Technology, Knowledge and Learning
https://doi.org/10.1007/s10758-020-09466-2

ORIGINAL RESEARCH

Gamification to Enhance Motivation and Engagement in Blended eLearning for Technical and Vocational Education and Training

Janaka Jayalath[1] · **Vatcharaporn Esichaikul**[1]

Abstract
Delivery of blended-mode eLearning programs is challenging due to a range of factors, including motivational and engagement issues. This is more challenging in the context of Technical and Vocational Education and Training (TVET), which aims to develop competencies to empower learner to find gainful employment. This study proposes an operational model and gamification design to develop blended eLearning programs, which embed motivational and engagement designs as an effective means of achieving learner success in the TVET context. The motivational design uses a motivational framework with the factors of attention, relevance, confidence, and satisfaction. The engagement design includes behavioural, emotional, and cognitive aspects for enhancing learning. Accordingly, appropriate game dynamics, mechanics, and components are used to gamify a blended eLearning course. This gamification design and operational model could be used as a tool to gamify and deliver the competency-based educational programs, using the blended eLearning approach. The study proposes fifteen game dynamics, relevant mechanics, and appropriate game components. The design utilises structural and content gamification in a sample online course, deploying an open-source learning management system. Furthermore, the study suggests embedding game components at the implementation stage of providing learning opportunities, to motivate and engage learners, thereby achieving the acquisition of expected competencies. The gamified course will be delivered to a selected group of learners in the TVET context to assess the feasibility and viability of this approach in anticipation of the future work.

Keywords Gamification in education and training · Blended eLearning · Motivation · Engagement · Game dynamic · Game component

✉ Janaka Jayalath
st116938@ait.ac.th

Vatcharaporn Esichaikul
vatchara@ait.ac.th

[1] Asian Institute of Technology, Pathumthani, Thailand

Published online: 31 August 2020

1 Introduction

Technical and Vocational Education and Training (TVET) provides practical skills, knowledge, and technology for knowledge-based and transition societies (Marope et al. 2015). Delivery of TVET programs through blended eLearning is becoming popular as a result of its geographical reach, cost-effectiveness, easy-access, and learner-centred design (Latchem 2017) in spite of challenges such as lack of awareness, funding issues, delivery inefficiencies, and institutional policies and procedures (Jayalath 2010). Factors affecting e-Learner success in TVET are engagement in educational activities, achievement in coursework, persistence, attainment of educational outcomes, and post-college performance (Kuh et al. 2006). Despite the significant growth and contribution of eLearning in the TVET sector and the associated benefits it provides, lack of engagement is a critical factor for lower performance and higher dropout rates than the physical classroom learning method (Raihan and Lock 2012; Uppal et al. 2018). Keller and Suzuki (2004) highlighted that inadequate instructional design, ineffective media design, lack of learner confidence, and dissatisfaction with the mode of delivery cause higher rates of learner dropout in eLearning than with face to face learning contexts. Furthermore, the absence of learner interest and motivation create a negative perception (Brewer and Burgess 2005) whilst it has been empirically demonstrated that the use of appropriate motivational techniques improves learning significantly and positively (Margueratt 2007).

In the education context, gamification improves motivation in eLearning (Landers et al. 2015; Muntean 2011). Deterding et al. (2011) define gamification as the "use of game design elements in non-game contexts". Gamified applications motivate users to continuously engage (Hamari et al. 2014), and some studies demonstrate a decrease in engagement when the novelty fades off (Koivisto and Hamari 2014). However, the lack of studies on gamified applications in the TVET context poses a challenge in demonstrating the impact of gamification. Therefore, the proposed study attempts to investigate the impact of gamification and to examine whether it is an effective approach to motivate and engage learners in blended eLearning courses in the TVET sector.

The objective of this study is to develop gamification design and an operational model in blended eLearning in TVET to improve learner success by increasing motivation and engagement to stimulate a positive outcome for the delivery of blended eLearning courses. The gamification design and operational model are aimed at contributing to a significant impact on future blended eLearning programs in the TVET sector. Embedding game-thinking in blended eLearning courses will foster the motivation of learners and engage them in their courses, using motivational design and engagement mechanisms. By implementing the proposed approach, it is expected that students will achieve the course learning outcomes, acquire competencies via blended eLearning programs and achieve higher success rates in TVET programs. The blended eLearning approach covers learning, performance support and knowledge management (Bielawski and Metcalf 2003). Wu et al. (2010) found that self-efficacy, system functionality, content features and interaction coalesce in blended eLearning. In delivering TVET programs, the blended eLearning approach is selected by many instructional designers and widely adapted in varied contexts as an optimal learning structure (Sorden and Munene 2013).

2 Theoretical Background and Related Works

2.1 Technical and Vocational Education and Training (TVET)

TVET is referred to as "those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic life" (UNESCO 2015). In achieving the above, TVET focuses on explicit, measurable and transferable learning objectives with personalised attention and meaningful assessments which lead to a positive learning experience (Wu et al. 2017). Furthermore, TVET provides better opportunities than the academic pathways to access the practical skills, knowledge and attitudes related to occupations (i.e. the competence) that promote decent jobs and thereby sustainable living. In its implementation, TVET uses Competency-Based Education (CBE) as the primary delivery approach (Argüelles 2000).

2.2 Competency-Based Education and Assessments

Competency is the acquisition and transfer of skills, knowledge and attitudes through a delivered course or prior learning and practices. Within the TVET context, CBE curricula, instructional and assessment material are developed according to competency standards derived from industry requirements. Competency standards mainly consist of "elements of competence" and "performance criteria" with other supporting structures for the delivery of CBE. The learning process is supported by continuous assessments and outcome-oriented competency-based assessments (CBA). Compulsory formative and summative assessments are required to measure learner performance continuously in CBE (Nduna 2017), compared to less practically-oriented classroom-based teaching.

2.3 Blended eLearning in TVET

Graham (2006) defines that "blended learning systems combine face-to-face instruction with computer-mediated instruction" (p. 5). Computer-mediated instruction includes offline or online content, eLearning, web-based learning etc. The blended learning approach is considered more effective in TVET (Yasak and Alias 2015) and it significantly increases learner performance (Şahin 2010). The success of the blended learning approach depends on forming a sustainable online learner community, who shares experiences using critical reflections on learning themes. Technological interaction and learning maturity help maintain a sustainable virtual community with transparent and consistent communication practices.

Practical sessions require a high level of instructor facilitation in laboratories and workshops, which provide hands-on experience to support the acquisition of the required competencies needed to maintain learner progress. Learner progress is sustained in such practical courses depending on factors such as motivation (John and Duangekanong 2018), satisfaction (Browne 2019) and engagement (Lister 2015). Vu et al. (2014) argue that self-motivation mainly drives system effectiveness and thereby learner success in online professional development. In a study by Beaudoin et al. (2009) reveals that the success of online learning depends on the self-determination of learners, more than the institutional support. Research studies confirm that learner motivation is a critical success factor in blended eLearning (Hodges 2004; Sun et al. 2008; Bhuasiri et al. 2012).

2.4 Games, Gamification, Motivation and Engagement

2.4.1 Games and Gamification

A game is defined as "a system, in which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome" (Salen and Zimmerman 2005). In the game context, "a system" refers to computer or video game which scaffolds the player to higher levels by deploying various techniques. Game designer, McGonigal (2011) explains that games consist of goals, rules, a feedback system, and volunteer participation as motivational techniques. People like to participate in games because they induce fun (Malone 1981; Prensky 2001), and encourage players to engage until the end. Kim et al. (2015) proved that the major contributor for the flow is the "fun" element, and it could be subdivided into emotional fun, cognitive fun and social fun.

Bateman and Nacke (2010) discovered that a positive brain effect occurs when playing games because of the release of chemicals such as dopamine (increases reward-seeking behaviour), epinephrine (increases stress and excitement), and norepinephrine (leads to excitement), which induce fun and motivate players to engage throughout the game. Even though a game is focused on the win, it is more fun being in the game and using game-thinking as a process (Kapp 2012). Any type of work comprised of processes could be made fun by using appropriate game elements. However, in education, simply inserting learning content into a game would not suffice to make the learning fun.

The use of game elements in non-game contexts is called gamification and it provides an immersive learning experience for a motivated and engaged learner in blended eLearning. Gamification is conceptualised from gameplay and applies game dynamics, game mechanics, and game components in gamifying real-world applications to motivate users. Gamification applications are being used in different fields and produce promising results in sustainable behavioural change (Garett and Young 2019).

Gamification can be divided into structural and content gamification (Kapp 2013) depending on the usage. Applying game-like situations in the structure around the content is called structural gamification. It includes setting clear goals, providing real-time feedback, transparency, status, and similar. It also provides progress indicators such as badges, leaderboards, points, levelling-up, virtual goods and external elements such as social sharing. Content gamification alters the content to become more game-like to attract users. Content gamification includes content related characters, such as avatars, and activity-related components, such as challenging tasks, content unlocking, and competitions. Game-like situations can be analysed and categorized into game dynamics, game mechanics and game components.

Game dynamics denote abstract level concepts created in the player's mind when game mechanics are applied in the real-world (Werbach and Hunter 2012). Game dynamics (such as achievements, emotions, constraints, and surprise) provide framing for games but do not directly interact with the players or users.

Game mechanics are the construction of rules, feedback loops, procedures, or methods invoked by the agent, designed for player interaction (Sicart 2008). Game mechanics represent a manifestation of game dynamics. Sample mechanics refer to the acts of rewarding, providing feedback, levelling-up, collaborating etc.

Game components are the manifestation of game mechanics to achieve goals, determined by game dynamics (Werbach and Hunter 2012). Game components are the real world interactions denoted by physical or virtual objects and acts. Game components are

referred to as game design elements at the level of game interface design patterns (Deterding et al. 2011). This study uses the "game component" convention since the term is well adopted in this research field (Werbach and Hunter 2012; Sailer et al. 2017; Bartel and Hagel 2016; Cheong et al. 2014). Game components work at the user interaction level (Bartel et al. 2015) within a non-game context, driven by the respective game mechanics. Further, the game components maintain and inform the game state representing the player, action, function, game space, and values (Salen and Zimmerman 2005). Popular game components are points, badges, and leaderboards (Lister 2015). For example, components such as badges indicate achievement and often motivate learners (Ifenthaler et al. 2016; Mah 2016). Digital or open badges are an online, validated record of achievement issued by credible organizations (Jovanovic and Devedzic 2014), which motivate and engage user to achieve a goal.

2.4.2 Motivation and Engagement

Motivation plays a major role in learning, including TVET (Lüscher and Dore 2011) and learner motivation is considered as a critical success factor in eLearning (McPherson and Nunes 2008). By proposing self-determination theory (SDT), Ryan and Deci (2002) demonstrated that humans are motivated because of competence, autonomy, and relatedness. They suggest that these factors trigger motivation, or inspire a person to perform an activity. If an activity is inherently interesting and enjoyable, it creates intrinsic motivation. Conversely, if the outcome of an activity is separable, it leads to extrinsic motivation (Ryan and Deci 2002). Learners find tasks inherently interesting and enjoyable when they are intrinsically motivated (Bosch et al. 2019). The desire to learn is considered more of intrinsic motivation, and the learner, therefore, spends more time on learning, which can contribute to better performance (Malone 1981). It has been empirically demonstrated that interesting and engaging course content leads to the intrinsic motivation of the learners (Ryznar and Dutton 2019). Firat et al. (2017) mentioned that intrinsic motivation in distance education and eLearning context is vital but does not vary according to gender, program structure, instruction type or academic disciplines. Conversely, it has been suggested that intrinsic motivation could be devalued because of external rewards (Husen and Postlethwaite 1994). Later, Mekler et al. (2013) found that points, badges and leaderboards do not reduce intrinsic motivation.

Keller (1987) presented a motivational model for instructional design, comprised of Attention, Relevance, Confidence, and Satisfaction(ARCS), which increases the motivation of online learners as confirmed through empirical evidence (Chaiprasurt and Esichaikul 2013). The ARCS model is more focused on self-learning, which, in a student-centred system, is divided into 12 sub-attributes in the educational context. The ARCS model has more attributes and is more descriptive than the self-deterministic theory which is described above. The model is customised and relevant motivational factors, with a psychological basis, and a design strategy are applied to embed motivational design into lesson planning, as shown in Table 1.

Hamzah et al. (2015) have used the ARCS motivational model with Gamification (ARCS+G) as a guide for the gamification of learning which extends confidence and satisfaction with a few game components. However, the ARCS+G model lacks the engagement factor. In another study (Hu et al. 2018), an ARCS motivation strategy is used to deliver basic maths lessons in elementary school using the blended mode. Similarly, a study by

Table 1 Motivational factors and psychological basis of the ARCS model (Keller 2000)

Motivational factor	Psychological basis (Design strategy)	Motivational factor	Psychological basis (Design strategy)
Attention	Capture interest (Perceptual arousal)	Confidence	Success expectations (Learning requirements)
	Stimulate inquiry (Inquiry arousal)		Success opportunities (Learning activities)
	Maintain attention (Variability)		Personal responsibility (Success attributions)
Relevance	Relate to goals (Goal orientation)	Satisfaction	Intrinsic satisfaction (Self-reinforcement)
	Match interests (Motive matching)		Rewarding outcomes (Extrinsic rewards)
	Tie to experiences (Familiarity)		Fair treatment (Equity)

Thurston (2018) highlights the ARCS model combined with the four-phased model of interest development, showing a positive impact on the learning experience.

Apart from the ARCS instructional model, the popular instructional design model called ADDIE (Analysis, Design, Develop, Implement and Evaluate) has a proven record of providing high quality instruction to learners acquiring specific expertise. The complexity of the original design and the lack of systemic connection to host organization were the drawbacks of the ADDIE model (Allen 2006).

This research deploys the ARCS model as it is seen as providing a more organised and systematic approach compared to other motivational models (Hodges 2004). The ARCS model extends into twelve subsections and addresses motivational attributes extensively in the educational context.

Engagement is a critical factor in eLearning and provides enhanced learning experience while helping to achieve good grades (Amriani et al. 2013). Gamification can be used to stimulate engagement by motivating the learner through making game-like situations in non-game contexts (Lee and Hammer 2011) such as eLearning. Further, engagement is divided into three main areas called behavioural, emotional and cognitive, which are described in Sect. 4.2.

2.5 Related Works

There are only few extensive literature reviews available on gamification. Our review therefore focuses on a selection of gamification studies (Hamari et al. 2014; Surendeleg et al. 2014; Dicheva et al. 2015; Seaborn and Fels 2015; Albertazzi et al. 2019) from the perspective of eLearning in higher education and blended eLearning in TVET.

The review of peer-reviewed empirical studies by Hamari et al. (2014) explores motivational affordance, psychological outcomes and behavioural outcomes of gamification. It shows that gamification provides positive effects and highly depends on the contexts and users. Surendeleg et al. (2014) noted that future gamified learning is more focused on lifelong learning and improving adult skills. They highlighted the need for exploring gamified interfaces and content related structures. The mapping study published by Dicheva et al. (2015) indicates the need for technological support and they report promising results in gamification applications in the education context. Seaborn and Fels (2015) conducted a study of available gamification literature focussing on theory and applied research and provided recommendations for future research in different directions. They have identified the pressing need for the exploration of a wider range of game components across different contexts and robust experimental designs. Albertazzi et al. (2019) have presented a panoramic research map of gamification and they have identified education, training and academia as the most concentrated research areas of gamification.

It has been recognised that gamification correlates with student performance, enhances voluntary participation in course activities, and helps foster interaction and positive feedback from learners (Iosup and Epema 2014). Iosup and Epema observed learner satisfaction and enjoyment during the course, with the outcome of increased participation and a higher pass rate. In another review, Lister (2015) presented a case-based survey to determine the extent of gamification that supports student achievement and motivation, which found a positive effect on learner motivation among post-secondary students. He analysed gamification studies and revealed that it supports student motivation and achievements at the post-secondary level. Lister emphasised the need for careful consideration of learning profiles when implementing gamification. Moreover, Glover (2013) has cautioned that

less-competitive, status-seeking learners, who usually represent the TVET sector, should not be discouraged due to high public competitiveness in gamification. Bartel et al. (2015) proposed a method of linking game dynamics to determinants of CBE in the TVET sector. They described a theoretical process of connecting dynamics as game design elements with CBE. Their study highlights the five most effective game dynamics in the context of CBE as constraint, emotion, narrative, progression, and relationship.

A case study on using gamification in technical higher education introduces the gamification toolbox (Iosup and Epema 2014). In their study, an evaluation was conducted and realized that gamification could be effectively used in delivering technically challenging courses. Furthermore, it has shown an increase in the pass-rates and participation in voluntary activities and challenging assignments with greater student satisfaction. Domínguez et al. (2013) designed and built a gamification plugin for a well-known eLearning platform in a university course, collecting quantitative and qualitative data in the process. In addition, the outcome was an excellent social and emotional impact through the reward system while providing innovation, fun and encouragement. Sailer et al. (2017) presented empirical evidence on the development of workplace competencies in the context of intra-logistics by gamifying training and manual work process. They examined work performance in manual order picking and observed that performance is significantly higher in the gamification group than in the controlled group.

Gamification aims at providing an immersive learning experience to the learner. According to Witmer and Singer (1998), immersion is a psychological state in which the learner perceives themselves to be enveloped in and interacting with a virtual learning environment. Immersion further provides a continuous stream of stimuli and experiences. Gamification creates intrinsic motivation (Lister 2015; Liao et al. 2019) using game dynamics, mechanics and components, and thereby the learner undergoes an immersive learning experience.

Compared to other selected gamification studies, the proposed study focuses on enhancing learner motivation by using gamification in blended mode eLearning courses in the TVET sector. To determine the impact on blended eLearning in TVET, control and experimental groups will be arranged in two parallel courses. Gamification design is embedded in one course, assuming other factors are similar to both groups. The study intends to use subjective and objective evaluations to assess the impact on learner success, and thereby evaluate the outcomes both quantitatively and qualitatively.

3 Methodology

The methodology section as shown in Fig. 1 consists of three stages, which provide information on the design, development, implementation and evaluation.

Sections 4 to 6 describe the entire process from the development of a conceptual framework up to the evaluation of the proposed blended eLearning course. Gamification design, including motivational and engagement design, is described under Sect. 4. Section 5 elaborates on the development of the operational model and the gamified course. Implementation of the gamified and non-gamified courses, including system architecture, is shown in Sect. 6, indicating how the system works and what game components are being used during the course implementation followed by evaluation of the gamification effect using objective and subjective approaches between control and experimental groups, which is planned at the next stage of the study.

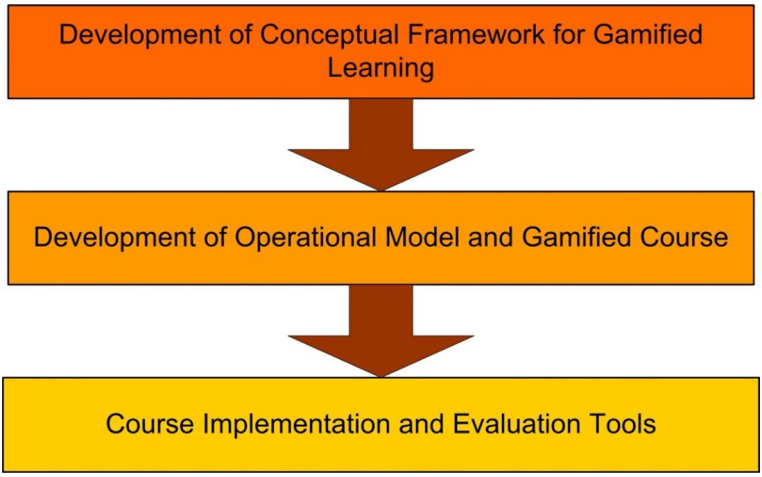

Fig. 1 Research stages

The research design approach, outlined in Fig. 2, commences with the conceptual framework and model-building phase, followed by design and development, implementation, and ending with the evaluation phase. Each phase is comprised of specific activities, described in detail. In the experimental design, motivation is considered as an independent variable while engagement and competency are the dependent variables. When motivation increases, engagement increases and more learning happens. This will be identified by measuring learner performance.

Model building Game dynamics, mechanics, and components are identified (according to the scope) through contextual inquiry and the theoretical foundation. Motivation and engagement designs are carried out according to the relevant theory. Then, relationships are identified to construct the conceptual framework and operational model. The proposed system uses objective and subjective evaluation data as feedback to improve the model. The paper discusses the conceptual framework in Sect. 4 and the operational model in Sect. 5.

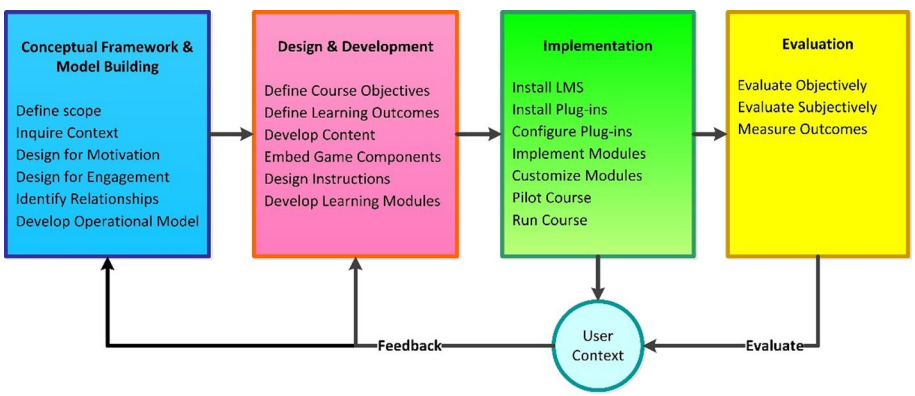

Fig. 2 Research design

Design and development Learning content is developed according to the course objectives and learning outcomes. Motivational and engagement designs are applied to course modules using game components. Module development is then completed by applying the instructional design to the learning content to achieve the learning outcomes. The Learning Management System (LMS) is tested in the design and development phase, to ensure the use of appropriate game components to implement methods invoked by the game mechanics.

Implementation This stage focuses on installing the webserver and the "Moodle" LMS. Necessary plug-ins are installed and configured to deploy game components in the LMS for structural and content gamification. Learning modules are implemented with the learning content. Modules are customised and the course gamification is ensured in terms of content and structure. Course delivery in the TVET context is carried out with the pilot run followed by the live run.

Evaluation A pre-test and post-test for all course modules are conducted for experimental and control groups to evaluate learner progress. Motivation, engagement, and competency are evaluated using pre-defined evaluation criteria. The results for learners in the gamified course are compared with the learners in the non-gamified course to evaluate the outcome of learner progress and gamification design. The outcome of the subjective evaluation of each learner is compared with objective data for verification.

During the experiment, it is assumed that only the gamification factor is different between the two learner groups and thereby that a change of engagement and competency is only dependent on motivation and that motivation is dependent on the effect of gamification.

4 Development of Conceptual Framework for the Gamified eLearning in Blended Mode

According to the author developed conceptual diagram (Fig. 3), the game dynamics, mechanics, and components in the game context are applied to the learning context through gamification design especially elaborated for the purpose.

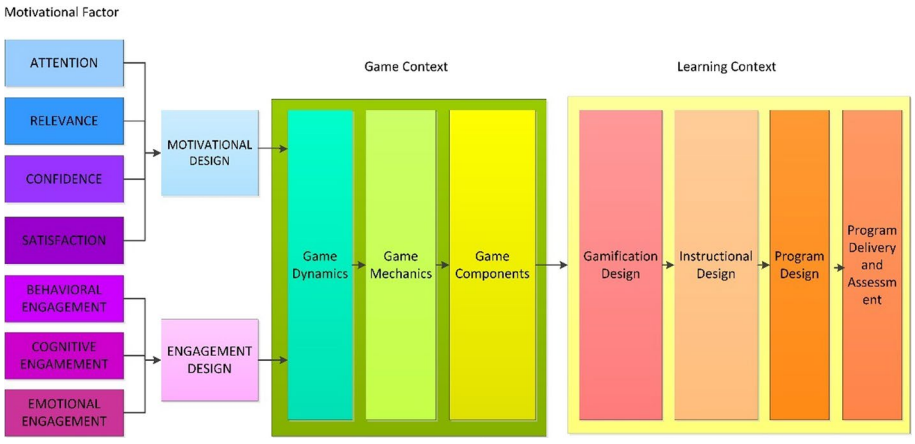

Fig. 3 Conceptual diagram for embedding motivational and engagement designs into eLearning

Figure 3 shows the conceptual diagram consisting of relevant concepts based on empirical research and describes the relationships between the main concepts. Game dynamics, starting from motivational and engagement elements work in the game context fed in to gamification design, which is incorporated into the learning context. The logical structure connecting two contexts (i.e. game context and learning context) provides a visual display of how components are linked together.

Game dynamics are selected according to the motivational and engagement designs. The course designer uses gamification design to gamify the learning content and activities followed by the instructional design for delivery in a virtual learning environment with face-to-face practical sessions using intermediary program design techniques. Evaluation of students will be carried out during and after delivery of learning modules to assess progression in learner competency development.

4.1 Motivational Design

Firat et al. (2017) identified the ARCS model of motivational design as being the most appropriate for the educational context, especially in blended eLearning environments, as the ARCS model's attributes are well attuned to the learner-centric educational approach.

According to the ARCS model (Keller 2000), different psychological elements contribute to driving motivational factors. These elements include as attention, relevance, confidence, and satisfaction. Keller (2000) divides *attention* into perceptual arousal, inquiry arousal, and variability. Poulsen et al. (2008) suggest that perceptual arousal can be achieved by creating a "surprise" occasion. The game dynamic "surprise" refers to an occurrence of an unexpected event, or non-occurrence of an expected event (Fischhoff and Beyth 1975). The surprise could be implemented using the game mechanic of an unexpected event in the eLearning context by deploying game components such as a pop-up quiz or surprise message. According to Keller (2009), "inquiry arousal" generates curiosity, which leads to positive emotions and a desire for information, learning, recognition, and pursuit of novel and challenging opportunities (Kashdan et al. 2004). The game mechanic "curiosity" refers to problem-solving and can be implemented through game components such as scenario-based problem-solving, provocative questions and quizzes (Poulsen 2008). The variability refers to the ability of a system or artefact to be efficiently extended, changed, customised, or configured for use in a specific context (Svahnberg et al. 2005). Variability uses the game mechanic "variation" for a more novel learning experience. The variation uses game components such as appealing styles and attractive designs for the user interface.

Keller (2000) divides *relevance* into familiarity, goal orientation, and motive matching. Familiarity is the understanding of an entity, often based on previous interactions, experience, and learning (Komiak and Benbasat 2006). Familiarity refers to the game mechanic "tie to experience", which could be implemented through practical material such as narrations, stories, and familiar characters. Goal orientation is defined as the effective use of self-regulation to set goals and manage the performance themselves (Landers et al. 2017). The game mechanic "goal setting" (Winters and Latham 1996) uses pre-defined learning goals and shows the progress of each goal during the course. Motive matching uses the game dynamic "control and choice" (Lowe 2012), which deploys user control over the environment. The degree of control over the study choices enhances learner interactivity. The game mechanic "meaningful choices" provides control over the selection of quizzes,

discussion-forum thread choices, and activity sequence choices, as game components to provide learner autonomy.

Confidence can be divided into the expectation of success, opportunities for success, and personal responsibility (Keller 2000). The course requires the expectation of success to be fulfilled during delivery and pre-informs the learners regarding course requirements. Consistently successful learning is fulfilled through dynamics and concepts such as the freedom to fail, rapid feedback, storytelling, and progression (Stott and Neustaedter 2013). The "progression" game dynamic can be selected as the psychological basis of "success expectations". Progression is the growth and development that occurs as a learner navigates a course, from novice to visionary level, in terms of key concepts, processes, strategies, practices, or habits of mind (Adams and Dormans 2012). Learner progress and levels represent the game mechanic, "levelling-up". Progress bars or module-end quizzes denote game components. "Challenge" can be selected as the game dynamic of "success opportunities" (Robertson and Howells 2008), which means the desire to attain a goal, together with its intrinsic value and perceived difficulty, is constrained by rules and limited resources (Van 2010). As Kapp (2012) suggests, game mechanic "challenge" can use the game component "flow-state". The balance between course challenge and learner skill can be used as the relevant game component. The game dynamic "achievement" can be mapped to personal responsibility (Zimmerman and Kitsantas 2005). Achievement, as defined by de Marcos et al. (2016) is the acquisition of cognitive and non- cognitive skills, successfully measured by an evaluation. The game mechanic "feedback" can be used as a tool to indicate "achievement" in a context where the relevant game components in the learning context are represented by grades, badges, rewards, which allow the learner to self-monitor their progress.

Satisfaction influences learners towards having positive feelings about their learning experience and is divided into intrinsic satisfaction, rewarding outcomes, and fair treatment (Keller 2000). Intrinsic satisfaction in eLearning refers to the provision of an effective, positive response by the learner, stimulated by the course quality, and drives the game dynamic "satisfaction". "Meaningful content", which refers to a material with significant concepts and propositions (Hay et al. 2008) is the relevant game mechanic. Use of relevant quality content for learner satisfaction is the game component in the eLearning context. Learner success and recognition are supported by rewarding outcomes as reinforcements (Keller 2000) and, therefore, "recognition" acts as a game dynamic extracted from gamethinking. The game dynamic "recognition" is defined as an assessment of social motivation created by the perception of being recognised by peers (Kim et al. 2018). "Reinforcement feedback" denotes the game mechanic while recognition of achievement in social groups is the relevant game component. The game dynamic "equity" is described as maintenance of a consistent standard, fair treatment, and standardised measurements in assessing learner tasks (Small 1999). Transparency, in which everyone's progress is known, can be considered as the game mechanic (Bedard 2015), which could be implemented through a leader board, where peer progress is the game component.

4.2 Engagement Design

Engagement is a critical success factor in learning and requires rigorous planning, creativity, and monitoring to obtain the desired learner performance (Carini et al. 2006). Raftopoulos (2014) states that engagement depends on the intrinsic nature of the activity itself and needs careful design to avoid value destruction risk. This occurs when some

applications target outcomes more than enjoyment. Therefore, the challenge in transferring engagement design from gameplay necessitates careful attention. Engagement is divided into three types: behavioural, emotional, and cognitive (Fredricks et al. 2004). Engagement types can be implemented by selecting appropriate game dynamics, mechanics, and components.

Behavioural engagement utilises efforts, attention, and persistence as qualitative aspects, and is measured through user ratings (Gonida et al. 2007). "Persistence" is selected as the game dynamic relevant to behavioural engagement (Deater-Deckard et al. 2014), valid for face-to-face, practical, online, or blended eLearning contexts (Milman 2016). Persistence is the likelihood of a learner's continued enrollment, intention, and willpower to complete the course (Shin 2003). Persistence uses the game mechanic "completion" (Lint 2013) with supporting game components such as student performance, marks, and Grade Point Average (GPA).

In eLearning, game thinking enhances *emotional engagement*, which eventually leads to intrinsic motivation (Lee and Doh 2012). Emotions are bodily expressions of feelings or reactions, defined as the combination of physiological, psychological and psychomotor components, and feelings of bodily expressions (Arbib 1992). Some emotions can be divided into positive and negative, for example: happy (positive), pride (positive), angry (negative), and bored (negative) (Connell and Wellborn 1991). Accordingly, "emotion" is selected as the appropriate game dynamic. Emotional feedback represents the game mechanic, which creates significant behavioural intention (Terzis et al. 2012). Emotional information in the eLearning context uses emoticons to express feelings by the learner, instructor, or other system feedback. User ratings on the LMS, content, tutors, learner-tutor relationship and learner's work orientation (Finn 1989) are indicators for measuring emotional aspects of engagement.

Cognitive engagement relates to flexible problem solving, preference for hard work, independent work styles, and coping with failures according to a study by Fredricks et al. (2004). They elaborate other factors as quality of discourse, authentic questions, and characteristics that encourage learner's engagement. Understanding, constructing, and self-regulating in knowledge construction confirm that learners comprehend learning contents well when the level of perceived cognitive engagement is high (da Rocha Seixas et al. 2016). The relevant game dynamic "comprehension" is defined as understanding the meaning of material and be able to translate, interpret, and extrapolate (Shareef et al. 2013). "Visualization" is considered as the game mechanic of comprehension (Kendall 1980) and could be implemented through game components like anchor charts.

Table 2 illustrates the design for gamification implementation, as per the ARCS motivational framework, using appropriate game dynamics, proposed game mechanics, and possible game components described in Sects. 4.1 and 4.2. The instructional designer can select appropriate game components to suit the application in different contexts and domains.

5 Development of Operational Model and Gamified Course

5.1 Operational Model Development

The schematic flow of the operational model for gamification design in blended mode eLearning for a TVET context is depicted in Fig. 4. The model proposed by the authors

Table 2 Motivational and engagement design for gamification implementation

Motivational factor	Psychological basis	Relevant game dynamic	Definition	Proposed game mechanic	Possible game component/s
Motivational design					
Attention	Perceptual arousal	Surprise	The occurrence of an unexpected event or non-occurrence of an expected event	Unexpected event	Pop quiz, Surprise message
	Inquiry arousal	Curiosity	Positive emotions and desire for information, learning, recognition, pursuit of novel and challenging opportunities	Problem-solving	Scenario-based problem-solving, Provocative questions, Quizzes
	Variability	Variability	The ability of a system or artefact to be efficiently extended, changed, customised, or configured for use in a particular context	Variation	Appealing styles, Attractive design of user interface
Relevance	Familiarity	Familiarity	One's understanding of an entity, often based on previous interactions, experience, and learning	Tie to experience	Use of practical scenario, Stories, Narrations, Familiar characters
	Goal orientation	Goal orientation	Effective use of self-regulation to set goals and manage their performance	Goal setting	Set learning goals and show progress
	Motive matching	Control and choice	User control over the environment enhances interactivity, in which the user has a degree of control over the study choices	Meaningful choices	Activity sequence Choices, Quizzes, Start/reply threads (Points oriented) in discussion forums

Table 2 (continued)

Motivational factor	Psychological basis	Relevant game dynamic	Definition	Proposed game mechanic	Possible game component/s
Confidence	Success expectations	Progression	Growth and development which occur as a learner navigates a course from novice to visionary level	Levelling up	Module end quiz, Progress bar levels
	Success opportunities	Challenge	Desire to attain a goal having intrinsic value and perceived difficulty, constrained by rules and limited resources	Flow-state	Balance between the course challenge and learner skill
	Personal responsibility	Achievement	Acquisition of cognitive and non- cognitive skills, successfully measured by an evaluation	Feedback	Grades/Badges/Rewards, Enable learner to self-monitor progress
Satisfaction	Intrinsic satisfaction	Satisfaction	Affective positive response of learner, stimulated by the course quality	Meaningful content	Use of quality content and supporting material
	Rewarding outcomes	Recognition	Social identification of a learner for previous encounters or knowledge	Reinforcement Feedback	Recognize achievement in social groups
	Fair treatment	Equity	Maintenance of consistence standard, fair treatment and standardised measurements for learner tasks	Progress transparency	Leaderboard with peer progress
Engagement design					
Behavioural engagement		Persistence	Likelihood of learner's continued enrollment, intention and willpower to complete the course work and practical	Completion	Points (Marks), Grade Point Average (GPA)

Table 2 (continued)

Motivational factor	Psychological basis	Relevant game dynamic	Definition	Proposed game mechanic	Possible game component/s
Emotional engagement		Emotion	Combination of physiological, psychological and psychomotor components and feelings of 'bodily expressions	Emotional feedback	Learners to use emoticons to express feelings
Cognitive engagement		Comprehension	Understand the meaning of material and able to translate, interpret and extrapolate	Visualization	Anchor Charts

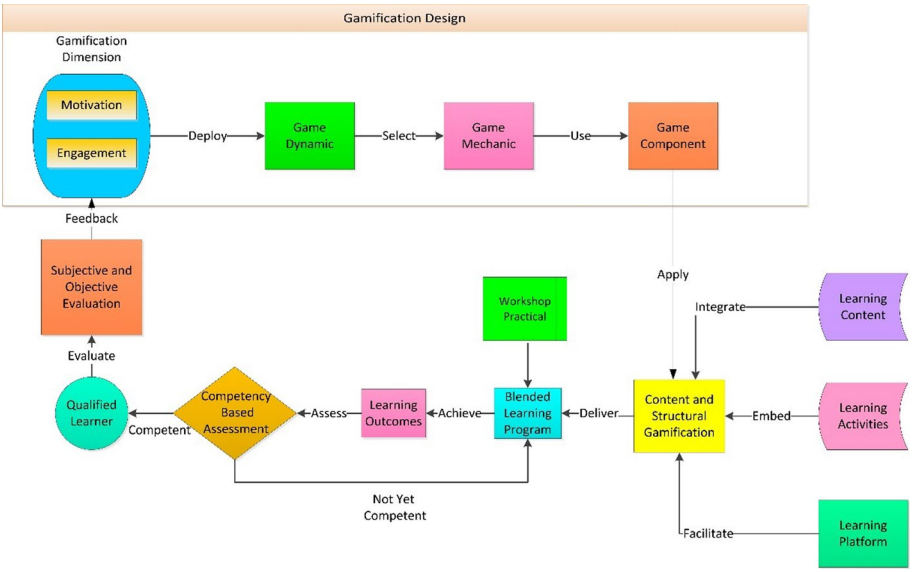

Fig. 4 Operational model for gamification in blended eLearning

aims to show the application and operation of game thinking in non-game contexts, which is blended eLearning in this case.

Bartel and Hagel (2016) presented a gamified course design process (GCDP) from competency profile to learning outcome and consolidate learning activities, which integrates game dynamics, mechanics and components. This finding was helpful in designing above operational model, which uses right mix of game components to achieve the intended learning outcomes according to the learner feedback.

In the proposed model, gamification design starts from motivation and engagement as vital requirements in an educational context. Keller's (2009) ARCS motivational design model and other theoretical foundations are used to deploy motivational and engagement design through appropriate game dynamics. Suitable game mechanics are selected to drive relevant game dynamics, and use appropriate game components. Game components are applied to content and structural gamification using different techniques, integrating into "Moodle" LMS. During the delivery of the course, learners' practical marks are entered into the system for final grades.

Proper use of game dynamics, mechanics, and components from the gamification design enhances positive outcomes in the desired behaviour of the learner. The desired behaviour of the learner is complementary to achieving the course objectives. The output of the gamification design enables the delivery of a blended eLearning course with workshop practical. CBA uses competency standards to assess whether and the extent to which learners have met the learning objectives. Additionally, CBA evaluates the learner in terms of levels of performance in skills, knowledge, and attitudes, using standard evaluation techniques supported by CBA material. This is guided by the evidence matrix (Petch et al. 2007), a specification of performance criteria and the type of evidence used to assess specific learner competencies. If the learner is sufficiently competent in all units in the competency standard, the Qualification Authority (QA) issues the qualification or otherwise redirects the learner to acquire lacking skills and study course resources to appear for a

re-assessment. This provides the learner with the necessary guidance and time to acquire the required competencies.

Feedback from learners will be used to improve system performance. The operational model supports different and changing behaviour of the learner, using varied and adjusted game components, intended to reinforce the desired behaviour of the learner. This model is deployed in the current study for implementation of the gamified course in the TVET context. The experimental design, based on the proposed operational model, will be implemented using a blended mode gamified eLearning program and delivered to the selected sample population. Competency development will be evaluated by assessing the learner competency before and after the blended mode eLearning programs.

5.2 Design and Development of Gamified Course

This study tries to build game thinking into activities to engage different types of learners, and make learning fun and pleasurable. Addressing the personal and social needs of the learner makes the learning journey an engaging experience. A learner scaffolding method is deployed to make the learner enthusiastic about learning, without feeling anxiety or boredom (Zichermann and Cunningham 2011). Different game dynamics, mechanics, and components are intended to enhance motivation and engagement during the learning process. New challenges embedded in the program design make the learner engaged in the learning lifecycle. Novice learners might need "onboarding" to overcome challenges in some learning activities. They start with easy tasks and develop as a regular learner through habit building. Eventually, the learner becomes enthusiastic and progress into the mastery level, developing full learning potential. The next sections describe how this transformation is accomplished.

Table 3 displays the motivational and engagement design proposed by the authors, used to gamify the target blended eLearning course on the "Moodle" platform, using each game component by deploying content and structural gamification, integrating learning content, and activities to deliver the blended eLearning course.

6 Implementation and Evaluation Plan of the Gamified eLearning Course

6.1 Implementation of Gamified and Non-gamified courses

In the proposed study, a staged approach is adopted.

Course development A non-gamified blended eLearning course will be created on the "Moodle" platform to be delivered to the target student group. A gamified version of the same course will also be developed.

Participant selection procedure: Segmentation of the student group will be done by offering an online selection test to all the registered students. Once the selection test marks are obtained, the group will be divided into two odd and even-numbered groups by arranging students' marks in ascending order. The two groups will be called the control group and the experimental group respectively. The control group will be offered the non-gamified eLearning course and the experimental group will be offered the gamified version.

Course design and delivery The system architecture for the gamified course delivery is shown in Fig. 5. The course will be delivered using a "Moodle" LMS which connects

Table 3 Gamification implementation in "Moodle" platform

Gamification Dimension	Psychological Basis	Relevant Game Dynamic	Game Component	Moodle Implementation
Motivational Design				
Attention	Perceptual arousal	Surprise	Surprise message	
	Inquiry arousal	Curiosity	Scenario-based problem-solving quiz	
	Variability	Variability	Attractive design of interface	
Relevance	Familiarity	Familiarity	Familiar characters	
	Goal orientation	Goal Orientation	Set learning goals	
	Motive matching	Control and Choice	Activity sequence choices	
Confidence	Success expectations	Progression	Progress bar	
	Success opportunities	Challenge	Levelling-up on task completion	
	Personal responsibility	Achievement	Badges	
Satisfaction	Intrinsic satisfaction	Satisfaction	Relevant quality content	
	Rewarding outcomes	Recognition	Recognise achievements in social groups	
	Fair treatment	Equity	Leaderboard with peer progress	
Engagement Design				
Gamification Dimension		Game Dynamic	Game Component/s	Moodle Implementation
Behavioural engagement		Persistence	Points(Marks), Grade Point Average (GPA)	
Emotional engagement		Emotions	Emoticons, (express feelings)	
Cognitive engagement		Comprehension	Anchor Charts	

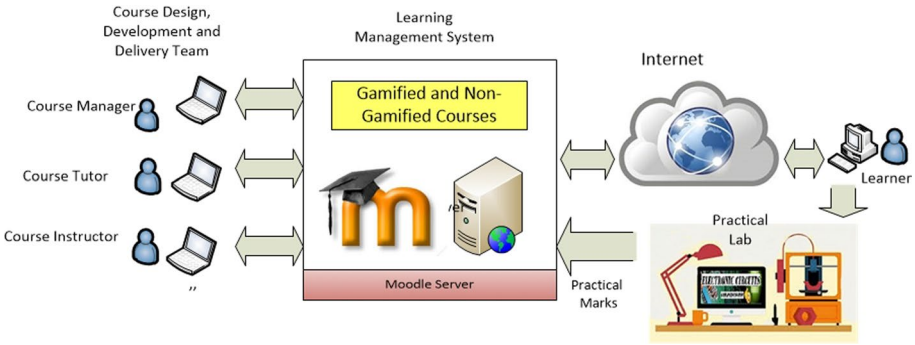

Fig. 5 System architecture for gamified course delivery

to the internet, allowing online users to interact with the course. The course delivery team will consist of a course manager, course tutor and course instructor, who support an effective learning experience. Laboratory assistants will keys-in marks for the practical into the LMS, enabling the issue of final module assessment results.

The proposed system implementation will use "Moodle" open source LMS, developed using PHP programming language and MySQL database, to implement the blended eLearning course. The blended eLearning course on "Electronic Circuits" is developed at the undergraduate level, and will be gamified with game components to achieve content and structural gamification.

In the gamified course, each game component will be carefully implemented within the course, aiming for the intrinsic motivation of the learner. The customised Moodle LMS will use 15 game components and Fig. 6 depicts a screenshot of the gamified course, which shows marked selected game components such as levels, progress bars, points, grades, virtual gifts, ranking, and "Facebook" block, to provide the gamified user experience.

A pilot course will be run to test the system. At the pilot stage, a focus group will be used to evaluate the developed course. Adjustments will be made based on the feedback

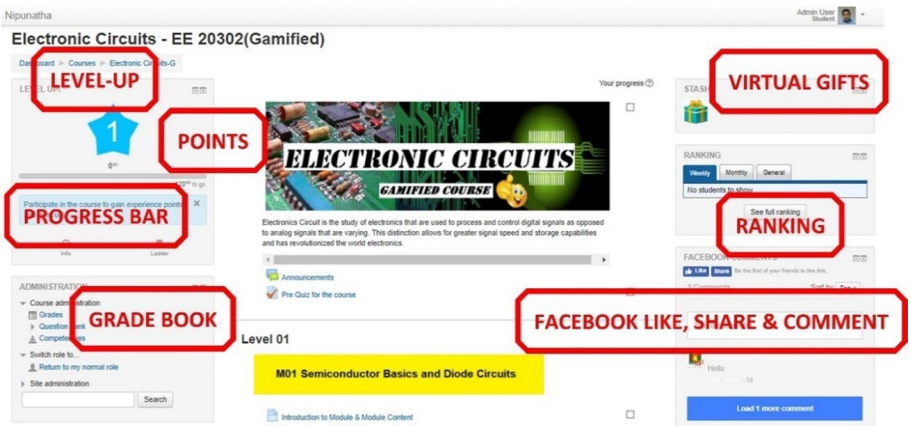

Fig. 6 Screenshot of gamified eLearning course

and comments according to the comments and course will then be opened for wider roll-out.

6.2 Evaluation Plan

The control group will be offered the standard blended eLearning course while the experimental group will be offered the gamified course. Both courses will run for 12 weeks before the final online test. Pre and post-test methods of assessment will be deployed to measure the progress made by each student for each module in the course. The game components under each game dynamic will be changed between the modules to examine the effectiveness of a particular game component for the selected learner group. At the end of each module, learner perceptions of each game component will be collected and analyzed (Cheong et al. 2014) to ascertain the appropriateness of the game elements for different learners. Demographic variables such as age, gender, geographic location, and education level will be collected via an online form for analysis to review against learner preferences and liking of the different game components.

During the course, learning outcomes will be measured using the online end-of-module assessment of knowledge for each module, and the results will be recorded. Practical labs will be conducted face-to-face and practical assessment marks will be added to the module marks to obtain the final competency-based assessments results. "Not Yet Competent" students will be directed again to practice the course and will be allowed re-assessment after a reasonable time to attain the qualification.

Learner liking of each game component will be evaluated using the five-point "Likert" scale at the end of each course module through an online questionnaire survey. The collected data will be analysed against demographic variables to identify the most effective game components for varied demographics.

7 Discussion

This study proposes a concept, design, and methodology to solve motivational and engagement issues in eLearning. While competency based education features broadly across all education sectors, the focus of this study is on the CBE in the blended mode within the skills development domain. As Bartel et al. (2015) reiterate, CBE requires different learning strategies to the transfer of knowledge and, within the vocational sector, focuses more on professional practices and emerging issues in the workplace. In CBE, more transparency is experienced by learners and assessors due to the articulation of clearly defined learning outcomes in curriculum outlines and performance criteria for leaner assessment established as part of the competency standards. Motivational and engagement design techniques enhance active learning and ensure learner-centred instructional design.

The proposed gamification design presents fifteen game components to apply within the content and, structural gamification for an eLearning course. The motivational design is based on the ARCS model (Keller 1987) and its applications in the education domain for developing the operational model. The motivational design of the ARCS model is mapped with appropriate game dynamics to blended eLearning in the TVET context. The application of game-thinking facilitates motivation and engagement of learners towards the eLearning. The proposed gamification design contains different game components, which are aimed at intrinsic motivation rather than extrinsic motivation. The diversification of

game components in user interaction design reduces the common use of points, badges, and leaderboards leads to limited creativity (Seaborn and Fels 2015). As immediate feedback is a necessity in implementing the motivational design in the learning platform design, the LMS can provide immediate feedback to the learner through automated responses, avoiding the delayed manual feedback by the tutor (Domínguez et al. 2013), which helps improve user engagement in eLearning.

The proposed gamification design and operational model facilitate the gamified eLearning course through guiding mechanisms for the manager, tutor and learners. Course challenges are matched with the ability of the learner to avoid boredom or anxiety. For example, as a result of feedback provided by learners through subjective and objective evaluations, adjustments can be made to the different game dynamics. In this case, alternative game mechanics and components can be selected to optimize the optimal learning experience. Simões et al. (2013) refer to flow-state, which is established by setting achievable learning challenges to match leaner skills. The task schedule offers tasks of incremental difficulty as the learner progress, in this way providing the necessary scaffolding for the learner (Werbach and Hunter 2012), and ensures course continuity.

The gamified course provides the learner with control and choice, addressing the issue of autonomy for intrinsic motivation (Blanchard and Frasson 2004). The feature of relatedness is embedded in the proposed course through quick recognition of learner achievements among social groups. The proposed motivational design of the gamified course complies with the three basic elements of self-determination theory (Ryan and Deci 2002): competence, autonomy, and relatedness.

As gamification is relatively new to the TVET sector, limited research studies are available as empirical evidence. In the experiment we plan to treat all learners equally with structural and content gamification within a course but it might not satisfy learners with different learning behaviours, which is a limitation of the study, as the gamified course cannot fulfil all learners' preferences due to the varied behaviour of the learners. Learner feedback is based on the expressed perception of learners and may not represent their actual feelings or likings. The study uses a purposive sampling method selecting an enrolled group of participants, which might not a representative sample for the entire student population. Furthermore, it is assumed that all other factors except gamification are similar to both experimental and control groups, which differs from the reality.

8 Conclusions and Future Work

This study aims to enhance motivation and engagement in blended eLearning, focusing on the development of gamification design and the operational model. The proposed gamification design intends to make a significant impact on CBE in TVET by introducing game thinking into the educational context to help improve learner motivation and thereby fostering the achievement of the required competencies. The proposed operational model can potentially be used to motivate users in different contexts, such as education, marketing, management, or customer support, all of which require high levels of user motivation and engagement. The emerging gamification trend is becoming stable and sustainable methods for deploying distributed human interaction systems for capturing emerging opportunities, especially in the education and training sector, have been adopted. When delivering blended eLearning programs for CBE, the need for higher

motivation and engagement is considered crucial in overcoming areas of weakness, such as higher learner dropout rates and low levels of achievement (Jayalath and Esichaikul 2016).

Although TVET is currently an emerging domain for the deployment of game thinking, the take up of such approaches can offer significant benefits by solving motivational and engagement issues as well as avoiding dissatisfaction and boredom of learners, thus offering a solution to higher dropout rates. Blended eLearning in TVET in developing countries faces the same challenges of low motivation of learners and shortage of well-designed content (Athanse et al. 2008). CBE, which features heavily in TVET, is a special focus in this study, following a different approach to purely academic programs. The requirement for greater practical skills together with core differences in delivery and evaluation mechanisms in CBE create a challenge for the implementation of blended eLearning programs. After program delivery, individual assessment requires compulsory evidence of student performance using continuous assessments for a vocational qualification to be awarded.

This research is one of the first of its kind on deploying game dynamics in TVET aiming CBE in the blended eLearning mode. Following the premise that in a gamified environment, the emotions which are generated through different game dynamics bring fun, enjoyment and pleasure to the learner (Robson et al. 2015; Dale 2014; Tiger 1992), every game dynamic used in the study is aiming to achieve those through the use of the ARCS motivational framework and its extension towards engagement dynamics. The design proposed in this study intends to provide fun and enjoyment using fifteen game components while achieving the expected learning outcomes through an immersive and pleasurable learning experience. The proposed design, which deploys gamification concepts in CBE through blended learning in the TVET context, is therefore novel and anticipates greater potential to diversify the use of game dynamics into new and practical areas.

Later, at the evaluation stage, course outcomes are to be measured using student achievement on the end-of-module online test for each module. Learners are assessed objectively through an online test for the knowledge assessment, and by using a laboratory practical test as the skills assessment. Student motivation will be measured using a self-reporting online questionnaire with a five-point "Likert" scale as a subjective measurement. Quantitative outputs will be verified using the qualitative responses of the learners to strengthen the outcomes. Subsequently, pre-test and post-test marks will be used to compare the change of competency and to analyse the outcomes of the experiment between gamified and non-gamified learner groups. User ratings for each game component will be collected after each module using an online questionnaire form to evaluate the usage of game components.

After a more widespread introduction of gamification applications in future, more game components will be invented, exposed and used in different gamified contexts. The cognitive experiences that evolve due to the exposure towards gamified applications could, however, modify human behaviour (Glover 2013), and create a potential risk in behavioural change. This was elaborated in a study over the concerns of externalizing problems or prosocial behaviour of users (Lobel et al. 2017) due to the online games. Longitudinal studies to examine the shift in human behaviour due to gamification could be an interesting area for future research. Finally, it will be worth exploring the effectiveness of game dynamics, mechanics, and components for demographically diverse audiences.

Acknowledgements This work is part of a research study supported by the Scholarship Donor: Skills Sector Development Programme (SSDP), Ministry of Skills Development and Vocational Training, Sri Lanka.

References

Adams, E., & Dormans, J. (2012). *Game mechanics*. Berkeley, CA: New Riders.

Albertazzi, D., Ferreira, M. G. G., & Forcellini, F. A. (2018). A wide view on gamification. *Technology, Knowledge and Learning, 24*(2), 191–202.

Allen, W. C. (2006). Overview and evolution of the ADDIE training system. *Advances in Developing Human Resources, 8*(4), 430–441. https://doi.org/10.1177/1523422306292942.

Amriani, A., Aji, A. F., Utomo, A. Y., & Junus, K. M. (2013). An empirical study of gamification impact on eLearning environment. In *Proceedings of 2013 3rd international conference on computer science and network technology* (pp. 265–269). IEEE.

Arbib, M. A. (1992). The cognitive structure of emotions: Andrew Ortony, Gerald L. Clore and Allan Collins.

Argüelles, A. (2000). Competency based education and training: A world perspective. Editorial Limusa.

Bartel, A., & Hagel, G. (2016, April). Gamifying the learning of design patterns in software engineering education. In *2016 IEEE Global Engineering Education Conference (EDUCON)* (pp. 74–79). IEEE.

Bartel, A., Figas, P., & Hagel, G., (2015), Towards a competency-based education with gamification design elements. In *Proceedings of the 2015 annual symposium on computer-human interaction in play (CHI PLAY '15)* (pp. 457–462). ACM, New York, NY, USA.

Bateman, C., & Nacke, L. E. (2010). The neurobiology of play. In *Proceedings of the international academic conference on the future of game design and technology* (pp. 1–8). ACM.

Beaudoin, M., Kurtz, G., & Eden, S. (2009). Experiences and opinions of e-learners: What works, what are the challenges, and what competencies ensure successful online learning. *Interdisciplinary Journal of ELearning and Learning Objects, 5*(1), 275–289.

Bedard, A. T. (2015). What candy crush saga teaches us about motivating employees. *Performance Improvement, 54*(4), 43–46.

Bhuasiri, W., Xaymoungkhoun, O., Zo, H., Rho, J. J., & Ciganek, A. P. (2012). Critical success factors for eLearning in developing countries: A comparative analysis between ICT experts and faculty. *Computers & Education, 58*(2), 843–855.

Bielawski, L., & Metcalf, D. S. (2003). Blended elearning: Integrating knowledge, performance, support, and online learning. Human Resource Development. ISBN 9780874257175

Blanchard, E., & Frasson, C. (2004) An autonomy-oriented system design for enhancement of learner's motivation in ELearning. In: J. C. Lester, R. M. Vicari & F. Paraguaçu (Eds) *Intelligent tutoring systems. ITS 2004*. Lecture Notes in Computer Science, Vol. 3220. Springer, Berlin, Heidelberg

Bosch, C., Mentz, E., & Reitsma, G. M. (2019). Integrating cooperative learning into the combined blended learning design model: Implications for students' intrinsic motivation. *International Journal of Mobile and Blended Learning (IJMBL), 11*(1), 58–73.

Brewer E. W., & Burgess D. N. (2005), Professor's Role in Motivating Students to Attend Class, https://scholar.lib.vt.edu/ejournals/JITE/v42n3/brewer.html Accessed 24 August 2017

Browne, C. J. (2019). Assessing the engagement rates and satisfaction levels of various clinical health science student sub-groups using supplementary eLearning resources in an introductory anatomy and physiology unit. *Health Education, 119*(1), 2–17.

Carini, R. M., Kuh, G. D., & Klein, S. P. (2006). Student engagement and student learning: Testing the linkages. *Research in Higher Education, 47*(1), 1–32.

Chaiprasurt, C., & Esichaikul, V. (2013). Enhancing motivation in online courses with mobile communication tool support: A comparative study. *The International Review of Research in Open and Distributed Learning, 14*(3), 377–401.

Cheong, C., Filippou, J., & Cheong, F. (2014). Towards the gamification of learning: Investigating student perceptions of game elements. *Journal of Information Systems Education, 25*(3), 233–244.

Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy, and relatedness: A motivational analysis of self-system processes. In M. R. Gunnar & L. A. Sroufe (Eds.), *The Minnesota symposia on child psychology*, Vol. 23. Self-processes and development (pp. 43–77). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

da Rocha Seixas, L., Gomes, A. S., & de Melo Filho, I. J. (2016). Effectiveness of gamification in the engagement of students. *Computers in Human Behavior, 58*, 48–63.

Dale, S. (2014). Gamification: Making work fun, or making fun of work? *Business information review, 31*(2), 82–90.

Deater-Deckard, K., Mallah, S. E., Changb, M., Evans, M. A., & Norton, A. (2014). Student behavioral engagement during mathematics educational video game instruction with 11–14-year olds. *International Journal of Child-Computer Interaction, 2*(2014), 101–108.

de-Marcos, L., Garcia-Lopez, E., & Garcia-Cabot, A., (2016). On the effectiveness of game-like and social approaches in learning: Comparing educational gaming, gamification & social networking. *Computers & Education, 95*, 99–113.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments* (pp. 9–15). ACM.

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Educational Technology & Society, 18*(3), 75–88.

Domínguez, A., Saenz-De-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., Pagé, S. C., & Martínez-HerráIz, J. J., (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*, 380–392.

Finn, J. D. (1989). Withdrawing from school. *Review of Educational Research, 59*(2), 117–142.

Fırat, M., Kılınç, H., & Yüzer, T. V. (2017). Level of intrinsic motivation of distance education students in e-learning environments. *Journal of Computer Assisted Learning, 34*(1), 63–70.

Fischhoff, B., & Beyth, R. (1975). I knew it would happen: Remembered probabilities of once—Future things. *Organizational Behavior and Human Performance, 13*(1), 1–16.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59–109.

Garett, R., & Young, S. D. (2019). Health care gamification: A study of game mechanics and elements. *Technology, Knowledge and Learning, 24*(3), 341–353.

Glover, I. (2013). Play as you learn: Gamification as a technique for motivating learners. In *Proceedings of world conference on educational multimedia, hypermedia and telecommunications 2013*. AACE, Chesapeake, VA, 1999–2008. ISBN 9781939797032

Gonida, E. N., Kiosseoglou, G., & Voulala, K. (2007). Perceptions of parent goals and their contribution to student achievement goal orientation and engagement in the classroom: Grade-level differences across adolescence. *European Journal of Psychology of Education, 22*(1), 23.

Graham, C. R. (2006). Blended eLearning systems: Definition, current trends and future directions. In C. J. Bonk & C. R. Graham (Eds.), *The handbook of blended eLearning: Global perspectives, local designs* (pp. 3–21). San Francisco: Pfeiffer.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. In *System sciences (HICSS), 2014 47th Hawaii international conference* (pp. 3025–3034). IEEE.

Hamzah, W., Haji Ali, N., Mohd Saman, M., Yusoff, M., & Yacob, A. (2015). Influence of gamification on students' motivation in using ELearning applications based on the motivational design model. *International Journal of Emerging Technologies in Learning (IJET), 10*(2), 30–34. https://doi.org/10.3991/ijet.v10i2.4355.

Hay, D. B., Kehoe, C., Miquel, M. E., Kinchin, I. M., Hatzipanagos, S., Keevil, S. F., et al. (2008). Measuring eLearning quality. *British Journal of Educational Technology, 39*(6), 1037–1056.

Hodges, C. B. (2004). Designing to motivate: Motivational techniques to incorporate in eLearning experiences. *The Journal of Interactive Online Learning, 2*(3), 1–7.

Hu R., & Shang J. (2018) Application of gamification to blended learning in elementary math instructional design. In S. Cheung, L. Kwok, K. Kubota, L. K. Lee, & J. Tokito (Eds.), *Blended learning. enhancing learning success*. ICBL 2018. Lecture Notes in Computer Science, vol 10949.Cham: Springer.

Husen, T., & Postlethwaite, T. (Eds.). (1994). *The international encyclopaedia of education* (2nd ed., Vol. 7). Oxford: Permagon.

Ifenthaler, D., Bellin-Mularski, N., & Mah, D. K. (2016). *Foundation of digital badges and micro-credentials*. Cham: Springer.

Iosup, A., & Epema, D. (2014). An experience report on using gamification in technical higher education. In *Proceedings of the 45th ACM technical symposium on Computer science education* (pp. 27–32). ACM.

Jayalath, J, (2010). Feasibility of using eLearning in capacity building of ICT trainers and delivery of technical, vocational education and training (TVET) courses in Sri Lanka, SEAVERN Journals, vol. 2.

Jayalath, J., & Esichaikul, V. (2016). Gamification-embedded eLearning courses for the learner success of competency based education: Case of Technical and Vocational Education and Training. Eighth Pan-Commonwealth Forum on Open Learning, 28 November 2016, Kuala Lumpur, Malaysia.

John, V. K., & Duangekanong, D. (2018). eLearning adoption and eLearning satisfaction of learners: A case study of Management Program in a University of Thailand.

Jovanovic, J., & Devedzic, V. (2014). Open badges: Novel means to motivate, scaffold and recognize learning. *Technology, Knowledge and Learning, 20*(1), 115–122.

Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. Hoboken: Wiley.
Kapp, K. M. (2013). *The gamification of learning and instruction fieldbook: Ideas into practice*. Hoboken: Wiley.
Kashdan, T. B., Rose, P., & Fincham, F. D. (2004). Curiosity and exploration: Facilitating positive subjective experiences and personal growth opportunities. *Journal of personality assessment, 82*(3), 291–305.
Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development, 10*(3), 2–10.
Keller, J. M. (2000). *How to integrate learner motivation planning into lesson planning: The ARCS model approach* (pp. 1–13). Santiago: VII Semanario.
Keller, J. M. (2009). Motivational design for learning and performance: The ARCS model approach. Springer Science & Business Media
Keller, J., & Suzuki, K. (2004). Learner motivation and e-learning design: A multinationally validated process. *Journal of Educational Media, 29*(3), 229–239.
Kendall, J. R., Mason, J. M., & Hunter, W. (1980). Which comprehension? Artifacts in the measurement of reading comprehension. *The Journal of Educational Research, 73*(4), 233–236.
Kim, H., Lee, H. J., Cho, H., Kim, E., & Hwang, J. (2018). Replacing self-efficacy in physical activity: Unconscious intervention of the AR Game, Pokémon GO. Sustainability (2071-1050), *10*(6).
Koivisto, J., & Hamari, J. (2014). Demographic differences in perceived benefits from gamification. *Computers in Human Behavior, 35*, 179–188.
Komiak, S. Y., & Benbasat, I. (2006). The effects of personalization and familiarity on trust and adoption of recommendation agents. *MIS Quarterly*, 941–960.
Kuh, G. D., Kinzie, J. L., Buckley, J. A., Bridges, B. K., & Hayek, J. C. (2006). *What matters to student success: A review of the literature* (Vol. 8). Washington, DC: National Postsecondary Education Cooperative.
Landers, R. N., Bauer, K. N., Callan, R. C., & Armstrong, M. B. (2015). Psychological theory and the gamification of learning. In T. Reiners & L. Wood (Eds.), *Gamification in education and business*. Cham: Springer.
Landers, R. N., Bauer, K. N., & Callan, R. C. (2017). Gamification of task performance with leaderboards: A goal setting experiment. *Computers in Human Behavior, 71*, 508–515.
Latchem, C. (2017). ICTs, blended eLearning and TVET transformation. Using ICTs and blended elearning in transforming TVET, UNESCO and Commonwealth of Learning.
Lee, H., & Doh, Y. Y. (2012). A study on the relationship between educational achievement and emotional engagement in a gameful interface for video lecture systems. In *2012 international symposium on ubiquitous virtual reality (ISUVR)*, (pp. 34–37). IEEE.
Lever, J. (1978). Sex differences in the complexity of children's play and games. *American Sociological Review*, 471–483.
Liao, C. W., Chen, C. H., & Shih, S. J. (2019). The interactivity of video and collaboration for learning achievement, intrinsic motivation, cognitive load, and behavior patterns in a digital game-based learning environment. *Computers & Education, 133*, 43–55.
Lint, A. H. (2013). ELearning student perceptions on scholarly persistence in the 21st century with social media in higher education. *Creative Education, 4*(11), 718.
Lister, M. C. (2015). Gamification: The effect on student motivation and performance at the post-secondary level. *Issues and Trends in Educational Technology*, *3*(2).
Lobel, A., Engels, R. C. M. E., Stone, L. L., et al. (2017). *Journal of Youth Adolescence, 46*, 884. https://doi.org/10.1007/s10964-017-0646-z.
Lowe, D. (2012). *Perceptual organization and visual recognition* (Vol. 5). Berlin: Springer.
Lüscher, Z., & Dore, R. (2011) Persistence and dropout in the vocational education high school in Minas Gerais. Program of Vocational Education in Minas Gerais, Brazil.
Mah, D. K. (2016). Learning analytics and digital badges: Potential impact on student retention in higher education. *Technology, Knowledge and Learning, 21*(3), 285–305.
Malone, T. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science, 5*(4), 333–369.
Margueratt, D. (2007). Improving learners' motivation through enhanced instructional design. Unpublished master's thesis, Athabasca University, Canada.
Marope, P. T. M., Chakroun, B., & Holmes, K. P. (2015). Unleashing the potential: Transforming technical and vocational education and training. UNESCO Publishing.
McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York, NY: Penguin.

McPherson M. A., Nunes M. B., (2008), Critical issues for eLearning delivery: What may seem obvious is not always put into practice. *Journal of Computer Assisted Learning*.

Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013). Do points, levels and leaderboards harm intrinsic motivation? An empirical analysis of common gamification elements. In *Proceedings of the first international conference on gameful design, research, and applications* (pp. 66–73). ACM.

Milman, N. B. (2016). What is engagement? *Distance Learning-Issue, 13*(3), 61.

Muntean, C. I. (2011). Raising engagement in eLearning through gamification. In *Proceedings of the 6th international conference on virtual learning* (pp. 323–329).

Nduna, N. J. (2017). Promoting effective Work Integrated Learning (WIL) and Recognition of Prior Learning (RPL) practices in the TVET sector through research. Vocational Education and Training in Sub-Saharan Africa, 282.

Petch, J., Calverley, G., Dexter, H., & Cappelli, T. (2007, February). Piloting a process maturity model as an eLearning benchmarking method. In *Proceedings of the 5th European conference on elearning: ECEL* (p. 273). Academic Conferences Limited.

Poulsen, A., Lam, K., Cisneros, S., & Trust, T. (2008). Review of ARCS model of motivational design. EDTEC 544

Prensky, M. (2001). Fun, play and games: What makes games engaging. *Digital Game-Based Learning, 5*(1), 5–31.

Raftopoulos, M. (2014). Towards gamification transparency: A conceptual framework for the development of responsible gamified enterprise systems. *Journal of Gaming & Virtual Worlds, 6*(2), 159–178.

Raihan, M. A., & Lock, H. S. (2012). Designing interactive and collaborative eLearning environments for TVET. *Journal of Educational Research, 26*(2), 177–201.

Robertson, J., & Howells, C. (2008). Computer game design: Opportunities for successful learning. *Computers & Education, 50*(2), 559–578.

Robson, K., Plangger, K., Kietzmann, J. H., McCarthy, I., & Pitt, L. (2015). Is it all a game? Understanding the principles of gamification. *Business Horizons, 58*(4), 411–420.

Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester, NY: University of Rochester.

Şahin, M. (2010). Blended eLearning in vocational education: An experimental study. *International Journal of Vocational and Technical Education, 2*(6), 95–101.

Sailer, M., Hense, J., Mandl, H., & Klevers, M. (2017). Fostering development of work competencies and motivation via gamification. In *Competence-based vocational and professional education* (pp. 795–818). Berlin: Springer.

Salen, K., & Zimmerman, E. (Eds.). (2005). *The game design reader: A rules of play anthology* (p. 80). Cambridge: MIT Press.

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of human-computer studies, 74*, 14–31.

Shareef, S. G., Ascet, G., & Rajendra, I. C. (2013) Classifying learners based on questionnaire style using Bloom's taxonomy. *International Journal of Advanced Engineering and Global Technology, 1*(3).

Shin, N. (2003). Transactional presence as a critical predictor of success in distance learning. *Distance Education, 24*(1), 69–86.

Sicart, M. (2008). Defining game mechanics. *Game Studies, 8*(2), 1–14.

Simões, J., Redondo, R. D., & Vilas, A. F. (2013). A social gamification framework for a K-6 learning platform. *Computers in Human Behavior, 29*(2), 345–353.

Small, R. V. (1999). Motivation in instructional design. *Educational Media and Technology Yearbook*, 89–92.

Sorden, S. D., & Munene, I. I. (2013). Constructs related to community college student satisfaction in blended learning. *Journal of Information Technology Education: Research, 12*, 251–270.

Stott, A., & Neustaedter, C. (2013). *Analysis of gamification in education* (p. 8). BC, Canada: Surrey.

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful eLearning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & education, 50*(4), 1183–1202.

Surendeleg, G., Murwa, V., Yun, H. K., & Kim, Y. S. (2014). The role of gamification in education-a literature review. *Contemporary Engineering Sciences, 7*(29), 1609–1616.

Svahnberg, M., Van Gurp, J., & Bosch, J. (2005). A taxonomy of variability realization techniques. *Software: Practice and Experience, 35*(8), 705–754.

Terzis, V., Moridis, C. N., & Economides, A. A. (2012). The effect of emotional feedback on behavioral intention to use computer based assessment. *Computers & Education, 59*(2), 710–721.

Thurston, T. N. (2018). Design case: Implementing gamification with ARCS to engage digital natives. *Journal on Empowering Teaching Excellence, 2*(1), 5.
Tiger, L. (2017). The pursuit of pleasure. Routledge.
UNESCO. (2015). UNESCO General Conference, 38th Session, Paris, 2015, Proposal for the Revised Recommendation Concerning Technical and Vocational Education, 37 C/Resolution 17.
Uppal, M. A., Ali, S., & Gulliver, S. R. (2018). Factors determining e-learning service quality. *British Journal of Educational Technology, 49*(3), 412–426.
Van Eck, R. (Ed.). (2010). Gaming and cognition: Theories and practice from the learning sciences. *IGI Global*.
Vu, P., Cao, V., Vu, L., & Cepero, J. (2014). Factors driving learner success in online professional development. *The International Review of Research in Open and Distributed Learning*.
Werbach, K., & Hunter, D. (2012). For the Win: How Game Thinking Can Revolutionize Your Business. Wharton Digital Press.
Winters, D., & Latham, G. P. (1996). The effect of learning versus outcome goals on a simple versus a complex task. *Group & Organization Management, 21*(2), 236–250.
Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence, 7*(3), 225–240.
Wu, J. H., Tennyson, R. D., & Hsia, T. L. (2010). A study of student satisfaction in a blended eLearning system environment. *Computers & Education, 55*(1), 155–164.
Wu, W., Martin, B. C., & Ni, C. (2017). A systematic review of competency-based education effort in the health professions: Seeking order out of chaos. Handbook on research on competency-based education in university settings, 352–378.
Yasak, Z., & Alias, M. (2015). ICT integrations in TVET: Is it up to expectations? *Procedia-Social and Behavioral Sciences, 204*, 88–97.
Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. O'Reilly Media, Inc..
Zimmerman, B. J., & Kitsantas, A. (2005). Homework practices and academic achievement: The mediating role of self-efficacy and perceived responsibility beliefs. *Contemporary Educational Psychology, 30*(4), 397–417.