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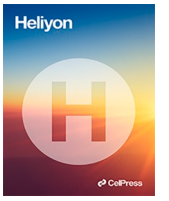

Research article

Towards an understanding of multi-generational higher education cohorts in gamified entrepreneurship education

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ABSTRACT

The increasing inclusion of gamified courses in entrepreneurship programmes in higher education have left gaps in understanding the critical essentials of the multi-generational student cohort undertaking these programmes. In this paper, we interrogate the educational experiences of multi-generational higher education students in a core gamified entrepreneurship course in an undergraduate business school programme. The research analyzed 392 course feedback responses from three generations (X, Y and Z) of a multi-generational cohort. The study developed and validated a behaviour-results model for gamified entrepreneurship courses leading to student entrepreneurial intention and entrepreneurial orientation, and disaggregated student engagement into it's multiple dimensions of cognitive, behavioural and emotional. The model also validated six dimensions of individual entrepreneurship orientation. Using the model, the study found differences in the component variables based on student Generations X, Y, and Z. Also, student cognitive and behavioural engagement led to entrepreneurial intention which also influenced student entrepreneurial orientation. There were marked differences in student grit, cognitive engagement, and emotional engagement between Generations X and Z. Furthermore, generational differences existed amongst Generation Z and Y, and also for Generation Z and X in student entrepreneurial intention. The study also confirmed the difference in entrepreneurial orientation between Generations X and Z. Additionally, the study found that there is a need to contextualize student engagement facilitators such as results demonstrability of the business simulation platform, student grit and user characteristics as they have selective effects on student cognition, behavioural and emotional engagements in a multi-generational student cohort of Generation X, Y and Z.

1. Introduction

In the last two decades, there has been the re-emergence of entrepreneurship globally as an alternative to other solutions for youth unemployment due to the global economic downturn [1–3]. This has served as a driving force in the increasing introduction of entrepreneurship education into university education [4,5] and the emphasis on cutting-edge entrepreneurship practice [6,7] with associated pedagogical enhancement with technological application [8,9]. However, entrepreneurship education has mainly been delivered in the traditional lecture room setting but the application of new technology in the delivery of entrepreneurship education

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specifically to simulate entrepreneurship realities in the lecture room requires understanding and mastery of the technologies which have not been adequately researched for the different types of undergraduates in the traditional university programmes [10–12].

In general, the increased application of technology to improve education has affected different domains to different degrees and plays important roles in different processes. In Higher Education (HE), current trends of increasing remote learning and the need to simulate reality in a safer environment in education [8] have ensured the application of virtual technologies in the context of online/web-based learning, blended learning, and collaborative learning [13,14]. This has also been construed as gamification, which Isabelle [10] posits as the use of gameplay mechanics for nongame applications. As applied to management education and specifically to entrepreneurship education in the form of business simulation for courses in entrepreneurship to simulate the reality of business markets and environments [8,9,15].

Entrepreneurship education has witnessed increased attention and has become an important part of higher education as an emerging policy to drive entrepreneurial activities in education for practice to stimulate intentions [4,6], policy direction [3,16], and also to promote the employability of higher education graduates [17]. According to the extant literature, entrepreneurship education is the use of a curriculum to provide students with knowledge skills, and passion for entrepreneurship [11,18,19]. Alberti et al. [20] posited a more contemporary and comprehensive depiction as the dissemination of knowledge, skills, and attitudes toward imparting entrepreneurial competence to transform entrepreneurial ideas into start-up intentions and enhance entrepreneurial behaviours. Also emerging is a stream of research on generations that posits that *'students' learning styles change from generation to generation requiring faster speed, a more visual approach and greater active engagement'* ([12],p 21). Thus, making it important to examine the introduction of entrepreneurship education in emerging multi-generational cohorts (Generations X, Y and Z). Besides, the increasing application of technology, such as the application of business simulation games (gamification) to teach entrepreneurship adds another layer to the complexity of the emerging phenomenon. Prensky [21,22] argued that current cohorts of learners in education think and process information profoundly differently from their previous generations as a result of early exposure to new technology in their surroundings, which has become part of them. Therefore, posing a complex learning environment for multi-generational cohorts of current undergraduate higher education programmes with these characteristics.

However, this trend of increasing application of gamification in higher education has been sparsely researched in the management education literature. Firstly, the shorter implementation times for the deployment of these systems have left the behavioural assessments of students (users) sparingly researched [14]. Secondly, research assessing the use of gamification in higher education and specifically entrepreneurship education with user reaction and learning [23–25] as compared to user behaviour and results [8,14,26] presents a gap for research. Thirdly, since the appearance of multiple generations of students in customary higher education cohorts, not much research has been done on these cohorts [27], specifically on their entrepreneurship education. Since research has shown there appear to be differences in pedagogical essentials [28], satisfaction [14] and gender [27] for multi-generation birth cohorts in E-Learning, (generally using computers in education). There is a necessity to research these areas as vital to ensure implementation, effective contextualized use, and positive impacts on learners.

Therefore, this study seeks to examine the application of business simulation games in teaching entrepreneurship in a multi-generational cohort (Generations X, Y and Z) in an undergraduate programme. This is done through the conceptualization of a gamified entrepreneurship education model from which the study examines the effects and differences of the different generations of student cohorts to elucidate the multi-generational perspectives of the gamification of entrepreneurship education. The study makes the following contributions: Firstly, to contribute to the current methodology literature on modelling gamified entrepreneurship education evaluation with a behaviour and results conceptualization as against the traditional behaviour and reactions conceptualization. The second contribution is a proposition that gamified entrepreneurship education is expected to improve student entrepreneurial orientation in a multigenerational consisting of Generations X, Y and Z learning environment. The third contribution is by demonstrating that there exist differences and nuances in student generations X, Y and Z with distinct characteristics in their learning and results in gamified entrepreneurship education courses. The forgoing sections will present the literature review, the research questions and the materials and methods sections. The materials and methods include the conceptual framework, hypotheses, research context, and methodology. The empirical results is presented and discussed in sections under data analysis and results, discussion, new contributions to practice, implications for research, limitations and future research.

2. Literature review

2.1. Entrepreneurship education in higher education

Entrepreneurship education has been posited as the dissemination of the knowledge, skills, and attitudes toward imparting entrepreneurial competence to transform entrepreneurial ideas into start-up intentions and enhance entrepreneurial behaviours such as intention and passion [18–20]. Therefore, the main thrust of entrepreneurship education is to develop an entrepreneurial mindset [17,29]. This according to the literature is a set of attitudes, skills, and behaviours to discover entrepreneurship opportunities, access resources, and create value even within uncertainty [18,19,29]. The literature classifies entrepreneurship education as education about entrepreneurship, education in entrepreneurship and education for entrepreneurship [6,30]. The literature classifies education about entrepreneurship as mainly dealing with the theoretical approach to building and enterprise operationalization, education in entrepreneurship concentrates on training experienced entrepreneurs in promoting business growth and education for entrepreneurship deals with the practical approach to business establishment and running [6,31,32]. These are then linked to practice as education about entrepreneurship is generally delivered through the traditional teaching methodology mainly emphasizing theory to enable students to understand the practice. Also, education in entrepreneurship is predominantly delivered in the start-up context, and

education for entrepreneurship is optimally delivered with an activity-based teaching methodology. In education for entrepreneurship, Hoang et al. [6] and Harmeling and Sarasvathy [33] aver that in this category, activities, and lectures are employed to provide information, inspiration, and passion to encourage entrepreneurship behaviours in risk-managed entrepreneurial surroundings.

In teaching entrepreneurship, Fiet [18] posits that entrepreneurship theory is a set of empirical generalizations about the world, economy, and how entrepreneurs should behave that allows for the prediction of true outcomes. Also, the literature indicates that most entrepreneurship theory emanates from other fields but is employed to better understand wealth creation by entrepreneurs and provide strong intellectual premises for students [18,19]. In the learning environment, entrepreneurship education employs different teaching pedagogies such as traditional lectures and experiential learning methods. Some of the experiential learning methods are business planning, online simulation, case studies, competition-based games, and other extracurricular activities [32,34]. In entrepreneurship pedagogy, traditional lectures are used to deliver business and entrepreneurship basics such as cost analysis, market analysis, opportunity recognition, financial statements and financing [10]. Whereas, business planning is used primarily as a learning method to learn how to engage data and research to designate the pre and post-state of organizations after decisions are made on data [35,36]. Isabelle [10] signalled the change in the trend of teaching with business models and also noted that traditional case studies have been employed to enable students to review hypothetical or real business situations by analyzing information to formulate assumptions and provide alternatives and recommendations. However, the drawback is that students do not get to implement the alternatives and recommendations to see the future outcomes. Additionally, with the deployment of technology in the delivery of education, online simulations are being increasingly used and have enabled competition-based learning games [9,10,15]. Lovelace et al. ([37], p.101) define these online simulations as "Internet-based, synthetic learning environments where decisions are made within a complex and dynamic setting, and where students experience real-time information and feedback". This has also been used to teach teamwork, critical thinking, and integration of knowledge in entrepreneurship education [38,39].

2.2. Gamification of entrepreneurship education

The extant literature asserts that technology has permeated education as a form of virtual environment or virtual reality [8,15,40]. This environment is defined as "computer-generated displays that allow the user to perceive, feel, and interact with an environment that is similar to the physical one by using multiple sensory channels, input and output devices, and simulated scenarios ([8], p.1). These environments have been introduced into entrepreneurship education as business simulation in experiential learning [10,41] and cognitive learning [15,42]. A stream of research labels the application of this environment as gamification [10,43,44] and defines gamification as "*the use of video game elements to improve user experience and user engagement in nongame services and applications*" ([44], p.2426). Thus, these are done with the motive of motivating the players (students) and include game elements such as points, badges, levels, leaderboards, status, trophies, rewards and progress bars, etc [43,45]. Deterding [43] asserts that these elements when incorporated into entrepreneurship education tasks are to engage, reward and motivate players (students) to learn new skills and change behaviours.

Business simulation games are classified by discipline, industry, scope; difficulty and dependence [46,47]. Clarke [46] noted that in the extent literature researchers have used different terminologies such as simulation games, learning laboratories, macro-worlds and micro-worlds to refer to computer-based Business Simulation applications. From the literature, these are business, firm or industry games where players (students) learn to manage simulated firms, business units, processes or functions in a competitive business or industry environment [38,39,48]. This can focus on internal management dynamics and their interaction with the business or industry environment with an emphasis on testing different strategies, venture creation, and running experiments to better understand reality. Generally, their outcome can be categorized into motivation; problem-solving (analytical thinking skills); transfer of knowledge; decision-making and cross-functional skills; increased retention of knowledge; adaptable learning; behavioural, attitudinal, and knowledge change [46]. It is used as a complement to conventional teaching tools to enhance learning and improve user experience, user engagement, extrinsic and intrinsic motivation, attitudes, and behaviours [10,39,46,49].

From the literature, several theories are engaged in the design of business simulation applications in a gamified entrepreneurship programme. As a tool to enhance motivation, Hamari et al. [39] conceptualised it as a motivational affordance leading to psychological outcomes and resulting in behavioural outcomes. This employs the self-determination theory [50]. As virtual environment multimedia, the literature presents Mayer's Cognitive Theory of Multimedia Learning [51] and the Technology Acceptance Model [52,53] as the leading theoretical frameworks applied in the design of educational virtual environments. The Technology Acceptance model which is based on the theory of reasoned action [54] is used to explain why people want to use technological innovation and user behaviours. This is applicable for use with Business Simulations in entrepreneurship education as the theory of reasoned action uses preexisting attitudes and behavioural intention to predict actual human behaviour but does not measure actual behaviour. In evaluations, Strojny and Dużmańska-Misiarczyk [8] propose Kirkpatrick's model of evaluation for evaluating the application of virtual environments in educational programmes.

2.3. Generations as social category characteristics and education

A new phenomenon of the emergence of different age groups in traditional undergraduate programmes has warranted the revisitation of pedagogical issues of mixed generations cohorts teaching and learning. In entrepreneurship education where the objective is to change behaviours in addition to thinking, the issue of pedagogy and teaching methods becomes critical. Drawing from generational theory and literature on generations, the concept of generations classifies society according to genealogy and historical sociology [55]. In the historical-sociology literature, Ryder ([56], p.845) defined a generational cohort as *"the aggregate of individuals*

(with some population definition) who experienced the same event within the same time interval." This concept was made popular as the generational cohort theory by Strauss and Howe [57] who presented the generational cohort as an appropriate social categorization for personality classification rather than other social categorizations. A generational cohort is usually marked as individuals born within a specific period of an interval of about 20 years [57,58]. The literature postulates that the distinct differences within generational cohorts are seen as 'peer personality' and 'generational persona' [59] which it defines as *"a distinctly human and variable creation embodying attitudes about family life, gender roles, institutions, politics, religion, culture, lifestyle, and the future"* ([59], p.40-41). In the education literature, the differences in experiences is posited to be what students of the different generations learn with and thus consistute their distinctiveness [60–62]. Generational studies literature uses different categorizations in different disciplines such as education, demography, marketing, sociology, and psychology [27,28,58,63,64]. To enable us to represent the current multiple generations in undergraduate programmes, the demarcations of the generations were set as Generation X for those born between 1965 and 1979, Generation Y are those born in 1996–2003 and Genration Z are those born between 1996 and 2003 as found in the literature [14,26–28,63].

From the generational theory literature, those born in 1965–1979 and classified as Generation X are known as "latchkey generation", and identified as a liberated and freedom-seeking generation [65]. They are known as the generation to first grow up with computers but did not encounter them in their education. This generation is identified with appreciation of feedback and constant desire for information on progress with recognition for professioal and personal development [66]. The generation with birth dates between 1980 and 1995, and categoriesd as Generation Y is known in the literature to have grown with the evolution of the development of computers and experienced the early use them in their education. They are generally connected in the use of computers due to their experience and the rapid adoption. This is seen in the their adoption and use of the internet and associated mobile gadgets [21, 66,67]. They are known generally as early adoptors of social media and prefer group or team centered learning [60,65]. They are also, known for their persona characteristics of confidence, high optimism, pressure, keenness to achieve, and generally conventional [59]. Additionally, those born between 1996 and 2003 are categorized as Generation Z.This generation grew up with the evolution of the internet and are accustomed to its adoption and use thereby identified with most accolades such as "Internet Generation", "Digital natives", "iGeneration", "Computer Generation" and "Net Natives" and many more [21,63,68]. They are idenfied with focus on relevant education which they can relate, which has shaped their lifestyle and impacting learning, recruitment and pedagogy in higher education [27,65].

The distinctions in generations have not received much attention in business and entrepreneurship education. There are major critical issues that should drive the continuing study of generations in education in general and specifically in entrepreneurship education as the drive for the application of virtual environment technology increases. First, as part of some research work in this area, Wagner et al. ([69], p.870) had earlier stated that "*When it comes to using computers, older adults have different needs and concerns compared to younger adults resulting from the natural physical and cognitive changes that come with ageing*". Secondly, earlier research in identifying the generations has labelled Generation Z with the insatiable use of computers and technology [21,22]. Thirdly, the literature found Generation Z to be more receptive to entrepreneurship as a career option than older generations [70,71].

In recent literature on multigenerational students of three generations (X, Y, and Z), Yawson and Yamoah [27] found distinctiveness in different dimensions of e-learning utility essentials among the generations in the gender of a multigenerational cohort. These differences they posit are embedded in multigenerational cohorts which are not easily visible from only gender or generational studies and these differences are an amalgamation of multigenerational cohort characteristics. In other studies, they have reported peculiarities in student e-learning satisfaction for different generations in a multigenerational cohort [14], general distinctiveness in the use of e-learning systems components for three generations in a multigenerational cohort [26], and differences in the pedagogical essentials of a multigenerational student cohort of an undergraduate course deploying e-learning [28].

These characteristics we posit will be nuanced in an undergraduate gamified entrepreneurship course. Therefore, it is an important research gap and critical to investigate whether these differences exist in gamified entrepreneurship courses and affect the use of Business Simulation games in undergraduate entrepreneurship courses in higher education. If these nuances exist within the generations in multigenerational cohorts, then there must be interventions and integration policies concerning the use of gamified entrepreneurship courses in business school programmes by higher education institution administrators and programme leaders. We, therefore, pose our research questions:

RQ1 Does the use of business simulation games to gamify undergraduate entrepreneurship courses lead to behavioural change in students in multigenerational cohorts?

RQ2 Do generational differences exist in the utility of gamified entrepreneurship courses within the three generations currently in higher education undergraduate programmes?

3. Materials and methods

3.1. Conceptual development

Research modelling entrepreneurship education is sparingly undertaken due to the complexity of the concept of entrepreneurship and the objectives of the education. Even though Strojny and Dużmańska-Misiarczyk [8] presented Mayer's Cognitive Theory of Multimedia Learning and Technology Acceptance Model as commonly used frameworks for the design of educational virtual environments, and Kirkpatrick's model for training evaluation. These are not adequate for entrepreneurship education as the virtual platforms are embedded in the entrepreneurship course and the course as a whole is what is being evaluated. Al-Fraihat et al. [23] have argued that attempts to define the success of e-learning systems have been mixed due to the complexity and interdisciplinary nature of

the activities being evaluated. Therefore, it allows the conceptualization of virtual environment systems with success models [25,72], user satisfaction models [25–27,73], individual characteristics [74], use [75] and quality models [76].

However, Hoang et al. [6] developed a model consisting of entrepreneurship education, self-efficacy, and learning orientation leading to entrepreneurial intentions to explore entrepreneurship education and the mediating roles of self-efficacy and learning intentions in university students. In this conceptualization, entrepreneurship education was measured with a four-item scale which we think is a general all-encompassing measurement of school education than an entrepreneurship programme or course. Also, Isabelle [10] drawing from literature developed a model for a gamified entrepreneurship course in which the pedagogy was based on the lean startup methodology and the business model generation approach to venture creation. The main variables were venture experience, collaboration student experience, and engagement leading to entrepreneurial self-efficacy. Hoang et al. ([6], p.119) have posited that self-efficacy is '*an inspirational source that pertains to one's conscious trust and belief in one's ability to achieve, which impacts one's cognitive degree.* However, entrepreneurship education, as defined by Alberti et al. [20] is to disseminate knowledge, skills, and attitudes towards the building of competence to transform ideas of entrepreneurial nature into intentions for start-ups and enhance entrepreneurial behaviours. We posit that the most appropriate variable to encapsulate the behaviour is the entrepreneurship orientation of the learner rather than only self-efficacy.

We, therefore, propose a new enhanced conceptual framework that is also generalized for evaluating gamified entrepreneurship courses, to address our research question: *RQ1 Does the use of business simulation games to gamify undergraduate entrepreneurship courses lead to behavioural change in students in multigenerational cohorts?* This is presented in Fig. 1. From the literature on entrepreneurship education, Yawson and Yamoah ([17], p.5) argue that '*the fundamental perception that entrepreneurship or 'enterprise skills' are for those who want to start their business, has been overtaken by the importance of developing an entrepreneurship mindset or orientation to work and understand entrepreneurs which is the emerging development embracing the foundational concepts of entrepreneurship and intrapreneurship in the current business environment.* This approach accommodates the postulation of the concept of the entrepreneurial mindset [77], which Ireland et al. ([78], p.968*) 'define as a growth-oriented perspective through which individuals promote flexibility, creativity, continuous innovation and renewal'*. This makes the entrepreneurial mindset an important concept that can be easily developed and delivered in an educational environment, specifically in an entrepreneurship course. Also, the associated skills can be matched and generally measured as an orientation at the individual learner level [17,79]. This is known as the individual entrepreneurial orientation in the education environment which has been measured as an aggregate variable with 6 components, achievement orientation, risk-taking, pro-activeness, competitiveness, learning orientation, and innovativeness [17,79]. From the perspective of entrepreneurship as a process, Bird [80] argues that this process starts with an intention. Thus, the literature argues that it is the best predictor of behaviour [6,81] and can be posited to have links with entrepreneurial orientation. This can be envisaged in an entrepreneurship course since the literature links entrepreneurial intentions as a desired output of entrepreneurship education [1,30,31]. Also, Sun et al. [82], found entrepreneurship education to directly predict entrepreneurship mindset and intention among higher education students. Since in education entrepreneurship mindset, is what is evaluated [20], then entrepreneurship intention will lead to a change in mindset [82], which is the individual entrepreneurship orientation [17,77,78]. We, therefore, posit that.

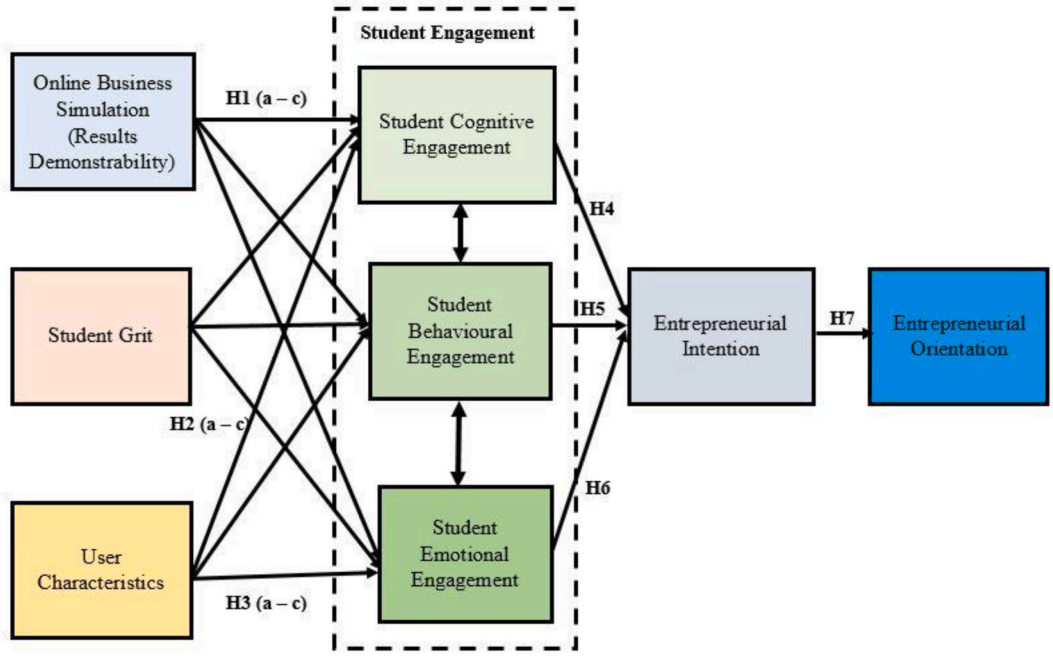

Fig. 1. Research model.

H7. Student entrepreneurial intention positively relates to student entrepreneurial orientation in a gamified entrepreneurship course.

In addition, the Business Simulation application which is embedded in the entrepreneurship course will be functional if learners engage with it as a technology-mediated medium [83,84]. Thus, student engagement has received attention in education literature [84, 85, 86–88]. Sun and Rueda ([85] p.193) succinctly refer to engagement as "the quality of effort students make to perform well and achieve desired outcomes". Furthermore, Fredricks et al. [86], conceptualised engagement as an aggregate construct consisting of cognitive, emotional, and behavioural dimensions. This conceptualization of a multidimensional approach to engagement is shared by Refs. [83,87,88]. Buil et al. ([87], p.165) render the dimensions of student engagement as "*Cognitive engagement refers to learners' efforts in understanding what is being taught; Emotional engagement refers to the feelings that learners have about the learning experience, such as interest, enjoyment, boredom, or frustration; finally, Behavioural engagement includes behaviours necessary to academic success, such as participation and attendance.*" Therefore, making the three engagement dimensions related to entrepreneurial intention the penultimate outcome of gamified entrepreneurial education.

Additionally, emotional engagement according to Wong and Liem [88] refers to student's affective responses to the learning environment. These emotional activities drive engagement in learning activities [89]. Redmond et al. [90], enumerated these emotional activities to include students' expectations, assumptions, commitment, motivations for learning, and sense of belonging to a community. We, therefore, posit that in a gamified entrepreneurship course, student's emotional engagement will positively relate to entrepreneurial intention as a penultimate outcome of a change in mindset. This is presented as.

H6. Student emotional engagement positively relates to entrepreneurial intention in a gamified entrepreneurship course.

Also, behavioural engagement as understood by Fredricks et al. [86], is the effort and participation, or students' involvement in learning activities. This is seen as observable behaviour, of students attending lectures and using the gamified entrepreneurship platform. These are seen as behaviours necessary for academic success [89,87]. Therefore, entrepreneurship intention which has earlier been argued as a penultimate to the outcome of entrepreneurship education will be positively influenced by student behavioural engagement. Therefore, we present the following hypothesis.

H5. Student behavioural engagement positively relates to entrepreneurial intention in a gamified entrepreneurship course.

Vermeulen and Volman [89] argue that in online education or learning, cognitive engagement refers to students' deeper investment in and reflection on their learning process. The literature argues that this appears in students' efforts to understand materials and master skills even at a more abstract level [84,86,88]. We, therefore, posit that cognitive engagement in gamified entrepreneurship education in higher education will positively associate with or influence entrepreneurial intention and present the hypothesis.

H4. Student cognitive engagement positively relates to entrepreneurial intention in a gamified entrepreneurship course.

Additionally, the literature posits that there are indicators of engagement and facilitators of engagement [83,87,91]. The indicators measure the variables whereas the facilitators are factors that enhance the variables [87]. The literature posits that internal individual characteristics and prior experiences with technology are known student engagement factors [83,84,92], with Bond and Bedenlier [93] arguing that educational technology is a facilitator for student engagement. Therefore, as a behaviour-results model [46,87], the individual learners' user characteristics also become important in evaluating the ultimate behavioural change as entrepreneurial orientation. Hadullo et al. [94] argue that for the evaluation of technology-mediated systems, individual factors of self-efficacy, internet use, personal motivation incentive to use the system, and experience with the course content are important factors that inform the evaluation. From Schindler et al. [92], these factors affect engagement, and Vermeulen and Volman [89] assert they affect all three dimensions of student engagement. Therefore, we posit the following three hypotheses as **H3a-c**.

H3. Student user characteristics positively influence a) student cognitive engagement b) student behavioural engagement and c) student emotional engagement leading to entrepreneurial intention in a gamified entrepreneurship course.

Also, Aparicio et al. [95] proposed grit as an important non-cognitive factor that affects the use of e-learning systems and heavily impacts evaluation. A position presented in the literature [89,93]. They posit that grit consists of perseverance effort and consistency of interest of the system user as an inherent individual behaviour. We, therefore, present three hypotheses **H2a-c**.

H2. Student grit positively influences a) student cognitive engagement b) student behavioural engagement and c) student emotional engagement leading to entrepreneurial intention in a gamified entrepreneurship course.

For a gamified entrepreneurship course, the ease with which the learning system demonstrates results becomes critical and is shown in the usefulness and satisfaction to the learner [83,89]. The literature posits that the "*degree to which an individual believes that the results of using a system are tangible, observable, and communicable*" ([52], p.277) drives user engagement. Yawson and Yamoah [26, 28] and Yawson and Yamoah [27] have argued for the use of results demonstrability for e-learning systems as a behaviour alternative indicator for technology use. We, therefore, present our final three hypotheses **H1a-c**.

H1. Results demonstrability of the Business Simulation platform positively influences a) student cognitive engagement b) student behavioural engagement and c) student emotional engagement leading to entrepreneurial intention in a gamified entrepreneurship course.

In the context of education in general and entrepreneurship education specifically, generational theory as discussed earlier, seeks to explicate the differences in attitudes and behaviours among learners [62,63] with the notion that the distinctions of experiences in generations are what students of different generations construct knowledge [56,57,60,66]. Therefore, in a behaviour-results model of entrepreneurship education, we address our research question (**R2)** and hypothesize as follows: ***RQ2*** *Do generational differences exist in the utility of gamified entrepreneurship courses within the three generations currently in higher education undergraduate programmes?*

H8. Statistically significant differences exist between the three student generations X, Y, and Z in the variables of the gamified entrepreneurship course model.

In summary, as a course in higher education students' engagement with the course will influence the relationship with entrepreneurship intention, which is a penultimate outcome of entrepreneurial orientation. Also, student engagement dimensions will be affected by individual learners' factors of grit, user characteristics, and results demostrability of the gamification platform. Additionally, as a behaviour-results model, these factors will be conditioned by the individual learners' characteristics of birth generation. We, therefore, present our model in Fig. 1.

3.2. Methodology

The research employs an Online based Business Simulation called "The Marketplace Simulation" which was used to deliver an entrepreneurship course in an undergraduate bachelor's Business School programme at a University in Accra, Ghana as the context. The application was used to deliver the gamified entrepreneurship course due to ease of use, accessibility, cost-effectiveness and its wide acceptance among universities. The game elements include badges, points, and a live leaderboard called "Balance Scorecard" for team ranking to facilitate social engagement and competition [10,38,92,93]. The software in addition to other features is unique in its ability to create an intuitive environment to start a real online business and to provide a suite of monitoring and evaluation systems. Third-year students of a four-year business programme in the 2021/2022 academic year class were made to form "groups of companies" of five students to compete with their classmates in a gruelling six rounds throughout the second semester. Student groups met to discuss their decisions on all aspects of the business ranging from the business plan, marketing, product development, choice of channels, location, finance, quarterly budgets, logistics, human resources, etc. before sending their input for a round.

The study deployed an electronic structured questionnaire, used as course feedback to collect data at the end of the gamified entrepreneurship programme for undergraduates. All the procedures in this research were carried out according to the ethical standards based on the approval of the Ghana Institute of Management and Public Administration (GIMPA) Institutional Review Board protocol number GM/IRB/2023/08. Informed consent was obtained from all students from a cover note on the feedback form and the feedback was voluntary and guaranteed confidentiality. Students were told their reponses will form part of an academic publication. The study used a registered student population of 392. Out of this student numbers, 316 students consented and submitted useable responses, giving 80.6 % response rate. The background information of the sample is shown in Table 1. For the analysis, the SPSS 23 and SmartPLS 4 [96] were used to conduct preliminary analysis and structural equation modelling on the survey data [97,98]. The SmartPLS 4 software is a Partial Least Squares Structural Equation Modelling (PLS-SEM) software. The procedure involves a suitable choice of a sample population, the creation of a measurement model, a structural model, and the test of the predictive accuracy and relevance of the model. The details are shown in sections 4.1 and 4.2. One-Way ANOVA with the Tukey HSD tests were conducted for differences in the variables of the research model by the different student generations [99].

3.3. Instrument

The survey research instrument was derived from a comprehensive literature review. The result demonstrability of the Marketplace

Table 1
Descriptive statistics of sample.

Descriptive Statistics			Percentage (%)
Sex	Female	220	69.6
	Male	96	30.4
Total		316	100.0
Generations	Generation Z (IGeneration) (2003–1996)	70	22.2
	Generation Y (Millennials) (1995–1980)	184	58.2
	Generation X (1979–1965)	62	19.6
Total		316	100.0
Student Status	Full-Time Student	113	35.8
	Student Worker	203	64.2
Total		316	100.0
Student's Work Experience	None	61	19.3
	Up to 1 year	43	13.6
	Up to 2 years	40	12.7
	Up to 5 years	75	23.7
	Up to 10 years	50	15.8
	More than 10 years	47	14.9
Total		316	100.0
Current work status	Non-Worker	115	36.4
	Junior Level Staff	46	14.6
	Middle-Level Staff	73	23.1
	Senior Level Staff	31	9.8
	Owner/Manager	51	16.1
Total		316	100.0

Simulation platform was measured using the 2 items of usefulness and overall satisfaction [27,52]. Measured on 7-point scales of usefulness and satisfaction. Student engagement was deployed with its three dimensions of cognitive engagement, emotional engagement and behavioural and measured with items from Buil et al. [87]. Cognitive engagement was measured with 3 items, emotional engagement with 4 items and behavioural engagement with 3 items. User characteristics were measured with 4 items of unique characteristics in e-learning derived by Hadullo et al. [94] and used in Yawson and Yamoah [27].

Student Grit was measured using the 6 items used in Aparicio et al. [95]. The entrepreneurial intention was measured using the 6-item Entrepreneurial Intention Scale (EIQ) by Linan and Chen [100]. While, the individual learner's entrepreneurial orientation was measured using the 32-item Entrepreneurial Orientation Scale (EOS) by Gorostiaga et al. [79] which was also used by Yawson and Yamoah [17]. The Entrepreneurial Orientation Scale (EOS) measures Pro-activeness with 3 items, Innovativeness with 4 items, Risk-Taking and Achievement Orientation with 5 items each, Learning Orientation with 7 items and Competitiveness with 8 items. We employed a 7-point scale of agreement, where Strongly Disagree (1) to Strongly Agree (7) for all the items as reflective measures. As earlier mentioned, the generations were measured with the categorizations of those born from 1965 to 1979 as Generation X, from 1980 to 1995 marked the birth dates for Generation Y and 1996 to 2003 for Generation Z [14,26–28,63]. As required for background information the instrument included control variables such as gender, student study status, work experience, and current work status [101]. The instrument opens with a screening question as to whether the respondent participated in the entrepreneurship course. A copy of the feedback form is attached in Appendix 3. Face validity was achieved by an in-depth literature review, which was conducted to identify the relevant concepts for the study and content validity was achieved by making sure all the research objectives were reflected in the questionnaire [102].

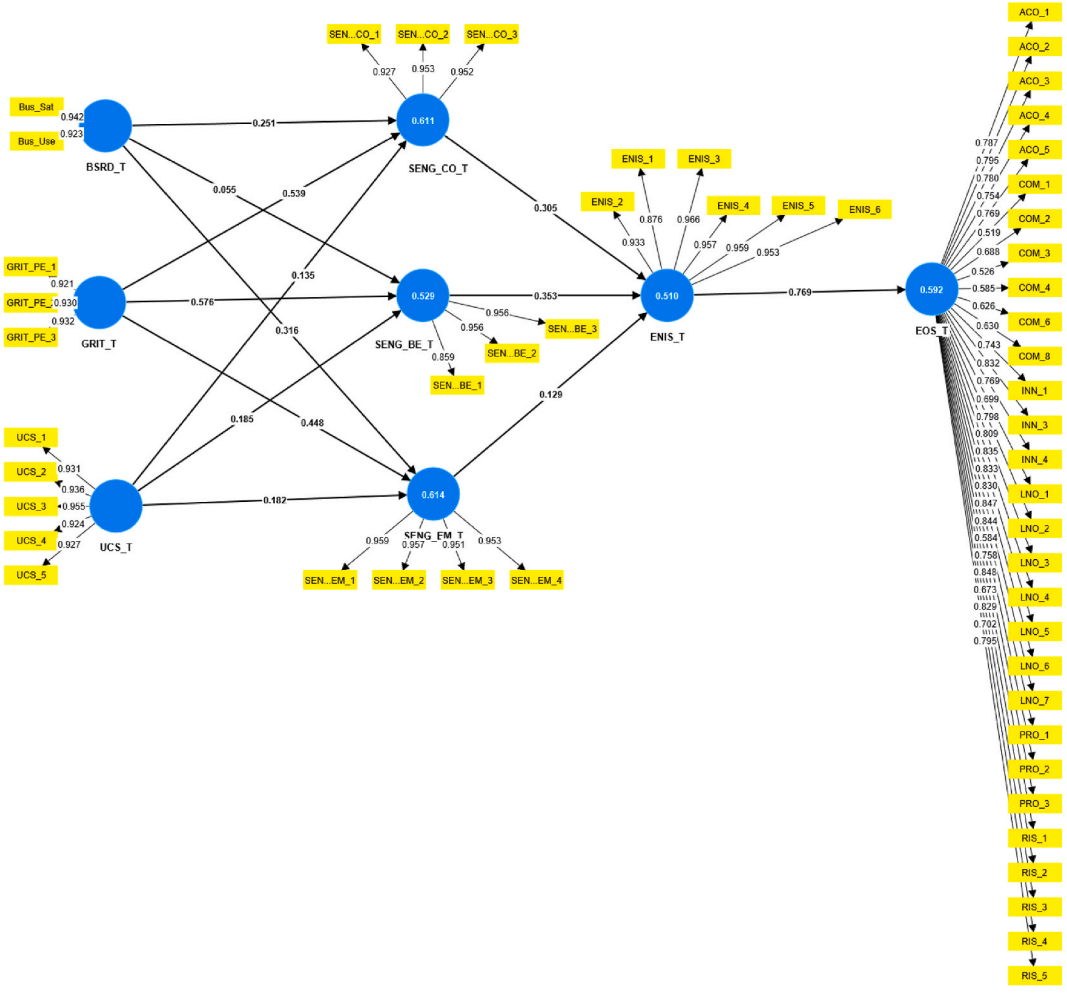

Fig. 2. Structural model showing results.

4. Data analysis and results

4.1. Results of the measurement model

In testing the hypotheses in the model a bootstrapping procedure with 5000 bootstrap iterations was performed using SmartPLS 4 [96]. All relevant protocols for PLS-SEM were followed as required (see Refs. [97,98]). Appendix 1 and 2 present the measures, items validity and reliability scores for variables in the model and entrepreneurial orientation respectively. For the measurement model, indicator reliability was tested and items with measures above 0.7 was used and those below 0.4 removed [97]. Cronbach's alpha (α), and Composite Reliability (CR) were tests performed to validate internal consistency reliability, cut-off value of ≥0.70 for both tests were obtained [103] to establish the validity of measures employed.

To ensure convergent validity, Average Variance Explained (AVE) values above 0.50 and Composite Reliabilities values above 0.70 were obtained [97]. In addition, the AVE values of the variables obtained were greater than the square of the correlations to satisfy the criterion for establishing discriminant validity [97,103,104]. Also, the heterotrait-monotrait ratio (HTMT) was used as an additional test for discriminant vality and the correlations did not exceed the lower end of 0.85 stated by the specificity criterion [105]. This achieved discriminant validity between constructs and indicated their acceptability in the model [106].

4.2. Results of the structural model

The structural model was then determined with the path estimates and indicator loadings shown in Fig. 2. This figure integrates all the results and provides a conceptual framework view of the results making it easier for comparison by the reader. The path estimates are then presented in Table 2 with the tests for the hypotheses. We proceed to discuss the results. Results from Table 2 suggest that as an engagement facilitator, Results Demonstrability has a statistically significant positive influence on Student Cognitive Engagement ($\gamma = 0.251$, $p < 0.001$) and Student Emotional Engagement ($\gamma = 0.316$, $p < 0.001$) but had a statistically non-significant relationship with Student Behavioural Engagement ($\gamma = 0.055$, $p = 0.44$). Therefore, we accept hypotheses **H1a** and **H1c** and reject **H1b.** Also, Results Demonstrability had a higher positive influence on Student Emotional Engagement than on Student Cognitive Engagement. Therefore, in a gamified entrepreneurship course of multi-generation cohorts, Results Demonstrability factors influence Student Emotional Engagement more than Student Cognitive Engagement but do not influence Student Behavioural Engagement.

Also, Student Grit as an engagement facilitator has a statistically significant positive influence on Student Cognitive Engagement ($\gamma = 0.539$, $p < 0.001$), Student Behavioural Engagement ($\gamma = 0.576$, $p < 0.001$) and Student Emotional Engagement ($\gamma = 0.448$, $p < 0.001$). Therefore, we accept hypotheses **H2a**, **H2b** and **H2c**. Also, Student Grit conceptualised as perseverance and consistency of interest positively influences engagement in the order of Student Behavioural Engagement, Student Cognitive Engagement and Student Emotional Engagement respectively. Additionally, Student Grit is the most influential factor in Student Engagement compared to

Table 2
Values of path estimates for the research model and hypotheses.

Measures	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	Hypotheses
Results Demonstrability - > Student Behavioural Engagement	0.055 [n.s]	0.059	0.072	0.773	H1b: Rejected
Results Demonstrability - > Student Cognitive Engagement	0.251[a]	0.252	0.062	4.025	H1a: Accepted
Results Demonstrability - > Student Emotional Engagement	0.316[a]	0.317	0.063	4.991	H1c: Accepted
Entrepreneurial Intention - > Entrepreneurial Orientation	0.769[a]	0.77	0.041	18.801	H7: Accepted
Student Grit - > Student Behavioural Engagement	0.576[a]	0.572	0.079	7.335	H2b: Accepted
Student Grit - > Student Cognitive Engagement	0.539[a]	0.531	0.074	7.288	H2a: Accepted
Student Grit - > Student Emotional Engagement	0.448[a]	0.438	0.078	5.728	H2c: Accepted
Student Behavioural Engagement - > Entrepreneurial Intention	0.353[a]	0.357	0.079	4.479	H5: Accepted
Student Cognitive Engagement - > Entrepreneurial Intention	0.305[c]	0.302	0.131	2.331	H4: Accepted
Student Emotional Engagement - > Entrepreneurial Intention	0.129 [n.s]	0.126	0.117	1.094	H6: Rejected
User Characteristics - > Student Behavioural Engagement	0.185[b]	0.189	0.068	2.708	H3b: Accepted
User Characteristics - > Student Cognitive Engagement	0.135[c]	0.14	0.061	2.221	H3a: Accepted
User Characteristics - > Student Emotional Engagement	0.182[b]	0.189	0.069	2.629	H3c: Accepted

Note: Standardized path coefficient; [c]$p < 0.05$, [b]$p < 0.01$, [a]$p < 0.001$. Non-significant (n.s).

Results Demonstrability of the gamification platform and the User Characteristics. Thus, Student Grit is an important Student Engagement facilitator in a gamified entrepreneurship course for multi-generational cohorts of Generation X, Y and Z.

In addition, User Characteristics as an engagement facilitator have a statistically significant positive influence on Student Cognitive Engagement ($\gamma = 0.135$, $p = 0.026$), Student Behavioural Engagement ($\gamma = 0.185$, $p = 0.007$) and Student Emotional Engagement ($\gamma = 0.182$, $p = 0.009$). Therefore, we accept hypotheses **H3a**, **H3b** and **H3c.** Also, Student User Characteristics positively influence student engagement in the order of Student Behavioural Engagement, Student Emotional Engagement and Student Cognitive Engagement respectively. Therefore, Student User Characteristics influence all three forms of student engagement and are the third influential engagement facilitator in a gamified entrepreneurship course for multi-generational cohorts of Generation X, Y and Z.

In the relationship between student engagement and student entrepreneurial intention, Student Cognitive Engagement resulted in a positive statistically significant relationship with Student Entrepreneurial Intention ($\gamma = 0.305$, $p = 0.020$). Therefore, we accept **H4.** Also, Student Behavioural Engagement resulted in a positive statistical relationship with Student Entrepreneurial Intention ($\gamma = 0.353$, $p < 0.001$) and therefore, we accept **H5.** However, the relationship between Student Emotional Engagement was statistically non-significant with Student Entrepreneurial Intention ($\gamma = 0.129$, $p = 0.274$). We, therefore, reject **H6.** Thus, in a gamified entrepreneurship course of multi-generations, Student Behavioural Engagement results in a higher Student Entrepreneurial Intention than Student Cognitive Engagement. Also, Student Emotional Engagement does not necessarily influence Student Entrepreneurial Intention.

Also, Student Entrepreneurial Intention resulted in a positive statistical relationship with Student Entrepreneurial Orientation ($\gamma = 0.769$, $p < 0.001$). Therefore, we accept **H7.** Thus, Student Entrepreneurial Intention leading to Student Entrepreneurial Orientation and the positive Student Entrepreneurial Intention as an antecedent to Student Entrepreneurial Orientation is validated in a gamified entrepreneurship course for multi-generational cohorts in higher education. Therefore, the attainment of higher Student Entrepreneurial Orientation could be used as a desirable assessment for gamified entrepreneurship courses in higher education.

We then move on to the results of assessing the predictive accuracy of the model as shown in Table 3, using the R^2 values the following results were obtained. All R^2 values obtained signify moderate levels of predictive accuracy as Entrepreneurial Intention (0.510), Entrepreneurial Orientation (0.592), Student Behavioural Engagement (0.529), Student Cognitive Engagement (0.611) and Student Emotional Engagement (0.614). Also, to establish the predictive relevance of the model, test of the values of cross-validated redundancy (Q^2) were checked and all were larger than zero as shown in Table 3 [97]. Thus, the model for gamified entrepreneurship courses could be used to predict and assess Student Entrepreneurial Orientation in multi-generational cohorts found in higher education contexts.

4.3. Results of One-Way ANOVA and post-hoc tests

One-way ANOVAs at 0.050 level of significance with Tukey HSD post hoc tests were employed to determine the statistical significance of differences between the three generations X, Y and Z in the utility of the component variables of the gamified entrepreneurship education model. In Results Demonstrability, the result shows statistically significant differences in the Generations *($F(2,313) = 6.952$, $p = 0.001$, $\eta 2 = 0.043$)*. A Tukey HSD Post Hoc test shows statistically significant differences for Generation Z *($M = 5.49$, $SD = 1.305$)* compared to Generation Y *($M = 5.88$, $SD = 1.049$, $p = .029$)* and Generation X *($M = 6.19$, $SD = 0.98$, $p = .001$)*. However, there were no differences between Generation Y *($M = 5.88$, $SD = 1.049$)* and Generation X *($M = 6.19$, $SD = 0.981$, $p = .129$)*. This suggest that in multi-generational cohorts taking gamified entrepreneurship courses, differences exist between Generation Z as compared to Generation Y, this is also seen in Generation Z compared to Generation X in their utility of Results Demonstrability of the gamification platform. Thus, making Results Demonstrability of the gamification platform an important factor in a multi-generational cohort taking gamified entrepreneurship courses.

The results revealed statistically significant differences in the utility of Grit in the Generations *($F(2,313) = 4.678$, $p = 0.010$, $\eta 2 = 0.029$)*. The follow-up Tukey HSD test found a difference between Generation Z ($M = 5.79$, $SD = 1.189$) and Generation X ($M = 6.32$, $SD = 0.612$, $p = 00.007$) which was statistically significant. All other comparisons of Generations in Grit were non-statistically significant. Thus, in a gamified entrepreneurship course, Generation Z and Generation X have and utilise Student Grit differently in multi-generational cohorts. However, the results found no differences that were statistically significant in between Generations for User Characteristics *($F(2,313) = 1.065$, $p = 0.346$, $\eta 2 = 0.007$)*. Therefore, Student User Characteristics do not differ across the generations in multi-generational cohorts for gamified entrepreneurship courses. Also, it makes clear the differences between Student User Characteristics and student generation characteristics. It can also allude to that Student User Characteristics in a multi-generational

Table 3
Values of predictive power estimation of the research model.

	R-square	Q^2predict
Entrepreneurial Intention	0.510[b]	0.467
Entrepreneurial Orientation	0.592[b]	0.523
Student Behavioural Engagement	0.529[b]	0.505
Student Cognitive Engagement	0.611[b]	0.600
Student Emotional Engagement	0.614[b]	0.598

Note: Coefficient of determination (R^2) (with the cut-off levels as: 0.190 weak[c]; 0.333 moderate[b]; and 0.670 substantial[a]).

cohort could be conditioned by intergenerational learning effects in the cohort.

The results indicate there are statistically significant differences for the Generations in Student Cognitive Engagement *(F (2,313) =3.449, p = 0.033, η2 = 0.022)*. The Tukey HSD test shows a difference for Generation Z *(M = 5.69, SD = 1.306)* as compared to Generation X *(M = 6.16, SD = .632, p = 0.030)* which was statistically significant. Results for the other Generations were not statistical significance. Consequently, Generation Z and X in a multi-generational cohort of gamified entrepreneurship courses, have and utilise Student Cognitive Engagement differently.

Results as reported also shows differences for the Generations in Student Emotional Engagement *(F (2,313) =3.100, p = 0.046, η2 = 0.019)* which were statistically significant. The follow-up Tukey HSD tests only revealed a difference between Generation Z (M = 5.69, SD = 1.308) with Generation *X (M = 6.16, SD = .791, p = 0.035)* which was statistically significant. Therefore, in multi-generational cohorts in a gamified entrepreneurship course, Generation Z and Y have and utilise Student Emotional Engagement differently.

The results however, found no statistically significant differences in the Generations for Student Behavioural Engagement *(F (2,313) = 2.426, p = 0.090, η2 = 0.015)*. Therefore, Student Behavioural Engagement does not differ across generations in the multi-generational cohort for gamified entrepreneurship courses and could have been conditioned by intergenerational factors of the cohort.

For Student Entrepreneurial Intention, the results revealed differences that were statistically significant in Generations *(F (2,313) = 6.515, p = 0.002, η2 = 0.040)*. A follow-up Tukey HSD test returned statistically significant differences for Generation Z (M = 5.56, SD = 1.398) as against Generation Y (M = 6.01, SD = 1.184, *p = 0.019)* and Generation X *(M = 6.28, SD =.815, p =0.001)*. Between Generation Y (M = 6.01, SD = 1.184) and Generation X *(M = 6.28, SD =.815, p = 0.261)* the difference was not statistically significant. Thus, in a multi-generational cohort engaging in gamified entrepreneurship courses, Generation Z has and utilises Student Entrepreneurial Intention differently from Generations X and Y. Conversely, no differences were found between Generation X and Y.

Furthermore, the results also returned differences in the Generations for Student Entrepreneurial Orientation *(F (2,313) =3.340, p = 0.037, η2 = 0.021)* which were statistically significant. The follow-up Tukey HSD tests only revealed a difference when Generation Z (M = 5.60, SD = 1.156) is compared to Generation *X (M = 6.00, SD = .550, p = 0.032)* which was statistically significant. Therefore, in a multi-generational cohort engaging in gamified entrepreneurship courses, Generation Z has a different Student Entrepreneurial Orientation from Generation X. Conversely, no differences were found between Generation X and Y.

Therefore, based on these results by the One-Way ANOVA and Tukey HSD tests, there are varying statistically significant differences between the three Generations X, Y and Z in the variables of the gamified entrepreneurial education model. We, therefore, accept hypothesis H8 (H8: Statistically significant differences exist between the three student generations X, Y and Z in the variables of the gamified entrepreneurship course model).

5. Discussion

The study developed a behaviour-results model for gamified entrepreneurship courses leading to student entrepreneurial intention and entrepreneurial orientation. The model consists of the following variables: Results Demonstrability, Student Grit, User Characteristics, Cognitive Engagement, Emotional Engagement, Behavioural Engagement, Entrepreneurial Intention and Entrepreneurial Orientation. This is in line with studies advocating for behaviour-results models to interrogate entrepreneurship education [4,19,31,86]. In addition, the model included student engagement which the literature [87,91] proposes both in education and e-learning as the central mode of delivering and receiving education [15,23,25]. The model also disaggregates student engagement into its dimensions to elucidate the nuances of the effects of engagement facilitators such as Results Demonstrability of the gamified platform, the Student Grit application and the Student User Characteristics [87,91,107]. The model then confirms the student engagement and entrepreneurial intention nexus as posited in the literature [4,6,10]. Furthermore, the model answers the quest for the introduction of entrepreneurship orientation to assess higher education students and higher education entrepreneurship courses, programmes and activities [17,79,108]. The model was validated with six dimensions of entrepreneurship orientation encompassing all the important variables for the education context such as learning orientation, achievement orientation, innovativeness, risk-taking, pro-activeness and competitiveness.

The model, therefore, provides an alternative framework for the assessment of gamified entrepreneurship education. In addition, the strength of the model as a behaviour-results model assesses gamified entrepreneurship education by first combining theory and practice. Secondly, by evaluating behaviour as vocational skills of the students and thirdly, by combining other skills and attributes of the student required in entrepreneurship practice but have not been generally measured in entrepreneurship education such as innovativeness, risk-taking, pro-activeness, competitiveness, achievement orientation and learning orientation.

Additionally, student emotional engagement and behavioural engagement can now be assessed with the model for students taking gamified entrepreneurial courses in addition to their cognitive engagement which has traditionally been assessed with written examinations. Also, student user characteristics and student grit for engaging in gamified entrepreneurship can now be factored into the assessment of gamified entrepreneurship courses using the model. Student expectations of gamified entrepreneurship courses captured or evaluated as results demonstrability can be factored into the assessment of the course using the validated model.

In addition, the study found in a general multi-generational cohort of students in a gamified entrepreneurship course, the nuances of engagement facilitating factors such as Results Demonstrability factors influence Student Emotional Engagement more than Student Cognitive Engagement but do not influence Student Behavioural Engagement. Also, Student Grit is the most influential factor in Student Engagement compared to Results Demonstrability of the gamification platform and the User Characteristics. Thus, Student Grit is an important Student Engagement facilitator in a gamified entrepreneurship course for multi-generational cohorts of Generation X, Y and Z. Additionally, Student User Characteristics influence all three forms of student engagement and are the third influential engagement facilitator in a gamified entrepreneurship course for multi-generational cohorts of Generation X, Y and Z.

Student engagement as recorded in the literature plays a critical role in entrepreneurship education [87,91]. In a disaggregated form, Student Behavioural Engagement results in a higher Student Entrepreneurial Intention than Student Cognitive Engagement. And, Student Emotional Engagement does not necessarily influence Student Entrepreneurial Intention. Student Entrepreneurial Intention and Student Entrepreneurial Orientation nexus is an important relationship in multi-generational cohorts [1,4]. Since the study confirmed the relationship with a positive Student Entrepreneurial Intention as an antecedent to Student Entrepreneurial Orientation Thus, attainment of higher Student Entrepreneurial Orientation could be used as a desirable assessment for gamified entrepreneurship courses in higher education.

Furthermore, we also found differences in the component variables based on student Generations X, Y and Z. Thus there were marked differences in student grit, cognitive engagement and emotional engagement between Generations X and Z. Also, generational differences existed between Generation Z and Y, and Generation Z and X for student entrepreneurial intention. The study also confirmed the difference in entrepreneurial orientation between Generations X and Z as posited in the literature [70,71]. In understanding multi-generational cohorts in gamified entrepreneurship courses in higher education we found the need to contextualize student engagement facilitators such as results demonstrability of the business simulation platform, student grit and user characteristics as they have selective effects on student cognition, behavioural and emotional engagements in a multi-generational student cohort of the three generations.

5.1. New contributions to practice

The study makes the following contributions to practice. Firstly, a behaviour-results model for gamified entrepreneurship courses has been developed and employed to explain the nuances in multi-generational cohorts at the undergraduate level in higher education. Secondly, the model developed by the study provides an alternative option for assessing gamified entrepreneurship courses in higher education programmes. Thirdly, the study explicates the distinctions in learning essentials in gamified entrepreneurial courses and programmes for multi-generational cohorts which are emerging in some higher education undergraduate programmes. Fourthly, the development and utilization of the study model account for developing countries constraints, since the study was done in that context and therefore, enhances its broad appeal for use in the increasing use of technology in delivering entrepreneurship courses. Fifth, the study innovatively deploys the behaviour-results model to research a critical area in entrepreneurship education which is becoming more technology-driven and an area currently encountering all generations in the traditional cohort environment, to bring out the nuances in course design, practice, and pedagogical challenges of student engagement.

5.2. Implications for research

The study first proposes and tests a behaviour-results model for evaluating and assessing student entrepreneurial intention and orientation in gamified entrepreneurship courses in higher education. This is in line with studies calling for new conceptualization for the assessment of gamified education platforms [2,10,14,17,109]. For research, the conceptualization opens up new and alternative interdisciplinary behaviour-results models to interrogate the field of gamified entrepreneurship education, moving away from the technology adoption inquiry perspective. Also, the innovative conceptualization of entrepreneurial orientation at the individual level encourages its application in entrepreneurship education [17,20,79]. In addition, the study presents opportunities for the deployment of other conceptualizations of student engagement to research gamified entrepreneurship education programmes with behaviour-results models for practice, bringing out pedagogical contextualization of different student generations. This extends the knowledge on higher education entrepreneurship courses evaluation and assessment, assessment of gamified entrepreneurship courses, and assessment of gamified entrepreneurship courses in multi-generational cohorts in higher education. The study, therefore, contributes by extending research in these multi-disciplinary areas stated. Therefore, extending the literature that has been sparse in these areas and disciplines.

5.3. Limitations and future research

As an exploratory study, the study is bound to have limitations. First, the study was carried out from one distinctive higher education establishment that accommodates multi-generational cohorts making the study relevant but the phenomenon of multi-generations in undergraduate higher education is still an emerging one. Thus, the model could be tested in non-multi-generational cohort contexts. Also, the study uses a cross-sectional research design and could be tested in a longitudinal research design context or a pre-test post-test research design context. These provide further opportunities for replicate studies and research in the three areas of education, business simulation application to entrepreneurship courses in undergraduate programmes, and multi-generational learning.

Considering the complexity of student engagement and the sparse research on gamified educational programmes, usually limited to technology adoption, we strongly encourage research into student satisfaction in using these technology-mediated platforms and other alternative assessment methods such as entrepreneurial orientation of students in higher education entrepreneurship programmes [93,110]. We also agree with the literature [83,84,90] to employ the different conceptualizations of the student engagement construct in conceptualizing and developing new behavioural-results models [111]. Additionally, these future models will elucidate the nuances of engagement in the relationships with entrepreneurial intention and also strengthen the literature on the entrepreneurial intention and orientation relationship [93,109,112].

6. Conclusions

In conclusion, we reiterate the emerging implications for entrepreneurship education in undergraduate activities, courses, and programmes as they are increasingly being mediated and delivered with technology (gamification). Their implications for the evolving phenomenon of multi-generational cohorts in undergraduate higher education programmes requires contextualization based on student generations to provide the best possible student learning outcomes. The study, thus, provides an interdisciplinary behaviour-results model with key elements for assessing gamified entrepreneurship programmes in higher education. It also provides a guide for multi-disciplinary researchers and academics for exploring the complexity of student engagement in entrepreneurship gamified programmes from a conceptual and practical basis. In practice, the study brings to light the nuanced challenges for course design and pedagogical practice. It also adds to the body of knowledge that emphasizes the distinctions in student engagement in gamified programmes and across different student generations.

Data availability statement

The dataset has not been deposited into any publicly available repository but can be made available upon request from the authors.

CRediT authorship contribution statement

Prince Derrick Dodoo: Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **David Eshun Yawson:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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 1. Table of Measures, items, validity, and reliability scores for Variables in the Research Model

MEASURE	ITEM	Code	Standard Factor Loading	Reliability and Validity	Related Studies
Results Demonstrability (BSRD_T)	What is your overall satisfaction level with the Business Simulation course?	Bus_Sat	0.942	CR = 0.864 AVE = 0.870	Yawson and Yamoah, [27]; Venkatesh and Bala [52],
	How would you rate the usefulness of the Business Simulation course to your study programme?	Bus_Use	0.923	Cronbach's alpha (α) = 0.851	
Student Grit (GRIT_T)	I finish whatever I begin.	GRIT_PE_1	0.921	CR = 0.920 AVE = 0.860	Aparicio et al. [95]
	Setbacks do not discourage me.	GRIT_PE_2	0.930	Cronbach's alpha (α) = 0.919	
	I am a hard worker.	GRIT_PE_3	0.932		
User Characteristics (UCS_T)	Your belief in your ability to achieve goals (Self-efficacy)	UCS_1	0.931	CR = 0.965 AVE = 0.873	Hadullo et al. [94]; Yawson and Yamoah [27].
	Your training on the internet.	UCS_2	0.936	Cronbach's alpha (α) = 0.964	
	Your personal motivation.	UCS_3	0.955		
	Incentives to take the sessions at your own time.	UCS_4	0.924		
	Your experience with the course content.	UCS_5	0.927		
Entrepreneurial Intention Scale (ENIS_T)	I am ready to do anything to be an entrepreneur.	ENIS_1	0.876	CR = 0.975 AVE = 0.886	Liñán & Chen [100],
	My professional goal is to become an entrepreneur.	ENIS_2	0.933	Cronbach's alpha (α) = 0.974	
	I will make every effort to start and run my own firm.	ENIS_3	0.966		
	I am determined to create a firm in the future.	ENIS_4	0.957		
	I have very seriously thought of starting a firm.	ENIS_5	0.959		
	I have the firm intention to start a firm someday.	ENIS_6	0.953		
Student Engagement (SENG_T)					

(*continued on next page*)

(*continued*)

MEASURE	ITEM	Code	Standard Factor Loading	Reliability and Validity	Related Studies
Student Cognitive Engagement (SENG_CO_T)	I try to connect it with what I am learning through my degree.	SENG_CO_1	0.927	CR = 0.941 AVE = 0.892	Buil et al. [87]
	I try to make all the decisions fit together and make sense.	SENG_CO_2	0.953	Cronbach's alpha (α) = 0.939	
	I try to relate what I am learning to what I already know	SENG_CO_3	0.952		
Student Emotional Engagement (SENG_EM_T)	I feel good.	SENG_EM_1	0.959	CR = 0.969 AVE = 0.912	Buil et al. [87]
	I feel interested.	SENG_EM_2	0.957	Cronbach's alpha (α) = 0.968	
	I have fun.	SENG_EM_3	0.951		
	I feel involved.	SENG_EM_4	0.953		
Student Behavioural Engagement (SENG_BE_T)	I try hard to do well in the game.	SENG_BE_1	0.859	CR = 0.933 AVE = 0.856	Buil et al. [87]
	I participate in group discussions.	SENG_BE_2	0.956	Cronbach's alpha (α) = 0.915	
	I listen very carefully to the teacher.	SENG_BE_3	0.956		

Appendix 2. Table of Measures, items, validity and reliability scores for Entrepreneurial Orientation Scale

MEASURE (Dimension)	ITEM	Code	Standard Factor Loading	Reliability and Validity	Related Studies
Entrepreneurial Orientation Scale (EOS_T)					
Innovativeness (INN_T)	I like lecturers with a different approach and who make use of new teaching methods.	INN_1	0.743	CR = 0.974 AVE = 0.559	Gorostiaga et al. [79]
	I like to work and take part in groups where new or innovative ideas emerge.	INN_3	0.832	Cronbach's alpha (α) = 0.971	Yawson and Yamoah [17]
	I like innovative lecturers more than traditional ones.	INN_4	0.769		
Risk-Taking (RIS_T)	You have to take risks at times in order to be successful in life.	RIS_1	0.848		
	I like to make risky decisions.	RIS_2	0.673		
	In order to create something of value, you have to be prepared to make mistakes.	RIS_3	0.829		
	I admire people who assume large risks.	RIS_4	0.702		
	In order to create something of value, you need to take risks.	RIS_5	0.795		
Pro-activeness (PRO_T)	I take the initiative whenever I have the opportunity to do so.	PRO_1	0.844		
	In class, I'm often the first person to propose things.	PRO_2	0.584		
	I like to take the initiative in almost everything I do.	PRO_3	0.758		
Competitiveness (COM_T)	I usually compete with my classmates.	COM_1	0.519		
	For me, being competitive is a good thing.	COM_2	0.688		
	Life in general is all about competition.	COM_3	0.526		
	I often strive to be better than others.	COM_4	0.585		
	I like lecturers who encourage competitiveness among their students.	COM_6	0.626		
	I see myself becoming a businessman/woman and always competing.	COM_8	0.630		
Achievement Orientation (ACO_T)	Before beginning a task, I need to set myself some clear goals.	ACO_1	0.787		
	Trying to do better in my studies is important to me.	ACO_2	0.795		
	I get a special feeling whenever I achieve a goal in my studies.	ACO_3	0.780		
	I like to set myself goals that imply a challenge (in class, in the game etc).	ACO_4	0.754		
	In order to achieve a goal, I usually break it down into smaller objectives.	ACO_5	0.769		
Learning Orientation (LNO_T)	My goal is to have a job where I am constantly learning new things.	LNO_1	0.699		
	You learn from your mistakes.	LNO_2	0.798		
	Life is a constant learning process.	LNO_3	0.809		
	I like people who never stop learning.	LNO_4	0.835		
	I try to learn new things every day.	LNO_5	0.833		
	For a company to be successful, its employees have to be learning all the time.	LNO_6	0.830		
	I always try to learn from my experiences.	LNO_7	0.847		

Appendix 3

Instrument.
Business Simulation Course Feedback Form.
Have you taken the Business Simulation Course offered in Level 300 at the GIMPA Business School? YES/NO.
PERSONAL INFORMATION [101].

1. Your Age Group? Generation X (1965–1979), Generation Y (1980–1995), and Generation Z (1996–2003) [14,26–28,63].
2. Your Gender?
3. Your campus of study?
4. Your Student Status?
5. Your Working Experience?
6. What is your current work status?

THE COURSE EXPERIENCE [27,52].

7. How would you rate the usefulness of the Business Simulation course to your study program?
8. What is your overall satisfaction level with the Business Simulation course?

ONLINE BUSINESS SIMULATION [27,94].

9. Indicate the usefulness of the following to the business simulation course you have taken.
   a. Your belief in your ability to achieve goals (Self-efficacy)?
   b. Your training on the internet?
   c. Your personal motivation?
   d. Incentives to take the sessions at your own time.
   e. Your experience with the course content.

STUDENT ENGAGEMENT [87].

10. Indicate your agreement with the following statements. When I am playing the business game …
    a. I try to connect it with what I am learning through my degree.
    b. I try to make all the decisions fit together and make sense.
    c. I try to relate what I am learning to what I already know.
    d. I feel good.
    e. I feel interested.
    f. I have fun.
    g. I feel involved.
    h. I try hard to do well in the game.
    i. I participate in group discussions.
    j. I listen very carefully to the teacher.

ENTREPRENEURIAL INTENTION [100].

11. Indicate your agreement with the following statements. When I am playing the business game …
    a. I am ready to do anything to be an entrepreneur.
    b. My professional goal is to become an entrepreneur.
    c. I will make every effort to start and run my own firm.
    d. I am determined to create a firm in the future.
    e. I have very seriously thought of starting a firm.
    f. I have the firm intention to start a firm someday.

PERSONAL DEVELOPMENT-GRIT [95].

12. Indicate your agreement with the following statements on your personal development when playing the game.
    a. I finish whatever I begin.
    b. Setbacks do not discourage me.
    c. I am a hard worker.
    d. I often set a goal but later choose to pursue a different one. (R)

e. I have been obsessed with a certain idea or project for a short time but later lost interest. (R).
f. I have difficulty maintaining my focus on projects that take more than a few months to complete. (R)

ENTREPRENEURIAL ORIENTATION [17,79].

13. Indicate your agreement with the following statements on your personal development when playing the game.
a. I like lecturers with a different approach and who make use of new teaching methods.
b. My goal is to have a job that is more about routine than creativity.
c. I like to work and take part in groups where new or innovative ideas emerge.
d. I like innovative lecturers more than traditional ones.
e. You have to take risks at times in order to be successful in life.
f. I like to make risky decisions.
g. In order to create something of value, you have to be prepared to make mistakes.
h. I admire people who assume large risks.
i. In order to create something of value, you need to take risks.
j. I take the initiative whenever I have the opportunity to do so.
k. In class, I'm often the first person to propose things.
l. I like to take the initiative in almost everything I do.
m. I usually compete with my classmates.
n. For me, being competitive is a good thing.
o. Life in general is all about competition.
p. I often strive to be better than others.
q. I prefer not to have to compete.
r. I like lecturers who encourage competitiveness among their students.
s. I often bet my classmates that I'm better than they are at something.
t. I see myself becoming a businessman/woman and always competing.
u. Before beginning a task, I need to set myself some clear goals.
v. Trying to do better in my studies is important to me.
w. I get a special feeling whenever I achieve a goal in my studies.
x. I like to set myself goals that imply a challenge (in class, in the game etc.)
y. In order to achieve a goal I usually break it down into smaller objectives.
z. My goal is to have a job where I am constantly learning new things.
aa You learn from your mistakes.
bb Life is a constant learning process.
cc I like people who never stop learning.
dd I try to learn new things every day.
ee For a company to be successful, its employees have to be learning all the time.
ff I always try to learn from my experiences.

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