gaining cross-cultural competence. Moreover, on the basic idea of SET theory [35], argued that "the more one is likely to engage in action the more valuable its rewards (p.600). In a Constructivist learning environment where students are centered, these students need to decide what to learn, and how to learn and to engage in more activities to complete their projects. Additionally, knowledge sharing is the main activity of the constructivist learning environment in this study, which involves providing personal experience and knowledge, such as interpersonal relationship techniques, communication skills, decision-making, creativity, design thinking, and problem-solving skills [35].

Social exchange theory refers to a two-sided rewarding process with many social groups [36]. It has been successfully used in many fields, notably for knowledge transfer [37]. Therefore, in this study, social exchange theory is applied to evaluate how students' outcomes when they engage more in the learning process and learning activities. On the other hand, social exchange theory seeks to explain the individual behavior involved in resource exchange. From the perspective of social exchange theory, the principle of individual behavior is to maximize benefits and minimize costs. Social exchange theory is widely applied to explain individual behavior across various domains, including information technology adoption [38], consumer behavior [39], information sharing and online communities [40,41]. This study used social exchange theory to analyze the impacts of a constructivist learning environment and learning motivation and strategy. Knowledge sharing between the facilitator and guest speakers in workshops and seminars in this project refers to exchange behavior.

2.5. Hypotheses development

The general student stereotype is that they struggle when applying theory and literature into practice. Only when the learning process is engaged and well connected with real-world contexts and issues, the students' motivation might also increase since learning can solve their problems. In other words, motivation is sustained through the use of real-world issues and projects Based on the DS approach, as [12] suggested, this project re-designed undergraduate business courses to tackle specific current teaching problems. By re-designing that teaching approach, we expected to create a constructivist learning environment to engage students further and create the motivation for them to be able to actively learn and gain more knowledge.

Therefore, from a review of the studies in the science education literature, it is hypothesized that the constructivist learning environment will enhance students' motivation to learn. According to Ryan and Deci (2000), student learning is impacted by motivation [42]. said that both intrinsic and extrinsic motivation is influenced by student learning per the learning environment. However, students were found that negatively motivated to learn science in a more constructivist learning environment. Hence, for the current research, we propose the following hypotheses:

H1a. The constructivism learning environment will have a positive impact on the intrinsic goals of students

H1b. The constructivism learning environment will positively impact the extrinsic goals of students

There were controversial findings on which type of motivation encourages active participation. According to self-determination theory, motivation can be classified into three groups, namely, motivation, which refers to nonrelevance or lack of motivation; intrinsic motivation, which implies internal affective motives such as joy, interest, or satisfaction; and extrinsic motivation, which refers to the external reasons for conducting certain behavior [43,44]. In this experiment, to investigate the impact of CLE on students' positive motivation, the authors only chose an intrinsic goal and an extrinsic goal as two variables to construct the hypotheses.

An Intrinsic goal indicates the personal significance of completing an action precisely, so people will motivate themselves to reach such outcomes because of their enjoyment or interest [44]. It was found that attention will be higher if the topics and stimuli are compatible with their interest [45]. Then, the learners' attention will provoke their perception afterward [46]. The elaboration of students refers to their increasing concern toward an event [46], and continuous knowledge reconstruction builds learners' perception [47]. Therefore, the authors predict the relationship between an intrinsic goal and students' elaboration in this study, as they both incline students' perceptions.

Critical thinking has long been the central purpose of higher education. As mentioned in the study of [48]; critical thinking is generally defined as the student's ability to think and understand logically and scientifically. Blended with individual experience, such thinking helps learners evaluate arguments, develop self-judgment, and thus construct their understanding. In this research, scaffold learning is adopted to open a series of learning opportunities practitioners and experts offer. From exposure to various backgrounds and experiences gathered from practitioners, learners can form their clarification and self-monitor their attitudes toward the learning process [49]. Thus, it is reasonable to predict the impact of intrinsic goals on students' critical thinking.

For meta-cognitive self-regulation, there are two aspects of this term. First, self-regulation refers to the ability to "plan, monitor" [50]; p. 62) and navigate behavior following cognitive wants and desires [51]. Second, meta-cognitive strategy is interaction and integration behavior to pursue a plan [52]. Taken together, meta-cognitive self-regulation is the ability that students have where they

can use a variety of strategies, thereby integrating prior knowledge with new knowledge to form new meanings. A high level of self-relevance and self-interest can motivate learners to pursue their learning pathway with passion. Hence, the authors predict that there will be a positive relationship between an intrinsic goal and meta-cognitive self-regulation. Taken together, the three hypotheses below are offered:

H2a. Intrinsic goal of students will positively impact the students' elaboration

H2b. Intrinsic goal of students will positively impact students' critical thinking

H2c. Intrinsic goal of students will positively impact students' meta-cognitive self-regulation

Extrinsic motivation refers to pursuing an instrumental goal, such as a reward or being a champion [53]. In the case of education, it is difficult to convince students that grades do not matter. Instead, grades are the extrinsic goal of many students [54] because high grades will open the door to many opportunities in the future. Extrinsic motivation, therefore, is a vital driver of students' learning achievements and an essential determinant of choosing the learning strategies to obtain success.

Although some believe that extrinsic motivation tends to foster a strategy of shallow learning using only memorization [55], some support the notion that both extrinsic and intrinsic motivations positively relate to the use of various learning strategies [56,57]. Especially with the development of information technology, students can access information related to subject content from numerous channels outside the classroom. Therefore, shallow learning by memorizing a piece of content is no longer enough to help students get high scores. Instead, the elaboration strategy facilitates their ability to connect and expand the information provided during the course into the students' background, other subjects they are taking, or practical ideas.

Critical thinking considered a deeper learning strategy [56], would enable students to analyze and evaluate evidence for further theoretical development and practical initiatives. As such, students can synthesize and report more profound conclusions. Also, meta-cognitive self-regulation encourages students to use good planning, have clear goal settings, and stay focused on learning [57] to absorb knowledge well and obtain the highest results possible. The authors expect that all elaboration, critical thinking, and meta-cognitive self-regulation are essential learning strategies for all students to be more intrinsically or extrinsically motivated. Specifically, regarding students with more extrinsic motivation, the performance approach is expected to link significantly to all three learning strategies. Thus, three other hypotheses are offered as follows:

H3a. Extrinsic goals of students will positively impact those students' elaboration

H3b. Extrinsic goals of students will positively impact those students' critical thinking

H3c. Extrinsic goals of students will positively impact those students' meta-cognitive self-regulation

Fig. 2 presents the proposed research model in this study as follows.

3. Methodology

3.1. Course design and implementation

Students were taught fundamental business and management concepts during the first year of the international business program at the University of Economics Ho Chi Minh City in Ho Chi Minh City, Vietnam. From the beginning of the second year to their fourth year, students learned specialized courses of the major. Among them, the Global Business Project (GBP) was one of the important courses in the curriculum. This course was planned for the last semester before the internship period. By developing special innovation and entrepreneur projects, GBP assisted students in further strengthening their business skills. Students could select their learning style in this course by building a mini-ecosystem for entrepreneurship (see Fig. 3). Students could collaborate with others in groups, discover the community, expand their network, and finally present their creative business concepts.

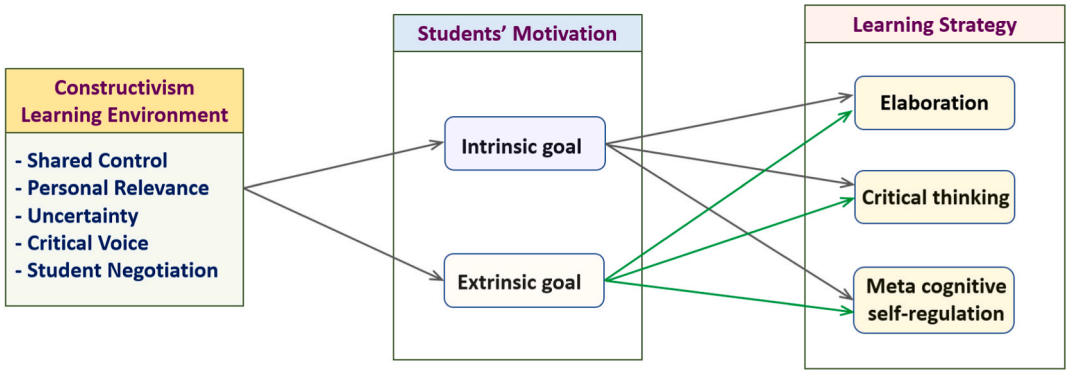

Fig. 2. Suggested research model (Source: Research Team).

This course offers students in International Business programs a brand-new learning environment designed to reflect a mini-–ecosystem (Fig. 3). In this new learning environment, students take on the role of active learners. They must actively plan their learning strategies and schedule by selecting different seminars, workshops, or facilitators to attend. The course's goal for students is to build their entrepreneur project using the knowledge gained over the previous three years. This course was designed to give students a better understanding of the entrepreneur project, which included conducting marketing research to investigate customer insight, developing new products, building marketing strategies, and managing finances. Additionally, the project-based course intends to teach students how to inspire, guide, and collaborate with others to achieve organizational and individual goals.

This module was a nine-week course that started in early January and was completed at the end of March. It included weekly assignments and activities. The course was taught using both in-person and online learning methods. During the course orientation, students received information about the course structure and the ongoing project. Students received instructions from the lecturer on how to study for this course and the specifics of each activity. In the final section, a poster presentation, each project was given 10 min to present to a committee, including company managers, financial managers, course lecturers, and other experts.

Students could complete their assignments by attending different online and offline workshops and seminars that were available for enrollment during the course. The learning management system (LMS) was also used for additional online activities. To promote cognitive development, a variety of activities, including "design thinking", "reflective journal," and "teamwork," were created. These exercises were given to scaffold students further so they could complete even more challenging tasks and support CLE. The course structure of design thinking encourages students to find new ideas in their everyday life or in their communities. Additionally, students could interact with professionals and business owners from various companies and organizations.

An online assignment called a reflective journal was created to help students think both critically and methodically. The class, workshop, or seminar students attended was mentioned in that reflective journal. Furthermore, with 16 classes and a total of 670 students in this course, teamwork was required from the students and the lecturers. In order to complete the project, the student groups needed to be organized with five or six people, and then they were requested to manage their teamwork professionally and support other team members to finish their assignments. Each group had one week to establish basic rules for how members would collaborate to complete the project's goals. Lecturers take on the role of facilitators, facilitating and guiding students online and offline during the classes to help them reach their learning objectives. Setting the learning agenda and offering specific instructors and learning activities, a timetable, resources, and learning materials were also included in the responsibilities of the lecturers.

Only half of the projects were presented on poster presentation day. When the projects did not meet the requirements regarding quality and innovation levels, students had to make an additional report to improve their scores. Therefore, only 302 students could fulfill all criteria and participate in the poster presentation. After presentation completion, all students received a questionnaire to assess how the design of the constructivist learning environment affected their learning motivation and strategies by applying the convenience sampling method.

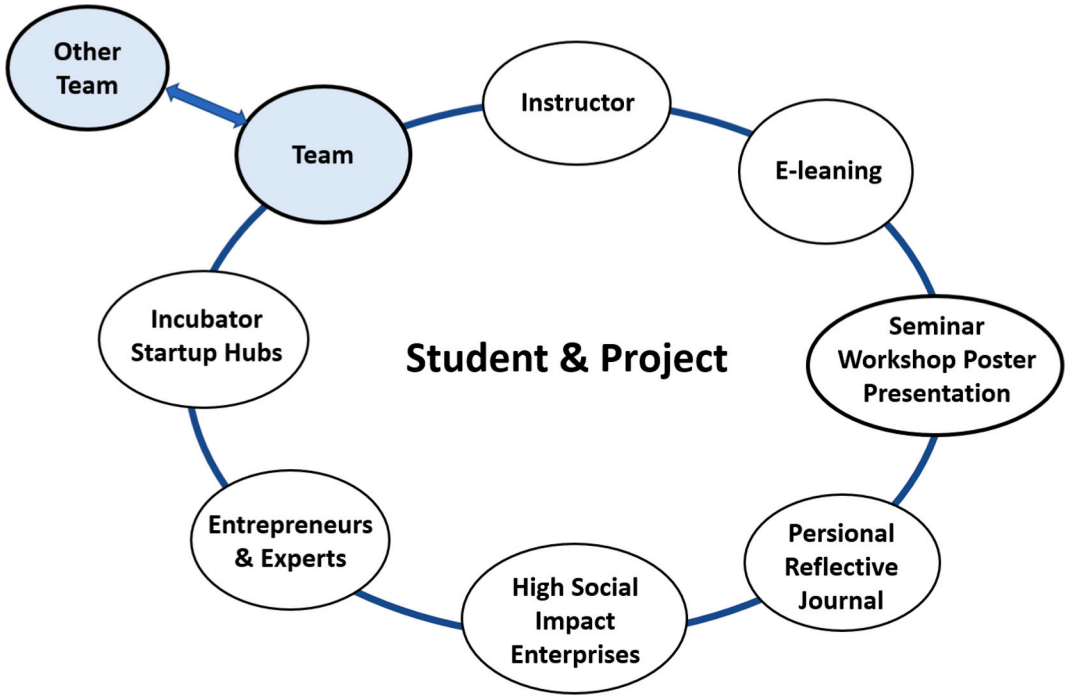

Fig. 3. A learning environment mini–ecosystem (Source: Research Team).

3.2. Questionnaire design, data collection, and data analysis

The questionnaire was designed based on a CLEs survey and an MSLQ survey using a 5-point Likert Scale ranging from 1 (strongly disagree) to 5 (strongly agree) to measure the respondents' evaluations.

The questionnaire consisted of three parts. The first part focused on collecting demographic information, such as class and gender. The second part measured constructivist learning using the survey question applied by Ref. [58]. There were 30 items measured for 5 variables (see Fig. 2), each measured by 6 items. According to Ref. [59]; CLEs questions showed acceptable reliability and validity in previous studies. Hence, adopting CLEs for the second part of this questionnaire was appropriate to fit and meet the current research objectives. The third part was designed following the guidelines of the MSLQ survey (Motivated Strategies Learning Questionnaire) developed by Ref. [60]. It measured the motivations and learning strategies of students and included 31 items.

The current study adopted purposive sampling. The target participants were third-year students at the University of Economic Hochiminh City. After completing 10 weeks of the new learning approach, all participating students were asked to complete a printed questionnaire on the final day. It took students around 15 min to answer all the questions, and researchers finalized everything. The offline questionnaire was distributed to all 302 eligible students however, there were 212 sent-back questionnaires. After scanning, only 193 were eligible for the data analysis.

The collected data were coded using SPSS25 software and then analyzed using SmartPLS 3.0 for structural equation modeling.

4. Results of the data analysis

This study employed two stages to evaluate the data collected from the questionnaire, following [61] approach. Cronbach's Alpha was used to assess scale reliability. That factor is reliable when Cronbach's Alpha is higher than 0.6 [62]. According to Table 1, the reliability of all the variables in this study had a Cronbach's Alpha greater than 0.6, indicating that the items in the scales were internally consistent. Further, most variables had an AVE greater than 0.5, meaning that the measurements of all the constructs had a high level of convergent validity [63]. The C.R. also showed that both constructions had a high level of internal consistency reliability, as shown in the table below.

Discriminant validity was met because all the square roots of each construct's AVE were greater than the correlation of the constructs to each other in the structural model. The discriminant validity of this model was validated based on the data shown in Table 2 below. Further, Harman's single factor test applied the standard method bias test. The skewness and kurtosis of the answers were evaluated since normality tests can only provide limited advice for using the nonparametric PLS-SEM technique [64]. The majority of the answers were within the appropriate skewness and kurtosis ranges of -1 to $+1$.

The study hypotheses were tested using bootstrapping techniques. Another nonparametric technique used for assessing the accuracy of the PLS estimate is the bootstrap. According to Ref. [62]; the bootstrap samples should be 5000 times.

Based on Fig. 4 and Table 3 below; firstly, the testing results show direct impacts between CLEs and student motivations to learn, including intrinsic and extrinsic goal (H1a: $\beta = 0.577$, $p = 0.000$, and H1b: $\beta = 0.219$, $p = 0.006$). This finding reinforces the results of previous research. It emphasizes the importance of Personal Relevance, Share Control, and Uncertainty of science as major factor influencing student learning motivation. Two other variables, namely, critical voice and student negotiation, need to be rejected due to $p > 0.05$.

Secondly, As illustrated in Table 3, another important relationship learned in this study was the influence of student motivations and learning strategies (critical thinking, Meta cognitive self-regulation, and elaboration. There are direct effects between both intrinsic and extrinsic to all the three factors of learning strategies were strong. Precisely, testing results of H2a, H2b, and H2c were $\beta = 0.292$, $p = 0.000$, $\beta = 0.307$, $p = 0.000$, and $\beta = 0.315$, $p = 0.000$, respectively, which indicate the acceptance for all mentioned hypotheses. Finally, the relationships between extrinsic goal and three learning strategies outcomes were further examined with testing results of H3a: $\beta = 0.277$, $p = 0.000$, H3b: $\beta = 0.296$, $p = 0.000$, and H3c: $\beta = 0.322$, $p = 0.000$). Thus, all hypothese were accepted.

5. Conclusion, discussion and future research

5.1. Conclusion and discussion

In the constructivist learning environment, students are active learners, conduct activities to promote learning, collaborate with

Table 1
Reliability and validity analysis.

	Cronbach's Alpha	rho_A	Composite Reliability
Constructivism Learning Environments	0.861	0.863	0.886
Critical Thinking	0.644	0.652	0.768
Extrinsic Goal	0.658	0.729	0.723
Elaboration	0.731	0.739	0.825
Intrinsic Goal	0.616	0.607	0.790
Meta cognitive self-regulation	0.548	0.548	0.768

Table 2
Discriminant validity analysis.

	Constructivism Learning Environments	Critical Thinking	Extrinsic Goal	Elaboration	Intrinsic Goal	Composite Reliability
Constructivism Learning Environments	0.613					
Critical Thinking	0.418	0.724				
Extrinsic Goal	0.219	0.389	0.770			
Elaboration	0.424	0.521	0.365	0.736		
Intrinsic Goal	0.577	0.396	0.302	0.376	0.746	
Meta cognitive self-regulation	0.423	0.424	0.417	0.340	0.412	0.725

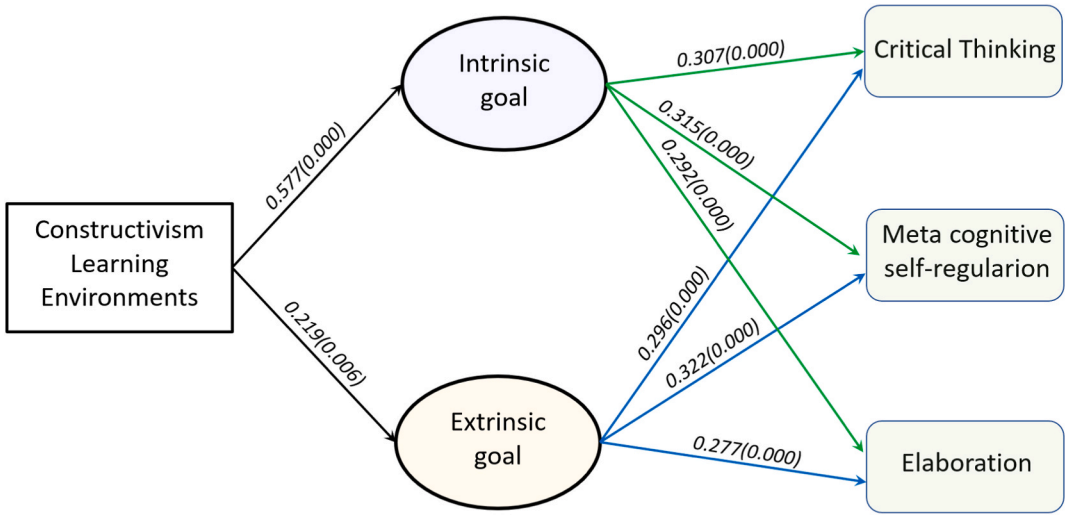

Fig. 4. SEM results (source: Research team).

Table 3
Hypotheses test results.

		Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	p Values	Result
H1a	Constructivism Learning Environment →Intrinsic Goal	0.577	0.593	0.044	12.984	0.000	Accepted
H1b	Constructivism Learning Environment →Extrinsic goal	0.219	0.234	0.079	2.759	0.006	Accepted
H2a	Intrinsic Goal →Elaboration	0.292	0.303	0.074	3.973	0.000	Accepted
H2b	Intrinsic Goal →Critical Thinking	0.307	0.314	0.065	4.685	0.000	Accepted
H2c	Intrinsic Goal →Meta cognitive self-regulation	0.315	0.319	0.071	4.418	0.000	Accepted
H3a	Extrinsic Goal →Elaboration	0.277	0.284	0.069	3.990	0.000	Accepted
H3b	Extrinsic goal →Critical Thinking	0.296	0.302	0.068	4.336	0.000	Accepted
H3c	Extrinsic Goal →Meta cognitive self-regulation	0.322	0.327	0.066	4.879	0.000	Accepted

peers during the learning process, and take responsibility for and in the class. Also, they are free to express their ideas and thoughts about the classroom environment. It was thus hypothesized that the CLEs positively affect student motivations to fully learn business and management courses. This study contributes to the theory by testing the relationship between the constructivist learning environment and student learning motivations and learning strategies. The results of this study provide important insights. First, the constructivist learning environment directly impacts intrinsic and extrinsic motivations. As such, once the constructive learning environment could be improved, learning motivations are also enhanced. The analytical results show that the constructivist learning environment has a significant impact on the intrinsic motivation of learners (H1a: $\beta = 0.577$, $p = 0.000$). Moreover, the results also indicate a significantly positive effect of the constructivist learning environment on the extrinsic motivation of learners (H1b: $\beta = 0.219$, $p = 0.006$). This finding implies that increasing the competitiveness and the motivations of team members and the other teams would significantly affect the students' capabilities to learn. These results support the findings by Kwan and Wong (2015), and Dindar

(2015).

The second stream of findings focused on examining student motivations' impact on learning strategies. Students often have multiple goals during their studies at university, such as obtaining knowledge and skills for a future job, satisfying their need for rewards, obtaining recognition, enhancing self-confidence, and so on [53,65]. Intrinsic motivation will foster lifelong learning, indeed one of the primary objectives of higher education [53], while extrinsic motivation tends to force students to focus on studying and obtain high performance. The analysis results showed a significantly positive influence from intrinsic and extrinsic motivations on three learning strategies: the students' elaboration, critical thinking and meta-cognitive self-regulation. These results confirm passion and performance-pursuing approaches' essential role in students' learning [57]. supports this study's results in examining the relationship between motivation and learning strategies of online and face-to-face courses.

In terms of intrinsic motivation, the data analysis positively impacted three aspects of the learning strategies – students' elaboration, critical thinking, and meta-cognitive self-regulation. These findings highlight the role of personal interests as a bridge from the learning environment to student behaviors. Prior studies on the relationship between constructivist learning environments and critical thinking have shown a linkage between two variables [58,66]. Notably, Kwan and Wong (2014) discovered that younger students would perceive a higher degree of constructivist learning environment than older students. However, the current study emphasized that higher education students still perceive and interpret constructivist learning environments and have it indirectly impact the building of their critical thinking ability if they have intrinsic goals. The same is true for elaboration. Few studies have examined these relationships in other experiment bases, such as medical education [67], and art education [68]. This study enlarged the findings utilizing economics and management education and emphasized the role of the personal affective state when interpreting the environment. The final aspect of a learning strategy, meta-cognitive self-regulation, was found to have a positive relationship with intrinsic goals. This finding is consistent with previous studies conducted in the workplace [69] and in physical education [70]. Thus, it can be said that internal motivation plays a key role in fostering learning strategies when students interact with new environments.

In terms of extrinsic motivation, the analysis results highlight the importance of motivation induced by rewards or recognition as one of the determinants leading to three learning strategies, including elaboration, critical thinking, and meta-cognitive self-regulation [71]. suggested that students with a more extrinsic motivated orientation were more likely to use learning via memorizing strategies but also had a lower academic performance. This argument supports the necessity of using various learning strategies to achieve higher grades for extrinsically goal-oriented students.

5.2. Contributions

5.2.1. Theoretical contributions

This study contributes to the literature in several ways. First, it explains and integrates three theories, namely, design science, constructivism theory, and social exchange theory to design the experimental course and evaluate the effectiveness of the new teaching approach when used for students. Following the signpost in Ref. [23]; the authors designed research questions and related research activities to implement design science in a real-education context. Together with using a constructivist theory orientation, the authors designed the GBP course in a new and integrative way which moved its students from a traditional lecture mode to a self-actively learning mode. Hence, the research explains how to construct CLEs courses effectively and evaluates their application in one student cohort.

Secondly, the study adopted and validated the measurements of constructive learning environments [58,59] and the motivated strategies for learning questionnaires [60] in an empirical study. As such, the results of this study contribute to and enrich the literature in the study design field.

5.2.2. Practical contributions

The practical contributions of this study are the highlight of this research outcome. The research process and its results offer various sustainable benefits not only for lifelong studying by students but also for the replication of a new course design approach for lectures and HEIs. For the students, through a series of workshops and seminars delivered by experts during the course, actual practitioners, and lectures, students can broaden their landscape by using different perspectives and develop the necessary skills to meet employers' needs, such as time management, critical thinking, actively independent research, and teamwork. Moreover, students can learn how to reflect on themselves and explore their lacking skills and weaknesses and then actively engage by attending relevant workshops to acquire more knowledge and practice with real projects. These accumulated skills will definitely help students' employability and lifelong learning on higher education pathways.

For lectures and HEIs, this study provides (1) a designed course based on design science and a constructivist approach and (2) empirical results that validate and measure the effectiveness of the new course design approach. Notably, the empirical evidence emphasizes how a study environment generates students' motivation and learning strategies in a Vietnamese university. These results confirm the importance of a constructivist learning environment and applying both intrinsic and extrinsic motivations as key determinants of various learning strategies for college students. This finding implies constructive lecture design's vital role in creating a more student-centered learning process by integrating numerous teaching methods, such as problem-based, role play, flipped learning, and more [24,25] in higher institutions in Vietnam. Based on these outcomes, it is clear that this course design can be helpful for applying to business and management education sectors and especially for courses that demand a high level of applications, i.e., project management, simulation, business analytics, and strategic management.

5.3. Limitations and future research

While this study highlights the significant influence of CLEs on student motivations and learning strategies in higher education, there remain limitations to address in further research. First, the collected data was solely gathered at the University of Economics Ho Chi Minh City which specialized in International Business major during one year. In fact, there are other Business related majors taught at UEH. Due to different in teaching schedules and syllabuses, authors have not approached the rest UEHers.Hence, the sample size and scope were limited.

Secondly, the questionnaire advantage was measuring evaluations and students' perception toward things or stimuli; however, the bias was inescapable. Future research should extend the research scope via the participation of many universities in one region or nation to generalize these results for cross-majors and, furthermore cross-cultural. Finally, this study only adopted the study for one cohort; hence, the future application of CLEs should be applied to several cohorts to collect longitudinal data and examine those deeper insights.

Ethics statement

The authors declare that research be submitted to and approved by an University of Economics Ho Chi Minh City ethics committee. The approval number is 2022-09-06-1140.

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Data availability

The data supporting this study's findings are available on request from the corresponding author, Dr Hai-Ninh Do. The data are not publicly available due to restrictions that the data containing information that could compromise the privacy of research participants.

CRediT authorship contribution statement

Hai-Ninh Do: Writing - review & editing, Writing - original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Bich Ngoc Do:** Writing - review & editing, Writing - original draft, Visualization, Validation, Investigation, Conceptualization. **Minh Hue Nguyen:** Writing - review & editing, Writing - original draft, Methodology, Investigation, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e22862.

References

[1] A.R. Hevner, S.T. March, J. Park, S. Ram, Design science in information systems research, MIS Q. 28 (1) (2004) 75–105, https://doi.org/10.2307/25148625.
[2] Y. Lin, Z. Hu, H. Alias, L.P. Wong, Knowledge, attitudes, impact, and anxiety regarding COVID-19 infection among the public in China, Front. Public Health 8 (2020) 236, 10.3389%2Ffpubh.2020.00236.
[3] A. Collins. *Toward a design science of education*, Springer Berlin Heidelberg, 1992, pp. 15–22.
[4] L. Vygotsky, Thought and Language, MIT Press, 1962.
[5] P.M. Piattelli, Language and Learning: the Debate between Jean Piaget and Noam Chomsky, Harvard University Press, 1980.
[6] D.S. Porcaro, Applying constructivism in instructivist learning cultures, Multicult. Educ. Technol. J. 5 (1) (2011) 39–54, https://doi.org/10.1108/17504971111121919.
[7] D.H. Jonassen, Objectivism versus constructivism: do we need A new philosophical paradigm? Educ. Technol. Res. Dev. 39 (3) (1991) 5–14, https://doi.org/10.1007/BF02296434.
[8] S.O. Bada, S. Olusegun, Constructivism learning theory: a paradigm for teaching and learning, Journal of Research & Method in Education 5 (6) (2015) 66–70.
[9] S.J. Lea, D. Stephenson, J. Troy, Higher education students' attitudes toward student-centred learning: beyond 'educational bulimia, Stud. High Educ. 28 (2003) 3 321–334, https://doi.org/10.1080/03075070309293.
[10] J.G. Brooks, Schooling for Life: Reclaiming the Essence of Learning, Association for Supervision and Curriculum Development, Alexandria, VA, 2002.
[11] M. Pande, S.V. Bharathi, Theoretical foundations of design thinking–A constructivism learning approach to design thinking, Think. Skills Creativ. 36 (2020), 100637, https://doi.org/10.1016/j.tsc.2020.100637.

[12] N.H. Thuan, P. Antunes, Positioning design science as an educational tool for innovation and problem solving, Commun. Assoc. Inf. Syst. 51 (1) (2022) 1, https://doi.org/10.17705/1CAIS.05120.
[13] E. Novak, B.K. Mulvey, Enhancing design thinking in instructional technology students, J. Comput. Assist. Learn. 37 (1) (2021) 80–90, https://doi.org/10.1111/jcal.12470.
[14] M. Herselman, A. Botha, Applying design science research as a methodology in post graduate studies: a South African perspective, in: Conference of the South African Institute of Computer Scientists and Information Technologists, vol. 2020, 2020, pp. 251–258, https://doi.org/10.1145/3410886.3410903.
[15] R. Winter, J. Vom Brocke, Teaching Design Science Research. In the 42th International Conference on Information Systems (ICIS 2021), Austin, TX, 2021.
[16] A.R. Hevner, Pedagogy for doctoral seminars in design science research, in: Engineering the Transformation of the Enterprise, Springer, Cham, 2021, pp. 185–198.
[17] A.K. Carstensen, J. Bernhard, Design science research – a powerful tool for improving methods in engineering education research, Eur. J. Eng. Educ. 44 (1–2) (2019) 85–102, https://doi.org/10.1080/03043797.2018.1498459.
[18] G. Goldkuhl, P. Ågerfalk, J. Sjöström, A design science approach to information systems education, in: International Conference on Design Science Research in Information System and Technology, Springer, Cham, 2017, pp. 383–397, https://doi.org/10.1007/978-3-319-59144-5_23.
[19] D. Keskin, G. Romme, Mixing oil with water: how to effectively teach design science in management education? Brazilian Administration Review 17 (2020) https://doi.org/10.1590/1807-7692bar2020190036.
[20] S. Mdletshe, M. Oliveira, B. Twala, Enhancing medical radiation science education through a design science research methodology, J. Med. Imag. Radiat. Sci. 52 (2) (2021) 172–178, https://doi.org/10.1016/j.jmir.2021.01.005.
[21] M. Apiola, E. Sutinen, Design science research for learning software engineering and computational thinking: four cases, Comput. Appl. Eng. Educ. 29 (1) (2021) 83–101, https://doi.org/10.1002/cae.22291.
[22] C. Coral, W. Bokelmann, The role of analytical frameworks for systemic research design, explained in the analysis of drivers and dynamics of historic land-use changes, Systems 5 (1) (2017) 20, https://doi.org/10.3390/systems5010020.
[23] N.H. Thuan, A. Drechsler, P. Antunes, Construction of design science research questions, Commun. Assoc. Inf. Syst. 44 (2019) 332–363, https://doi.org/10.17705/1CAIS.04420.
[24] J. Jin, K.E. Hwang, I. Kim, A study on the constructivism learning method for BIM/IPD collaboration education, Appl. Sci. 10 (15) (2020) 5169, https://doi.org/10.3390/app10155169.
[25] J. Pelech, Student-centered Research : Blending Constructivism with Action Research, Information Age Publishing Inc, 2021.
[26] L.M. Padirayon, M.V. Pagudpud, J.S.D. Cruz, Exploring constructivism learning theory using mobile game, IOP Conf. Ser. Mater. Sci. Eng. 482 (1) (2019), 12004, https://doi.org/10.1088/1757-899X/482/1/012004.
[27] L.S. Vygotsky, Mind in Society, Harvard University Press, Cambridge, 1978.
[28] B.T. Duane, M.E. Satre, Utilizing constructivism learning theory in collaborative testing as a creative strategy to promote essential nursing skills, Nurse Educ. Today 34 (1) (2014) 31–34, https://doi.org/10.1016/j.nedt.2013.03.005.
[29] M. Rob, F. Rob, Dilemma between constructivism and constructionism: leading to the development of a teaching-learning framework for student engagement and learning, J. Int. Educ. Bus. 11 (2) (2018) 273–290, https://doi.org/10.1108/JIEB-01-2018-0002.
[30] J. Bruner, The Culture of Education, Harvard University Press, 1996.
[31] E. Ampadu, A. Danso, Constructivism in mathematics classrooms: listening to Ghanaian teachers' and students' views, Afr. Educ. Rev. 15 (3) (2018) 49–71, https://doi.org/10.1080/18146627.2017.1340808.
[32] C. Beck, C. Kosnik, Innovations in Teacher Education – A Social Constructivist Approach, Suny Press, 2012.
[33] O. Dziubaniuk, M. Nyholm, Constructivist approach in teaching sustainability and business ethics: a case study, Int. J. Sustain. High Educ. 22 (1) (2020) 177–197, https://doi.org/10.1108/IJSHE-02-2020-0081.
[34] H.H. Kelly. The Social Psychology of Groups, Transaction Publishers, , 1959.
[35] G.C. Homans, Social behavior as exchange, Am. J. Sociol. 63 (6) (1958) 1858–1958, https://doi.org/10.1007/978-3-030-84655-8_12.
[36] S.M. Rasoolimanesh, M. Jaafar, N. Kock, T. Ramayah, A revised framework of social exchange theory to investigate the factors influencing residents' perceptions, Tourism Manag. Perspect. 16 (2015) 335–345, https://doi.org/10.1016/j.tmp.2015.10.001.
[37] A. Kankanhalli, B.C. Tan, K.K. Wei, Contributing knowledge to electronic knowledge repositories: an empirical investigation, MIS Q. (2005) 113–143, https://doi.org/10.2307/25148670.
[38] D. Gefen, M. Keil, The impact of developer responsiveness on perceptions of usefulness and ease of use: an extension of the technology acceptance model, Data Base for Advances in Information Systems 29 (1998) 35–49.
[39] W.L. Shiau, M.M. Luo, Factors affecting online group buying intention and satisfaction: a social exchange theory perspective, Comput. Hum. Behav. 28 (2012) 2431–2444, https://doi.org/10.1016/j.chb.2012.07.030.
[40] H. Hall, G. Widen, L. Paterson, Not what you know, nor who you know, but who you know already: examining online information sharing behaviours in a blogging environment through the lens of social exchange theory, Libri. 60 (2010) 117–128, https://doi.org/10.1515/libr.2010.011.
[41] B. Jin, J.Y. Park, H.S. Kim, What makes online community members commit? A social exchange perspective, Behav. Inf. Technol. 29 (2010) 587–599, https://doi.org/10.1080/0144929X.2010.497563.
[42] P.R. Pintrich, E.V. De Groot, Motivational and self-regulated learning components of classroom academic performance, J. Educ. Psychol. 82 (1) (1990) 33. https://psycnet.apa.org/doi/10.1037/0022-0663.82.1.33.
[43] V. Good, D.E. Hughes, A.H. Kirca, S. McGrath, A self-determination theory-based meta-analysis on the differential effects of intrinsic and extrinsic motivation on salesperson performance, J. Acad. Market. Sci. 50 (3) (2022) 586–614, https://doi.org/10.1007/s11747-021-00827-6.
[44] R.M. Ryan, E.L. Deci, Intrinsic and extrinsic motivation from a self-determination theory perspective: definitions, theory, practices, and future directions, Contemp. Educ. Psychol. 61 (2020), 101860, https://doi.org/10.1016/j.cedpsych.2020.101860.
[45] H. Alamri, V. Lowell, W. Watson, S.L. Watson, Using personalized learning as an instructional approach to motivate learners in online higher education: learner self-determination and intrinsic motivation, J. Res. Technol. Educ. 52 (3) (2020) 322–352, https://doi.org/10.1080/15391523.2020.1728449.
[46] R. Wei, V.H. Lo, H.Y. Lu, The third-person effect of tainted food product recall news: examining the role of credibility, attention, and elaboration for college students in taiwan, Journal. Mass Commun. Q. 87 (3–4) (2010) 598–614, https://doi.org/10.1177/107769901008700310.
[47] N. Ding, R. Bosker, E. Harskamp, Exploring gender and gender pairing in the knowledge elaboration processes of students using computer-supported collaborative learning, Comput. Educ. 56 (2) (2011) 325–336, https://doi.org/10.1016/j.compedu.2010.06.004.
[48] M.G. Erikson, M. Erikson, Learning outcomes and critical thinking–good intentions in conflict, Stud. High Educ. 44 (12) (2019) 2293–2303, https://doi.org/10.1080/03075079.2018.1486813.
[49] A. Ghanizadeh, The interplay between reflective thinking, critical thinking, self-monitoring, and academic achievement in higher education, High Educ. 74 (1) (2017) 101–114, https://doi.org/10.1007/s10734-016-0031-y.
[50] A.L. Brown, Motivation to learn and understand: on taking charge of one's own learning, Cognit. InStruct. 5 (1988) 311–321.
[51] J. De la Fuente, P. Sander, J.M. Martínez-Vicente, M. Vera, A. Garzón, S. Fadda, Combined effect of levels in personal self-regulation and regulatory teaching on meta-cognitive, on meta-motivational, and on academic achievement variables in undergraduate students, Front. Psychol. 8 (2017) 232, https://doi.org/10.3389/fpsyg.2017.00232, 232.
[52] D.R. Perry, A.K. Steck, Increasing student engagement, self-efficacy, and meta-cognitive self-regulation in the high school geometry classroom: do iPads help? Comput. Sch. 32 (2) (2015) 122–143, https://doi.org/10.1080/07380569.2015.1036650.
[53] Y. Lin, J.M. Wilbert, Y.C. Kim, College student intrinsic and/or extrinsic motivation and learning, Learn. Indiv Differ 13 (3) (2003) 251–258, https://doi.org/10.1016/S1041-6080(02)00092-4.
[54] S. Reiss, Intrinsic and extrinsic motivation, Teach. Psychol. 39 (2) (2012) 152–156, https://doi.org/10.1177/0098628312437704.

[55] J.A. Lyke, A.J. Kelaher Young, Cognition in context: students' perceptions of classroom goal structures and reported cognitive strategy use in the college classroom, Res. High. Educ. 47 (4) (2006) 477–490, https://doi.org/10.1007/s11162-005-9004-1.
[56] M.T. Drysdale, M. McBeath, Motivation, self-efficacy and learning strategies of university students participating in work-integrated learning, J. Educ. Work 31 (5–6) (2018) 478–488, https://doi.org/10.1080/13639080.2018.1533240.
[57] E. Stark, Examining the role of motivation and learning strategies in student success in online versus face-to-face. Courses, Online Learn. 23 (3) (2019) 234–251, https://doi.org/10.24059/olj.v23i3.1556.
[58] Y.W. Kwan, A.F.L. Wong, The constructivist classroom learning environment and its associations with critical thinking ability of secondary school students in Liberal Studies, Learn. Environ. Res. 17 (2) (2014) 191–207, https://doi.org/10.1007/s10984-014-9158-x.
[59] J.M. Aldridge, B.J. Fraser, P.C. Taylor, C.C. Chen, Constructivist learning environments in a crossnational study in Taiwan and Australia, Int. J. Sci. Educ. 22 (1) (2000) 37–55, https://doi.org/10.1080/095006900289994.
[60] P.R. Pintrich, D.A.F. Smith, T. Garcia, W.J. McKeachie, A Manual for the Use of the Motivated Strategies for Learning, School of Education Building, The University of Michigan, Michigan, 1991.
[61] J.C. Anderson, D.W. Gerbing, Predicting the performance of measures in a confirmatory factor analysis with a pretest assessment of their substantive validities, J. Appl. Psychol. 76 (5) (1991) 732. https://psycnet.apa.org/doi/10.1037/0021-9010.76.5.732.
[62] J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson, Multivariate Data Analysis, seventh ed., Pearson, 2010.
[63] C.R. Fornell, D.F. Larcker, Structural equation models with unobservable variables and measurement error: algebra and statistics, J. Market. Res. 18 (1918) 39–50, https://doi.org/10.1177/002224378101800313.
[64] J.F. Hair Jr., G.T.M. Hult, C.M. Ringle, M. Sarstedt, A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM), Sage publications, 2021.
[65] S.Y.C. Lai, P.C. Hui, Service-learning: impacts of learning motivation and learning experience on extended social/civic engagement, High Educ. Res. Dev. 40 (2) (2021) 400–415, https://doi.org/10.1080/07294360.2020.1756748.
[66] I. Sasson, I. Yehuda, N. Malkinson, Fostering the skills of critical thinking and question-posing in a project-based learning environment, Think. Skills Creativ. 29 (2018) 203–212, https://doi.org/10.1016/j.tsc.2018.08.001.
[67] Y. Wang, Y. Di, J. Ye, W. Wei, Study on the public psychological states and its related factors during the outbreak of coronavirus disease 2019 (COVID-19) in some regions of China, Psychol. Health Med. 26 (1) (2021) 13–22, https://doi.org/10.1080/13548506.2020.1746817.
[68] Z. Tomljenovic, T.S. Vorkapic, Constructivism in visual arts classes, CEPS Journal 10 (4) (2020) 13–32, https://doi.org/10.26529/cepsj.913.
[69] R. Steinbauer, R.W. Renn, H.S. Chen, N. Rhew, Workplace ostracism, self-regulation, and job performance: moderating role of intrinsic work motivation, J. Soc. Psychol. 158 (6) (2018) 767–783, https://doi.org/10.1080/00224545.2018.1424110.
[70] G. Jordalen, P.N. Lemyre, N. Durand-Bush, Interplay of motivation and self-regulation throughout the development of elite athletes, Qualitative Research in Sport, Exercise and Health 12 (3) (2020) 377–391, 10.1080/2159676X.2019.1585388.
[71] Maureen T.B. Drysdale, Margaret McBeath, Motivation, self-efficacy and learning strategies of university students participating in work-integrated learning, J. Educ. Work 31 (5–6) (2018) 478–488, https://doi.org/10.1080/13639080.2018.1533240.