GAME-BASED LEARNING: IMPACT TO FOSTER CRITICAL THINKING AMONG ART AND DESIGN STUDENTS FROM GENERATION Z

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Abstract – **This paper presents findings of a Malaysian study of game-based learning as a teaching and learning method for tertiary-level art and design students in creative programmes. Game-based learning is considered a suitable strategy for Generation Z's learning style who prefer visual-based and interactive learning methods, and the ability to keep students focused and engaged which fits closely with the demographic's motivations and characteristics. Game-based learning literature shows its potential to be a suitable medium for learning creatively while fostering critical thinking processes such as reflection and reasoning, analysis, problem solving, comparing options, drawing conclusions, and making decisions independently. A set of research objectives were developed for a mind mapping game based on a critical thinking subject, 'Idea Generation and Problem Solving for Design', with the subtopic of mind mapping, aimed at examining the critical thinking values of Generation Z students, who have distinct mental and behavioural traits. An experimental and a control group of game playing participants showed two different levels of critical thinking values exists among junior-level art and design students: the experimental group who made mistakes while playing, and the latter who needed greater support and guidance and were less capable in producing critical results despite technical assistance. The findings of this study show that among Generation Z students, two existing learning styles, lecture and tutorial and experimental styles, determine students' responses towards game-based learning. Analysis suggest deficiencies in critical thinking values may exist, although the differences noted between the experimental and control group were not too much in terms of performance. Lastly, this paper shares some practical recommendations on ways to harness the benefits of game-based learning for teaching critical thinking to different cohorts of Generation Z demographics.**

Keywords – **Art and Design, Critical Thinking, Game-Based Learning (GBL), Generation Z (Gen Z), Zone of Proximal Development (ZPD)**

I.   INTRODUCTION

The benefits of technological advancements are increasingly being harnessed by higher education institutions. Among education leaders, equal concerns have arisen as to how colleges, universities, and learning managers should effectively adapt in fulfilling higher education requirements and learning outcomes, through academic policies, in the classrooms, and how this eventually shape students' learning behaviours (Romero, 2015). As digitalisation become prominent in course management, delivery, and assessments, lecturers and instructors must understand how these processes impact on Generation Z students.

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Generation Z (Gen Z), also known as digital natives, Net Generation, or i-Generation (Seemiller & Grace, 2016) are the demographics shaped by technology since young. Gen Z are well-versed in development in the virtual world. Many aspects of technological dependence determine their values, thinking and beliefs, transferring into their attitudes towards learning. The absence of internet or mobile phones may even cause Gen Z to be anxious, less creative, and unable to solve problems on their own. The "24-hour plugged in" privilege is what distinguishes Gen Z from Baby Boomers, Gen X, and the Millennials.

Education leadership authority Corey Seemiller and Meghan Grace cite the shadow of the economic recession of the late 1990s as having a decisive role in the generation's motivations and decision making, affecting their concerns, lifestyle habits, learning styles, and so on (2016). "They are under no illusions about their prospects for employment after college" (Seemiller & Grace, 2016). On the positive note, Gen Z are found to be exceptionally adaptive behaviourally, socially concerned, innovative, and broadminded when it comes to learning new ideas using new ways. This concurs with Tolbize (2008), who differentiates the distinct social and cultural values and behavioural traits of the four main generations based on age and significant life events, as impacted by media and technology.

Gen Z exhibits distinct behavioural traits in the classroom. Seemiller and Grace (2016) who conducted studies of more than 1,100 Gen Z college students found that the constant connection and engagement with family and close circles, as well as exposure to news and issues in the media makes them appreciate direct experience, participation, and active processing of information.

Problem Statements

Born between 1995 and 2009, Gen Z make up 29% of the total Malaysian population (Tjiptono et al., 2020). Gen Z cohorts are now reaching matured age and a huge number of the demographic are pursuing higher education. As with Gen Z youths everywhere in the world, the dependence on technologies contribute to their inability to keep focused, being easily distracted, and disengaged. The traditional studying process may find them seeking for more visual ways of learning.

The visual learning process comprise sight stimuli with graphic materials and demonstration-based presentations. For instance, sixty Malaysian vocational college students who participated in a survey using the Felder-Soloman's *Index of Learning Styles* (ILS) Questionnaire show that 90% of them prefer to learn visually (Tee et al., 2015). The study identified the potential role of interactive learning methods and alternatives in the learning process which might suit better compared to conventional teaching, which applies traditional critical thinking methods for problem solving (Tee et al., 2015). This suggests another major problem

may exist, the state of critical thinking among Malaysian Gen Z students.   To understand this issue further, literature from instructional experts and local educational policies were sought.

Critical thinking among Gen Z has been greatly hindered in the smartphone era.   Gen Z demographics are fed with overwhelming information that affects the credibility of decisions made in their daily lives.   Research links the lack of critical thinking among Gen Z students to the lack of focus in the classroom when information is used for instant gratification (Rothman, n.d.).

This concurs with Salame and Thompson (2020) found that students across different fields of academic pursuit prefer to copy lecture notes directly and extensively into their journals during classes and tutorials, instead of spending time reflecting and applying what they learn. While taking notes play a role in preparing for examinations and in improving grades, it is the strategy and skill of note-taking that are questioned.

Malaysian scholars and the education communities have largely blamed this phenomenon on the government's over-emphasis on the mass churning out of graduates, many who become unemployable due to a lack of soft skills, and the lack of learning competencies at the workplace.   The government of Malaysia has acknowledged these issues openly, but changes require long term strategies, which the *Malaysian Education Blueprint 2015-2025* is not effectively addressing, as educational institutions always defer to short term employment market situations and make decisions based on the close associations between economic and political issues that have beset the nation for decades (Tjiptono et al., 2020, pp.146-147).

Additionally, the importance of critical thinking is reflected in the *Malaysian Quality Agency* (MQA, 2020) *Programme Learning Outcomes* (PLO) policy, the accredited standard of academic attainment which state that art and design undergraduates are to be able to "critically analyse historical, contextual, conceptual theories, and ethical judgement in Art and Design practice" upon completing the course of study (p.9).

Research Objectives

This study aims to provide an alternative teaching method in order to measure the difference towards the students' learning process for the undergraduate students in art and design.   The researcher also hopes to create awareness towards critical thinking values in preparation for the students' teaching and learning pursuit ahead.

From the problem identification process, the key assumption (hypothesis) is that critical thinking is a learning deficiency among Gen Z overall.   Among creative students, this can affect their grades for certain subjects, but of greater concern is the inability to acquire the 21st century learning competencies that comprise of active listening, information processing, and writing that formal learning environments such as colleges and universities demand of graduates and in their future employment.   Based on the problem, key research questions are:

- *What are the suitable factors to be considered in developing a mind mapping game for art and design students from the Gen Z cohorts?*
- *What are the implications of students demonstrating improved critical thinking values through game-based learning in the classroom?*

The research objectives for this paper are: First, to develop a mind mapping game for Gen Z students in art and design programme.   *Game-Based Learning* (GBL) was chosen to be the experiment approach due to the visual nature of the learning method.   Second, to ascertain the process of learning critical thinking values through GBL from the students' perspectives.   Third, to provide recommendations on ways to harness the benefits of GBL in fostering critical thinking among Gen Z learning cohorts.

Significance Of the Study

GBL is an alternative method for Gen Z students. Educators could use it to overcome attention deficiency by providing students with instant feedback and problem-solving skills, while still giving them a platform to enjoy gaining knowledge.   As Malaysian Gen Z make increasing decisions based on digital and interactive media, their critical thinking will be called into question in the future working environment.   This study contributes to fostering of critical thinking values, one of the 21st century learning skills framed by non-profit organisation, *Partnership for 21st Century Learning* (Battelle for Kids, 2019, Figure 1). These skillsets will push Malaysia to strengthen its foothold its readiness for the *Fourth Industrial Revolution* (4IR).

Figure 1. P21 21st Century Skills

II.   LITERATURE REVIEW

Critical thinking is a mental habit in outlining detailed exploration of issues, ideas, artefacts, and events (Association of American Colleges and Universities, AACU, 2009).   It is a reflective way of thinking, making decisions and taking actions (Ennis, 2011).   Mental activities include formulating hypotheses, making enquiries, discovering, and weighing options, carrying out experimentation, analysing findings, and constructing alternative opinions.   These require a wide range of dispositions and abilities focusing on reflection and reasoning.   For learning, critical thinking may be based on a range of rubrics, but the intended outcomes must be framed "clearly and inclusively" (Abrami et al., 2015, p.277). Critical thinking outcomes are generally assessed in self-regulated or independent mode across most study disciplines (Abrami et al., 2015).

Critical Thinking Skills

Critical thinking may be a complicated process considering multiple range of skills and cognitive abilities such as identifying others' perspectives, evaluating evidences, balancing arguments and evidences reasonably, identifying false assumptions, recognising and applying techniques to make some positions appear more appealing than others, reflecting of issues in structured ways, making judgments, decisions and drawing conclusions based on synthesized data and information, and presentation of perspectives in a structured, clear, well-reasoned and convincing ways (Cottrell, 2017). Student-centred instructions for critical thinking in the classroom teaching environment should be designed to enable the teacher to "share control" with students, allowing exploration, decision making and self-discovery, even though encountering mistakes in the process of finding answers (Brown, 2008).

Game-Based Learning (GBL)

Numerous journals and publications support the use of GBL in the classroom. Some highlights are reviewed here to identify elements required in developing GBL for a specific target audience. GBL is defined as the use of digital games in the pursuit of purposeful learning goals (Betts, 2013). There are five types of games for learning: *drill and practice, serious games, commercial games, and alternate reality games*. In research that focused on the use of computer-based games and simulations for K-12 students, Klopfer and Yoon (2004) found GBL an authentic medium for learning creatively while fostering critical thinking among tech-savvy demographics as the method help "[build] bridges between students' experiences from outside the classroom" as they apply them naturally within formal learning environments in learning important subjects such as mathematics and science." Commercially, the market size for global game-based learning was estimated to be US$10.88 in 2021 (Emergen Research, 2022). These include game types that incorporate *augmented reality* (AR) and *virtual reality* (VR), *artificial intelligence* (AI), and games for specific solutions, such as language learning.

HEXA-GBL

The HEXA-GBL methodology developed by Romero (2015) comprise six phases to design and evaluate GBL effectiveness through a learner-centred perspective (Figure 2). GBL strategy is based on three key elements of *prior knowledge, zone of proximal development and flow*. According to Romero (2015), injecting these measures into game-based learning must consider these factors to ensure that the game is enjoyable yet would be able to teach the participants on the same level as conventional teaching approaches. Some relevant aspects are discussed in the following.

Figure 2. Game-Based Learning Design and Evaluation Framework

Prior Knowledge

Prior knowledge must fully define the final outcomes of the idea generation process. Students are to be given a professional brief which involves creative problem solving as their job where the 'real world' situation was simulated. The "creativity" aspects should be identified and included in the brief. Idea generation comprise three key constructs: separation, structure, and strategy (McAdam, 2004). Mind mapping is a structured idea generation process which can be reflected in GBL. Mind mapping fosters critical thinking by cultivating the necessary skills for real-life problem solving such as systematic sorting of data, seeking evidence, balancing arguments, recognising opposing or alternative perspectives, decision making, and deriving conclusions or solutions.

Zone Of Proximal Development (ZPD)

ZPD is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under supervised guidance or in collaboration with more capable peers (Vygotsky, 1978). This concept of "learning by doing" notes that Gen Z students who are provided with reasonable options, a sense of freedom, and allowed to make mistakes, find better learning support (Mohr & Mohr, 2017). Consequently, they develop positive mental habits of resourcefulness, adaptability, and a pragmatic outlook in decision-making tasks (Tolbize, 2008). In determining ZPD during GBL session, the key elements are:

- Participants are clearly instructed on objectives, processes, and tasks to be completed.
- Instructor is present in the classroom at any given time for assistance.
- Storyline to be implemented within the game.
- Activities that require storyline or storytelling to be completed.
- Activities to be implemented in increasingly challenging level.

Flow

This is defined as "the state of being in total involvement" (Csikszentmihalyi, 2013). In the experience of flow, learning is an outcome when skill level and the challenge are equal. In the classroom, students need to have activities that they can complete. In the GBL context, it should be more challenging as they progress towards results. The elements necessary are:

- Increasing number of keywords at every level.
- Single player based.
- Decision making made on an individual basis.
- Different challenges, stories, and rewards to keep players motivated.
- Players allowed specific duration to play the game on their own, and the only help provided is mainly technical assistance.
- Participants' progression to be recorded.
- At the end of game, students to receive a medal based on accumulated marks.
- Objectives emphasised at the beginning, during, and at the end of game.

III. METHOD

This paper held the focus of study on junior-level of undergraduate students in creative art and design programmes due to the certain level performance in subjects that require critical thinking and decision making. The main criterion for trial participation was that participants answered the Felder-Soloman's *Index of Learning Style* (ILS) Questionnaire on their individual learning styles, whereupon a basic framework for the game was developed, based on the critical thinking value rubric developed by AACU (2009).

Research Process

During the first half of the research process, qualitative data was relied on to understand the Gen Z demographic. The other half of the research used mixed-methods sequential explanatory design, as quantitative results as well as qualitative data. To engage Gen Z, learning methods that is quick, instant, and fun are required. Upon analysing the different type of learning styles, the researcher found that GBL, a fairly new concept of learning that suits the distinguishing attributes of Gen Z.

Respondents were divided into Control and Experimental groups. The Control Group comprise students who prefer lecture and tutorial learning, while the Experimental Group were made up of students who prefer visual method of learning.

IV. FINDINGS

The premise is that in terms of knowledge, both groups are assumed to be equal in background understanding. Terms that are not clearly understood were repeatedly emphasised on, while clear instructions on the mind mapping process to be represented in a simple animation were given. However, slight differences in briefing were used to fit the style of learning of each group. This was based on a pre-test observation by the researcher that found

that in certain subjects, respondents deliberately exited classes in the middle of a lecture or a tutorial session. 40 respondents past academic performances were then considered at this stage. Analysis of academic performance showed 20% (8 respondents) of total respondents in the institution achieved distinction grade, 35% (14 respondents) achieved credits, while the remaining 45% (18 respondents) managed pass grades.

It was decided to apply Romero (2015) HEXA-GBL methodology to assess GBL design and evaluation effectiveness as the game design and evaluation framework. In the first phase, learning objectives are based on specific topics. During briefing, students were informed on the topic, 'Idea Generation and Problem Solving for Design' and why the mind mapping process was effective in fostering critical thinking. Respondents were informed that critical thinking would focus on gameplay objectives, evidence, influence of contexts, students' positions, how conclusions were reached, and related outcomes. In the second phase, research utilised quantitative and qualitative methods. An in-class GBL experiment based on mind mapping was developed. A digital game for educational purposes was prototyped. A total 20 junior-level undergraduate of art and design students participated focus group. The small sample enables a controlled environment for critical observation and qualitative responses. In the third phase, GBL strategy was embedded within the game's modality and mechanics.

Pre-Test And Post-Test Randomised Controlled Trial

The briefing for both Control and Experimental groups was based on Table I and Table II respectively. The brief called for the process of mind mapping to be animated, and participants had to propose a design based on a chosen theme, either to build a mascot (Control Group), or to design an official stamp (Experimental Group).
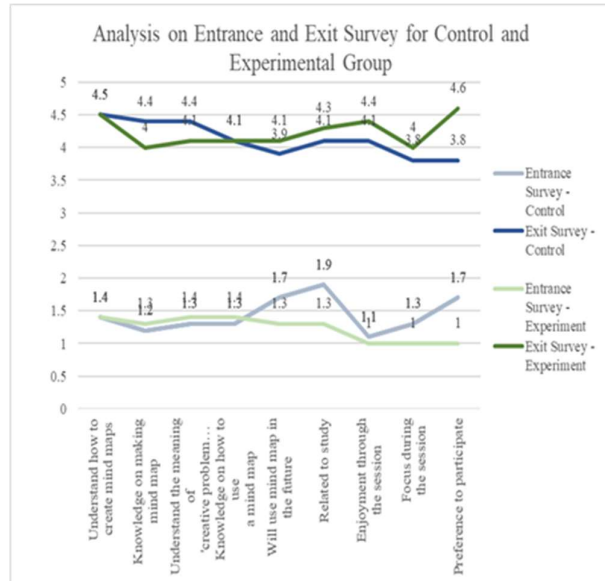
TABLE I: CONTROL GROUP
TABLE II: EXPERIMENTAL GROUP

Control Group
Time allocated: Two hours
Total time spent: One hour and fifty minutes including surveys
Content: Lecture on the terms definition, mind mapping process. Tutorial on how to build a mind map.
Main Topic: The higher education provider itself.
Creative Problem: To build a MASCOT for the institution.

Experimental Group
Time allocated: Two hours
Total time spent: Forty minutes including surveys
Content: Playing the game in order for them to learn the topics.
Main Topic: The town of your favourite animal
Creative Problem: To help the town generate ideas for the design of the new OFFICIAL STAMP for your favourite animal.

Entrance And Exit Survey

As part of the GBL, respondents were asked to answer an Entrance and Exit survey. The results from the survey are presented below in Table III.

TABLE III: ENTRANCE AND EXIT SURVEY

Based on assessment of the critical thinking values rubric, Table IV shows the difference in performance for critical thinking for the Experimental Group, who performed 8% better than the Control Group. While the critical thinking performance score was higher, respondents in the Experimental Group scored very low in their result positions, scoring only 7 out of 40. On the other hand, the Control Group scored quite high in their positions, but lower for Influence of context and assumptions, for which they only scored 3 out of 40.

TABLE IV: CRITICAL THINKING VALUES SCORES

Critical Thinking Values	Control Group	Experimental Group
Explanation of issues	9 / 40	19 / 40
Evidence	16 / 40	16 / 40
Influence of context and assumptions	3 / 40	17 / 40
Students' positions (perspective, thesis/hypothesis)	18 / 40	7 / 40
Conclusions and related outcomes (implications and consequences)	16 / 40	19 / 40
Total marks	62 / 200	78 / 200
Percentage	31%	39%

Semi-Structured Interviews

Semi-structured interviews allow more focus on the process of exploring participants' mindsets. The process of semi-structured interviews should be casual and conversational (Adams, 2015). Semi-structured interviews with the 20 participants were transcribed and analysed to seek more intuitive perspectives from students which directly reflect on theories demonstrating the potential benefits of GBL. Several outcomes emerged on three areas below.

The Keyword of Subject and Subtopic

Participants' prior knowledge included:
- Weak understanding of the term 'idea generation'.
- Very weak understanding of the term 'creative problem solving'.
- Strong understanding of the term 'mind mapping'
- Average understanding of the relationship between 'mind mapping' and 'creative problem solving'.
- Average understanding of the mind mapping process.

The Degree of Being In ZPD

Participants' input reflects included:
- Requiring guidance prior to playing the game.
- Tutorial to be included during gameplay.
- High preference towards story rather than delivering outcomes.

The Convergence Between Players

Flow reflects on players' involvement and achieving desired results to ensure optimal learning. The main input are as follows:
- Increasing challenge at every level.
- Preference towards individual game.
- Reward system implemented.
- Simple *user interface* (UI) and clear objectives.

Focus Groups Open-Ended

An open-ended questionnaire was distributed for participants to provide immediate feedback upon game completion and end of in-class session. The focus of the interview was on participants' opinions about the capabilities and weaknesses of the game. Participants' responses were recorded and presented below. The open-ended questionnaire gave opportunity for participants to weigh the benefits and problems carefully and objectively in completing the game, thus enhancing their critical thinking and interpretation of their own experiences. Data that emerges from the interview came from instant written responses and provides more authentic insights on their attitudes. The use of thematic analysis is then applied to discuss the findings, identify patterns and preferences for visual-based GBL which emerged.

Retrospective Evaluation

It provides a detailed analysis of the strength, weakness, and further development suggestion for the game. Participants identified the game strengths as:
- Great design and colours.
- Appealing character design.
- Fun learning experience.
- Gameplay more interesting than educational game.
- Effective as a visual learning method.
- Short amount of time needed to play and learn simultaneously.

Weaknesses were as follows:
- Game is too short.
- Not enough interactive options.
- Tendency to be childish.

- Bugs in the game

Suggestions for improvement included:

- To be able to choose the final design (stamp).
- To include voiceover.
- To add non-interactive objects for visual excitement.
- To implement hidden challenge levels in the game.

Based on the two learning styles, the results of the in-class GBL will now be analysed, and implications on students' critical thinking values summarised.

V. DISCUSSION

The Experimental Group showed a slightly higher score on the mind mapping topic and generally meeting the learning objectives while the Control Group followed closely behind. The same was observed in the critical thinking value assessment where both Control and Experimental groups scored 31% and 39% respectively. Participants were generally satisfied and enjoyed the time and process of playing the game.

The Control Group did their best to stay focused during the session. The participants were observed to be bound rigorously to instructions, thus lowering their capacity to problem solve on their own. For the Experimental Group, the researcher was allowed to help participants specifically to resolve technical problems, which forced them to be decisive in actions taken. Interestingly, some Experimental Group participants approached the researcher a week after playing the game and argued that the same game will be played by another cohort, and the latter's results might repeat their own. From the researcher's point of view, it is a good sign that the game was being talked about, inculcating cross-sharing and interpersonal communication between participants from different intakes. This suggests that certain critical thinking values had been subtly transferred to the participants based on the two learning methods. The assumption is that while junior-level undergraduate students should not be viewed as 'experts' in critical thinking, the overall evaluation of results shows participants performing quite well within the context of the subject taught in the classroom, which was mind mapping.

While some critical thinking values were missed in the lecture and tutorial learning, the GBL method made up for it. It was also found that Control Group participants were less likely to allow themselves to be influenced on their hypothesis during the tutorial, as they are guided by the questions asked by the researcher. Participants tend to respond slowly to avoid making mistakes, which they assumed they would be penalised for. This situation is not obvious in the Experimental Group, as they were aware that GBL was a tool to learn; performance mistakes would not be penalised, and it is thus acceptable to make mistakes. However, the Experimental Group showed weaker standpoint compared to the lecture and tutorial group, as they only focused on the most obvious element within the game itself.

VI. LIMITATIONS OF THE STUDY

Key limitations of this research are that GBL methodology was applied to study only one specific topic of a subject (i.e., mind mapping) and playing games as a

learning technique is not the only critical thinking tool. As research was conducted among junior level of undergraduate students, it was accepted and acknowledged that their critical thinking abilities are on the average scale. Additionally, inputs from data should be taken with the consideration that the primary sample was limited, albeit in-depth data was presented. Future researchers could fill emerging gaps in teaching and learning that stems from root cause such as disengagement and poor critical thinking, and to modify the game prototype to address the problems according to their needs.

VII. CONCLUSION AND RECOMMENDATION

Overall, the mixed-methods research in this paper suggests that both lecture and tutorial teaching method and GBL are effective in reaching the learning objectives to engage students. Some students may be sceptical and hesitant in learning through GBL at the start, but they eventually gain decision making skills and a voluntary willingness to carry out tasks individually, and to make mistakes in the process of "learning by doing", compared to depending on tutorial instructions. For Malaysia, GBL shows much potential, but indicates there is limited research examining GBL geared specifically for the teaching and learning of art and design subjects. Limited resources exist to guide instructors and lecturers in relation to mind mapping as an idea generation technique to foster critical thinking. Although GBL may reflect specific preferences towards games that Gen Z like to play, with careful study on Gen Z's learning needs, their prior knowledge, ZPD to ensure optimal learning and flow, GBL can be used to reduce classroom attention deficiencies, improve creative problem-solving confidence, while delivering learning with enjoyment. GBL may not the most ideal prototype for all disciplines, but inputs from creative students' perspectives and insights can help GBL researchers to resolve and improve the game prototype before rollout.

Suggestions for Further Studies

This paper will now propose recommendations to foster critical thinking values using GBL. As it stands, junior-level undergraduate art and design students' deficiency to solve problems and sort knowledge properly from data can reduce their effectiveness in information filtering which determines their analytical and decision-making abilities, and in reaching clear conclusions. The idea of going to school to play games should not be frowned upon. The tendency of games to appeal to younger cohorts could be beneficial for children mental development. The focus of future researchers could also be shifted from studying GBL to develop critical thinking effectiveness to its overall impact on younger demographics. Future study could look how to ensure constant flow state of the game in the classroom for specific periods of time. This would align with data that shows a drop in Gen Z students' apparent attention deficiency in the classroom. It is further recommended that gaming experts and researchers collaborate to develop a Malaysian GBL prototype which could be customised to fit different teaching and learning needs of local students, for instance, engineering, medical science, or psychology. Many GBL types could be

prototyped, from AR- and AI-based, to skills-based games. The knowledge, training and gameplay environment will not only stimulate focus and engagement among Gen Z students but may help to determine their critical thinking capacities and the retention of knowledge. Higher-level undergraduate students could benefit from playing games to learn complex topics. There are possibilities of blended (hybrid mode) learning in a game-based setting. Application of game elements in social media to play a collaborative game that challenges their critical thinking values, is another viable GBL strategy to consider.

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Figure 1: *Battelle for Kids* (2019). "P21 Partnership for 21st Century Learning". http://www.p21.org/our-work/p21-framework

Figure 2: Romero, M. (2015). "Work, games and lifelong learning in the 21st century". *Procedia – Social and Behavioral Sciences*, 174, 115-121.