Can Bloom's Higher Order Thinking skills be achieved by Gamified Learning through Social Networking Sites (SNS) like Facebook?

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Abstract. Medical students commonly may resort to rote learning of complex medical topics such as neuroanatomy, primarily if they disengage and work in silos. Providing students with engaging and interactive content, especially of Higher Order Thinking Skills (HOTS) of Blooms, to understand such complex topics and simultaneously providing an opportunity for collaborative learning can be beneficial. This can allow authentic learning towards competency to handle complex medical issues. To address this, the present study developed a novel social network site using three key aspects: An integrated curriculum delivery approach with the integration of games to stimulate creativity (Gamified content), real-life medical scenarios (authentic Case-based learning), and the provision of a social networking platform (Facebook) to voice 'students' thoughts through simple, group brainstorming in an informal learning space (social media). Innovatively 'Bloom's taxonomy is used to create gamified quizzes of increasing difficulty levels and HOTS levels. We identify' students' engagement and learning effectiveness of social networking and gamified learning by medical students over traditional learning management systems. The Lecturers' feedback also evaluates how well the learning outcomes are planned to be achieved through the learning designs of such games. We found that this learning design combining SNS with games at various levels enhanced the learning processes.

Keywords: Medical education; Gamification; Serious Games; Bloom's Taxonomy; Case-based Learning; Game design; Social Networking Sites for Learning.

1 Introduction

Theoretical knowledge of medicine and treatment is of no practical application if the clinician cannot apply it to an actual medical scenario. To apply a medical practitioner's key skills i.e., to arrive at a provisional diagnosis, both medical knowledge and competencies in various skills such as effective communication with peers as a health team, selecting appropriate diagnostic procedures, formulating a differential diagnosis,

performing tests [1], and analysing the test results are required. Learners must be competent in such critical thinking skills when treating health problems [2]. As medical education is competency-based, with students needing to achieve learning objectives of increasing complexity, medical academics and researchers have emphasised the importance of developing Higher Order Thinking Skills among students during their studies at medical college itself [3].

1.1 Why is learning transformation required in medical education?

Learning transformations in medical education are needed to produce a better generation of doctors who can deal with the problems they will face in their future practice to provide quality patient care [3] – thus, the need for authentic learning experience in the early years of medical school. Because clinical reasoning (to formulate a differential diagnosis - given that one sign or symptom can have many causes) does not develop spontaneously, achieving higher-order thinking should be at the forefront of any medical teaching and learning. Hence, it is critical that the curriculum be central to the instructional process, with Active Learning tasks delivered at the higher levels of Bloom's taxonomy. Academic goals depend on a student's self-motivation to learn medicine [4, 5]. Indeed, to improve the effectiveness of medical teaching and learning, lecturers must address the importance of incorporating HOTS into their course curricula which have proven benefits of increasing retention and its translation to better medical practice. As a result, medical educators are keen to immerse learners in complex, interactive experiences that are both rich and real to achieve learning outcomes at increasing levels of complexity. By providing an immersive experience, medical educators can take advantage of the brain's parallel processing of information.

Another critical aspect of medical education is that students need to be exposed to learning challenges throughout the learning process. Such challenges raise a student's mental alertness to the desired level. This is called 'Active Processing of Experience' [6]. Medical students should no longer view their education as a task to be merely completed as a routine but rather as an active experience. Game-based learning is excellent for encouraging the 'Active Processing of Experience' [6,7,8]. Applying game concepts to medical curricula makes sense because both medicine and games require proficiency in specific level skills before progressing to the next more challenging level [9]. The use of a gaming incentive system would allow for the tracking of progress and the mastery of learning skills. Although playing games in silos motivate students in ways that other activities do not, the experience of playing games in a collaborative online environment has more significant benefits, such as peer support and peer guidance. It even can form more positive memories of learning than playing alone [10,11].

2 Literature Review

Thus, it is imperative to implement collaborative game-based learning as a solution to some of the challenges of medical education, as highlighted above. We conducted a literature review to find some specific game-based learning solutions for our Active Learning tasks delivered at the higher levels of Bloom's taxonomy, The sections below are devoted to specific examples of game-based learning and social media-based learning used in medical education. In this section, we look at the research on curriculum transformations in medical education, chosen pedagogies appropriate to the study's context, successful gamified learning, and social media platforms for learning.

2.1 Game-based learning and medical education

Implementing gamified learning significantly impacts student motivation and their entire learning experience since it encourages greater student engagement [12]. A learning experience is most frequently described in the literature as a multifaceted construct encompassing engagement in behaviour, attitude, and cognition [13].

In a systematic review of education research articles (n = 44) assessing the use of gaming characteristics [14], gamification-related adverse outcomes in health professions education were not identified. Instead, the assessment characteristics were found to be combined with conflict/challenge characteristics. The systematic review emphasised the following themes: gamification can improve learning outcomes in health professions education, and game aspects, particularly, improve medical students' learning behaviours and attitudes.

Another related study [15] found that third-year medical students that have taken part in an online game featuring self-guided presentations and multiple-choice tests during six 6-day intervals outperformed non-participants in the post-exposure test and had a decreased incidence of erroneous responses. This reiterated that learning through competitive gaming is an effective way of training medical students.

2.2 Social media for learning

Based on several research studies, students' engagement and learning effectiveness are multidimensional (multifaceted) constructs that can be measured with dynamically interrelated dimensions such as emotional engagement, cognitive development, and learner reasoning emerging through learning activities in a social environment [16]. According to research, using social networking platforms such as Facebook for study purposes increases students' motivation due to peer engagement so that they study beyond the classroom contact hours and take the study material out of the University [16]. Furthermore, medical students who participated in a team-based learning approach in neurology achieved higher mean post-test scores than their classmates who participated in a passive learning approach. [17]

Considering the growing difficulty of developing the learner-teacher relationship, using a private Facebook group that offered a cost-free and effective way for preclinical medical students and teachers to communicate, a study found that their second-year

undergraduate medical students claimed that the faculty-student relationship had significantly improved as did their understanding of the subject matter, and their overall attitude. [18]

While the researchers at the Ontario Tech. University highlighted the use of Facebook as a Learning Management System in the educational environment and provided examples of how to utilise it to support a community of learners; they also highlighted the effectiveness of using it as an LMS. [18]

2.3 An integrated curriculum delivery approach

While there is evidence of gamified learning and social media-based learning in medical education, a combined approach that supports game-based learning through social media space is not designed earlier to support the development of students' higher-order thinking skills. This present study highlights the educational innovation adopted in a medical course offered in one of the higher education institutions in Malaysia using an integrated approach of combining different pedagogies such as Game-based learning, Gamification and Social constructivism to promote students' higher order thinking skills. The educational innovations featured in this study use game-based learning as a specially tailored approach to some weekly classes. At the same time, gamified quizzes were created using case-based learning and storytelling methodologies.

The main goal of the study is to incorporate Active learning through synchronous and asynchronous gamified activities at increasing levels of learning complexity, as well as achievement of Higher Order Thinking Skills (HOTS) through interactive quizzes, and to allow collaboration and rich interactions (21st-century skills) through Facebook as a learning platform.

3 Methods and Methodology

This section incorporates new educational design strategies used for neuroanatomy medical curriculum delivery, such as study topic selection, gamification approaches, use of Bloom's taxonomy in the game design process, and social media page design leading to a Facebook page with games being developed. In addition, the section discusses the evaluation strategies used to assess the efficacy of such educational design.

3.1 Selection of the topic

Medical students find complex topics in medical learning, such as neuroanatomy, to be disengaging and challenging to integrate because the content is frequently presented at the Lower Order Thinking Skills (LOTS) level in Bloom's taxonomy [19]. Medical students learn a vast amount of theoretical knowledge but fail to develop systematic problem-solving skills and effective clinical decision-making because passing grades and the promising future medical career that comes with a university degree have long

been the only motivators for medical students [20, 21]. This results in a failure to develop 21st-century skills such as critical thinking, collaboration, creativity, and rich interactions among students, and teaching them is frequently found to be difficult for medical lecturers as well. The curriculum topic selected for the study is 'Cranial nerves' which based on their medical students' feedback, is the most daunting topic as it needs the application of integrated knowledge integration for that including Anatomy, Physiology, and Clinical Skills [4].

3.2 Gamification of the content

Gamification of the course material 'Cranial nerves' aimed to increase participation and engagement in online learning activities. The following elements were incorporated into the SNS as part of gamified content to increase such engagement and interaction:

- Rapid-fire question rounds with randomness and unpredictability to gamified scenario-based medical conditions are one of the most important gamified elements incorporated into the content.
- Characters that stand in for teaching staff, eye-catching visuals, and aesthetically pleasing designs that make the eLearning more appealing;
- Bright colours and graphics are also used for a visually stimulating learning experience;
- Leader boards are included so that students can compare their performance to that of their peers; Smaller, more frequent tasks are given, and the difficulty level increases as the study progress;
- Scoreboards and badges for rewarding students aim to help students stay motivated and engaged for more extended periods of time;
- Instant feedback after a task or quiz is completed helps students stay focused and engaged because it enables them to track their progress as they move through the various stages.

3.3 Use of Bloom's taxonomy in the game design process

Two lecturers, who are teaching at the Monash University Medical School, played the role of Subject Matter Experts (SMEs) for the gaming content. They populated the medical case scenarios and analysed the complexity at different gaming levels. During the design of gaming strategies, the different levels of pedagogical uses of gaming are differentiated, ranging from passive ingestion (direct quizzing) to interactive consumption (skilful thinking and planning to achieve game credits). Bloom's Taxonomy's cognitive domain is used to develop gaming levels of increasing complexity, which in this study are the following gaming levels: preliminary, league, quarterfinal, semi-final, and final. When gaming conditions are met, each gaming level is set with goals and actions that can be decomposed further into operations.

3.4 The interface design of the Facebook page, 'MUM MED Cranial Nerves'

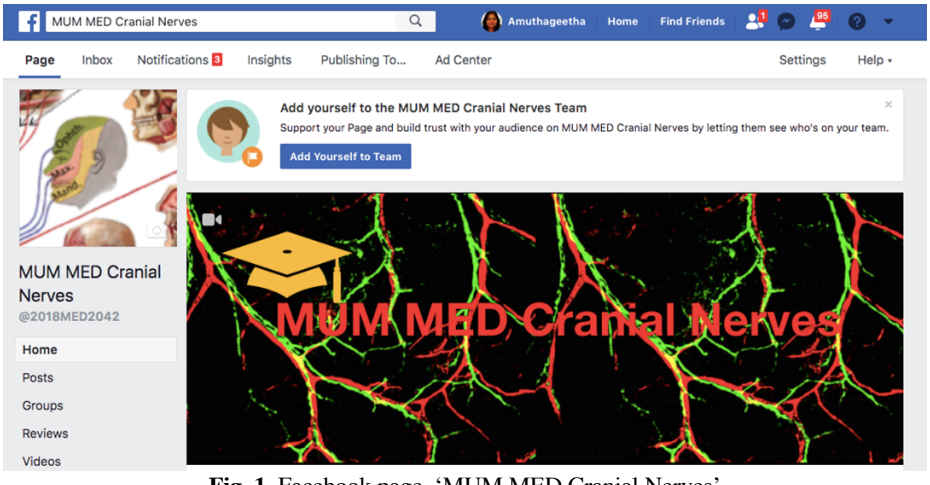

Fig. 1. Facebook page, 'MUM MED Cranial Nerves'

As Facebook is such a large and diverse social media network, students may become disoriented as they navigate through the various layers of posts. The following measures are taken to improve learning through the Facebook page used in this study:

- The template chosen for the 'MUM MED Cranial Nerves' Facebook page (Fig. 1) has organised navigation and allows students to quickly return to the home page from a post or link.
- Compared to the LMS that medical students use for learning, the level of learning behaviours expected on the Facebook application is substantially higher. With the goal of increasing platform interactivity, the size of the icons has been increased to make them more easily tappable and clickable.
- The text and icons in blue are more legible than those in white. A minor increase in visible contrast has improved reading, text visibility, and element visibility.
- Notifications are set to help Pages stay engaged with students so that they receive more notifications that prompt them to post to their peers and stay active.
- A closed Facebook group is created to gather feedback and students' perspectives on how active learning through social media improves their higher-order thinking skills.
- Students were asked to use Facebook tools to review the resources and activities to answer their difficulties and determine how much they believed they had learned. Furthermore, if they searched for and found a good resource on cranial nerves while playing a game, they were invited to use the space as a room for sharing their resources on Cranial Nerves. This contributes to an asynchronous online learning environment that allows for more time to consider all aspects of learning engagement.

3.5 Novel educational design with innovative technological tools

The delivery of the 'Cranial nerves' topic in the curriculum has been redesigned around three themes: 1) an integrated curricular approach, 2) game-based learning, and 3) social learning with technology enhancements. The integrated curriculum approach is employed to innovate curriculum delivery, such as the use of real-life situations to make the content easy to learn by gamifying the medical case-based scenarios, the incorporation of playful games to stimulate creativity (Game-based learning), and the provision of a social networking platform (Facebook) for students to voice their thoughts through simple brainstorming, group brainstorming, or paired brainstorming, informal learning setting (social media). Second, the learning design uses a variety of technology tools to improve student's learning experiences, such as the learning platform Facebook, which allows students to learn at their own pace, and interactive tasks through game design, which are designed to keep students active, focused and engaged. To better support the students, a face-to-face session was organised (Fig. 2), with the students instructed to bring their own devices for the session. During the sessions, the students used various devices, including desktops, laptops, iPads, tablets, and mobile phones.

Fig. 2. Learners' peer interaction and collaborative learning activity while discussing the Facebook and the games quiz

Apart from using Facebook as a learning platform in the present case, other technological tools are used in designing and developing the redesigned curriculum. 'Balsamiq' mock-ups, a user interface design tool for creating low-fidelity prototypes, are used to replicate the experiences of the gamified quizzes used in this study. In this study, prototyping aided the removal of ambiguities and the improvement of accuracy in developing game requirements and functionality. Furthermore, the mock designs are intended to allow the learning designer to experiment with ideas and receive feedback

from the academics, which is an important step in preparing to develop games that are fit for purpose. [22, 23]

In addition, an e-learning authoring tool, 'Articulate Studio' is used for developing gamified quizzes. The designer can obtain the gamified quizzes in SCORM format from Articulate Studio. SCORM is an acronym for "Shareable Content Object Reference Model." SCORM acts as a guideline or reference point for how developers can successfully use multiple standards in combination. In SCORM, the SCO, or "Shareable Content Object," defines the smallest unit of training in an online course that is both reusable and self-contained within the context of a lesson or training program.

3.6 Evaluating the efficacy of the education design

The primary goal of the learning design is to assess the achievement of higher-order thinking skills (HOTS) through the implementation and facilitation of Active Learning approaches using gamification and social media as a learning platform. Multiple methods are employed to assess the efficacy of the novel instructional design adapted for the study. They are:

1) Apart from being used as a learning platform, Facebook is also a research tool because it allows researchers to bypass the limitations of self-reports and laboratory-based studies by providing access to records of actual students' behaviour expressed in a virtual environment. Facebook has a powerful analytical tool called 'Insights,' with a plethora of quantitative data points available to measure, such as likes, engagement, reach, and page actions. Facebook's 'Insights' tool tracks 'likes', page views, reach, and many more. Insights helped to understand how the information on the 'MUM MED Cranial Nerves' page resonates with the students' community.
2) Activity Theory[24] is used as an analytical lens to measure the outcome of learning activities in a social learning space. The observation and analysis in dynamically changing settings (Facebook) are based on 'transforming experiments' (gaming activities). Those experiments radically restructure the environment (Facebook), producing new configurations (learning outcomes) that activate previously unrealised behavioural potentials of the subjects (Medical students). In the learning process, the following components of the theoretical framework will not function as individual entities but combine to make new connections and develop new configurations to achieve the intended outcomes: Subject: Medical College students; Object: Games-based learning activities; Community: Medical students' group.; Outcome: Higher Order Thinking Skills; Tool: Facebook, Computing Devices; Rules: Gaming rules, Gaming Strategies; Division of labour: Subject matter Experts, Educational designers, Students
3) During their regular semester, 118 second-year undergraduate students from the School of Medicine actively participated in a changing situation (Learning Transformation). An online end-of-the-topic survey is conducted with the students enrolled in the Medicine 4 unit. The survey required approximately 15 minutes to complete. The end-of-topic survey included a section

specifically designed to elicit student feedback on their general opinions of the gamified quizzes used on Facebook. The survey is entirely voluntary and anonymous. The confidentiality of their response was also made known to the students. Notably, there was no reward for taking part.

4) A focus group interview is conducted with the academics teaching the topic. In the focus group, the academics were asked to reflect on their expectations regarding teaching delivery design to cover the learning outcomes and how the Facebook page and the games fulfilled such expectations. The focus group included some open questions related to how gamification and Active Learning through Facebook impacted student engagement.

4 Results and Discussion

This section presents and discusses the outcomes that resulted from the study's novel educational approaches and detailed descriptions of the Facebook pages and the games. The outcomes of each technique used to evaluate the effectiveness of the education design in terms of engagement and developing students' higher-order thinking skills are also presented.

4.1 Gamified quizzes developed for the medical unit

There are five gamified quizzes designed for the chosen topic. The prototype for Game 1 is shown below. (Fig. 3)

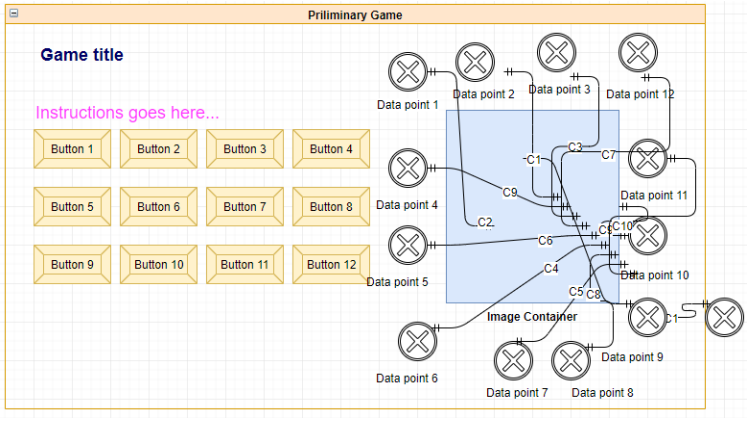

Fig. 3. Design Prototype of Game 1

Game 1 is a preliminary level game in which students label the exit foramen (Data points) by matching the 12 pairs of cranial nerves arising from the forebrain and brainstem. Through this game level, students will receive feedback on their knowledge and understanding of the function of each of the 12 cranial nerves, which will be linked

to the anatomy of the course of each nerve. This, in turn, should help students understand how lesions in various areas of the brain can lead to deficits in the function of each cranial nerve. In preparing to develop games that are fit for purpose, the students' LOTS, such as knowledge and comprehension, are evaluated at this stage.

The second game, at the league level, applies the facts, rules, concepts, and ideas of the sub-classification of the cranial nerves and their location at various levels in the brainstem in a relatively fun and painless manner. The user interaction allows the students to drop the correct cranial nerve nuclei to their proper location and functional type. This is the first step in providing students with feedback on their higher-order thinking skills.

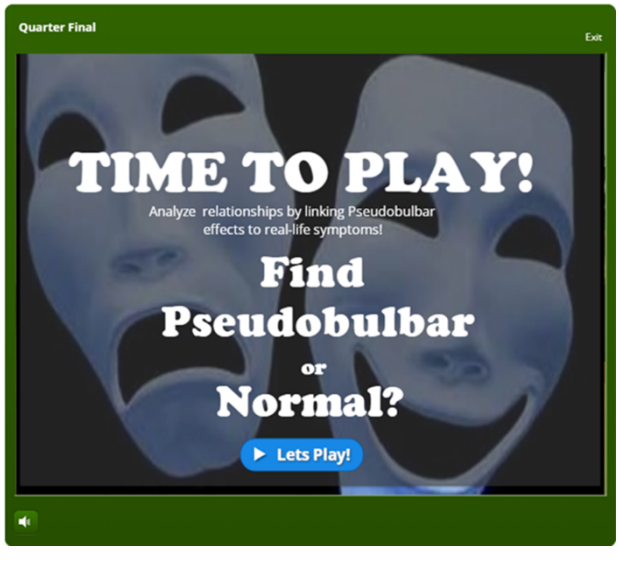

Fig. 4. Quarterfinal level game: Feedback on analysing the symptoms of a given medical condition

The quarterfinal level game (Fig. 4) analyses relationships by linking pseudobulbar effects to real-life symptoms and providing feedback on analysing the signs of a given condition, which is at the fourth level of measure learning via Bloom's Taxonomy. If the students already understand what pseudobulbar palsy is, then this game level should be a fun way for them to see if they can pick up on relevant situational clues such as someone laughing or crying based on true emotion or through inappropriate activation of 'laughter' and 'crying' centres in the brainstem. Game 4 selects the site of the lesion based on clinical features and measures how students can analyse the various possible causes of the patient's multiple symptoms and then reason which ones were most likely in this particular scenario.

In the final game (Fig. 5), formulate and construct a differential diagnosis based on the clinical features of the case, and provide feedback on how students can create a diagnosis.

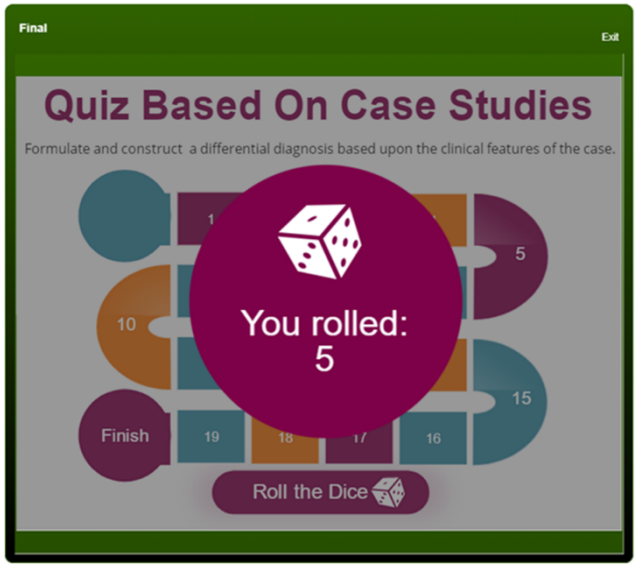

Fig. 5. Quarterfinal level game: Feedback on analysing the symptoms of a given medical condition

4.2 Evaluation based on Facebook data

According to Facebook's Insights, the 'MUM Cranial Nerve' Facebook page has reached all 118 students who participated in the research study. The 'Organic Reach' is 118, which shows that all the students have seen the page contents without paid distribution, which ensures the students' interaction with the contents without any promotion or advertisements. Out of the organic reach, 50 students became 'Followers' of the page, which allowed them to receive updates on the page in their own Facebook timeline. This is considered behavioural engagement, focusing on students' level of investment in learning. There are forty-nine Net likes over seven days, with fifty Likes and 1 Unlike. The 'Like' metrics showed more than one-third of the participants were positively oriented toward the educational gaming activities posted through Facebook. The neutral behaviour of two-thirds of the students proves that the behaviour of the online community does not influence the 'Like' metrics and disproves the 'Like' or 'Unlike' endorsement is not typically broadcasted to the subset of the learning community.

Research suggests that higher-order thinking as structured inquiry is acquired when: learners construct knowledge rather than passively ingest information; learners involve in collaborative interaction with peers; learners are measured for higher-order thinking through complex activities rather than simple recall of facts. A learner develops cognitive skills more when the interactions between the learner and the material are richer and more comprehensive. In learning Medicine 4, the percentage of interactions between the learner and the material is calculated through the engagement

rate on Facebook. The engagement Rate on Facebook includes reactions, shares, comments, and clicks for playing the games. From Facebook insights, it is observed that the Preliminary game has 500% engagement, the League level game has 267% engagement, the Quarterfinal game has 325% engagement, the Semi-final game has 150% engagement, and the Final game has 138% engagement. The data with more than 100% engagement in each game shows that all five games were played more than once to reach the highest level of achievement.

4.3 Evaluation based on Activity Theory

According to Activity Theory [24], learner reasoning as emerging through learning activities in a social environment forms the outcome of activities and can be best understood by the relationship between the subject (medical students) and object (gamification). It is observed that the students have not expressed any constraints over their social learning experiences, such as interaction, communication, social connectivity, and social presence. Also, learning with students usually occurs an outcome of gaming activity in the social culture in which it occurs or is situated. This contrasts with LMS learning activities, which typically involve abstract knowledge and are out of context. Moreover, socialising, making new friends, and learning something more from their peers can be hard to achieve through LMSs. Of course, LMSs still have online chat rooms, but the level of personal connection would hardly be the same as in college. So, some students might feel isolated and disadvantaged without such support. Another important factor is feedback, one of the biggest drivers of students' progress. The students can improve only when they know their mistakes and weak areas. While lecturers give students feedback and comments through LMS, they still might not have enough time to provide effective feedback and explain every detail. This could lead to some students falling behind, having gaps in their knowledge, and not completing an activity successfully enough. Alternatively, using Facebook enhances students' learning through positive interactions among them, including mutual assistance and sharing of ideas that is possible through the Facebook tools. No students have commented on the limitations of gamified content deployed through Facebook as a constraint to playing them online but helped them share their experiences on the same platform and support each other in the process. The impact of students' higher-order thinking abilities based on Activity Theory is analysed at three different contextual levels by making relationships between the components listed above in section 3.6. At each level of the analysis, the relationship and configuration between the components vary to produce the expected outcome.

At the lower contextual level, the learning process is analysed in the activity system, where playing online games is transformed into an outcome. It is understood from the students' (subjects) comments that the learning process (outcome) is hierarchical and very complicated when going from the League level game to the Final level game (objects). They also stated that the prior level game influences the gaming (rules, strategies) at each higher level, and at every stage of the process, the outcome of the gaming is highly significant for the development of playing the next level (rules). It is also proved by Facebook's engagement statistics, where the higher-level games were played a lesser number of times to reach the highest level of achievement

compared to the lower-level games. This illustrates the impact of gaining HOTS as they pass through the gaming levels individually, creating their strategies to win at each game level.

At the middle contextual level, the intervention concerning students' distributed online interactions (community) was analysed as a measure of gaining the learning outcome. The medical students (subjects) have shared their learning experiences through their comments on Facebook (Tool). They share their difficulties with their peers, for example, one student discussed Scenario B in the Semi-final game and commented on the accuracy of an answer, and the student requested peers to clarify the question as well. Likewise, the conversation went relevant to the discussion, engaging other students in the conversation, and received at least ten replies (outcome) for each comment in each gaming activity. This demonstrates the impact of gaining skills as the students critically analyse to answer the questions made by their peers.

At the higher contextual level, the benefits of using social media platform (Tool) and gamification for learning purposes is acknowledged as the intended outcomes. The students used different computing devices (Tools), for example, desktop computers, laptop computers, and mobile devices, for gaming (object) and learning during the Active Learning session. Although the use of different devices and operating systems ensures portability, it is not a consideration of this study. However, the focus is on how the students (subjects) evaluate their learning experiences using those devices. The students did not view the computing devices for learning as personal devices but rather as inter-networked devices. Hence, the interaction between them was not confined to their personal devices but incorporated their peer's devices into their network, which means the personal experiences of playing a game also affect the group's overall experience in terms of sharing their challenges among themselves. Evaluation is the top level of Bloom's taxonomy pyramid because it is at this level that medical students (subjects) are expected to mentally assemble all the components such as gaming, peer support, social media, gaming strategies (Object, Community, Tool, Rules), they have experienced in the learning process to make informed and sound evaluations of the learning. It is also apparent from the engagement analytics that overall experience is a critical component of situated learning where students become involved in a community of practice. As the novice student or beginner moves from the borderline of this community to its epicentre, students become more dynamic and engaged within the culture and hence assume the role of expert or professional when playing the game more than once. Furthermore, situated learning is usually unintentional rather than deliberate. These ideas are what Lave & Wenger call the process of 'legitimate peripheral participation'. [25])

4.4 Students' Feedback

The end-of-topic survey was conducted online to gauge the students' learning impact of the SNS and the games. Some eighty-nine respondents completed the end-of-topic survey out of the total 118 students enrolled in the Medicine 4 unit, constituting a 75.4% response rate. The responses were grouped and analysed based on their learning impact (Table 1).

Table 1. Students' qualitative responses

Question: How does the gamified activities presented through Facebook in this unit improve your skills to go beyond basic observation of facts and memorisation compared to traditional teaching methods?
Student responses:
The gamified tasks in this topic offered me a learning strategy for exploring complicated topics, uncovering assumptions, analysing concepts, distinguishing what I know from what I don't know.
Although the gaming levels gradually increase in complexity from level 1 to level 5, it helps me develop my skills to understand complicated concepts throughout.
The games demand fast thinking on my part. Furthermore, I must use logic to think three steps ahead in order to answer quizzes and accomplish levels. *This is fantastic since it will benefit me later in life because the gaming activities helped me build logic, accuracy, and the ability to think on my feet and outside of the box.*
When comparing this Facebook based approach to standard teaching approaches, I realised that they are slow and rigid in terms of understanding difficult concepts. Because there are friends online in my same pace with whom I discuss my challenges.
I believe the games demonstrated the importance of learning through experience. It also helps me establish confidence and self-esteem while teaching me patience and concentration.
I find that problem-solving comes with practice. I am not scared to take additional rounds and learn from my mistakes or learn from my friends.
I found the game quizzes in Facebook to be a challenging environment where I could learn first-hand. This, I believe, is the foundation for developing coping methods for greater professional experiences as a medical practitioner.

It was found that students thought (Table 1) that the requirement to think critically ("must *use logic to think three steps*"; "*explore complicated topics*") while playing the games online helped them to gain a better knowledge of the course material. The vast majority reported that gamified learning had increased information retention and a deeper understanding of the lecture content. Most importantly, most acknowledged that they found the peer learning ("*learn from my friends*"; "*friends in my same pace*") that was offered through the SNS useful in understanding complex topics.

4.4 Lecturers' Feedback

Lecturers' feedback through a focus group discussion was designed to gauge how far the design of the games and delivery through SNS (Facebook) achieved the intended Learning outcomes of the topic. The lecturers have commented on the learning design and students' learning engagement. Thematic analysis of the transcript of the lecturers' responses are:

- Bloom's Taxonomy not only assists in developing and phrasing appropriate learning outcomes, but it is also well suited for game design because both Bloom's and games emphasise achievement at various pedagogical levels, progressing towards the highest level of learning difficulty.
- Incorporating Bloom's taxonomy into game design shifts superficial learning (rote learning) to deep learning.
- Gamification in education is an excellent example of incorporating competencies in medical practice. Students develop plans and strategies for the future management of complex medical issues by playing games and integrating what they have learned through reflection.
- Effectively incorporating gamification into medical education necessitated a careful examination of the level of target students (their level, i.e., Year 2 within the five-year-long course), the learning outcomes, the immersive structure of the learning experience, and consideration of which specific rewarding elements and motivation mechanisms (badges, trophies, leader board ranking) will make a meaningful learning experience.
- There are unintended positive outcomes of playing educational games, such as problem-solving techniques, hand-eye coordination, enhanced critical thinking, enriched social skills, and heightened concentration and team contribution, that cannot be considered a success after assessments and exams in formal academic settings.
- Though the art of playing the game is taught to students through instructions, they cannot simply follow the instructions. To win the game, they must devise strategies based on their knowledge of neuroanatomy concepts and contexts.
- While generic LMSs at universities provide access to resources and activities through a dynamic learning management interface, they are pretty disengaging and ineffective in student motivation.
- Learning Management Systems (LMS) provide optimal support to students on and off-campus by allowing students to access various online resource support but fail to communicate with each other dynamically as a whole system. Students absorb the resources and activities available through the LMS without typically engaging with the information.
- Facebook contributes to an asynchronous online learning environment that allows more time to consider all aspects of learning engagement.

5 Conclusions

The practice of medicine is based on positive peer interaction and critical thinking. Because social media and other digital technologies play such an essential role in today's medical team management and interprofessional communication, the medical curriculum delivery must include a variety of digital sharing platforms to incorporate such interaction and communication while working on the complex medical problem as in the authentic circumstance in a hospital setting. This study has given educators insight into how to incorporate gamification strategies into existing medical curricula by Bloom's Taxonomy to design complex learning activities. This study found that using collaborative tools and games at increasing difficulty levels on SNS like Facebook improved students' achievement through peer collaboration, such as mutual assistance, idea sharing, and other motivational activities. It is also suggested that gamification in education is an addictive experience, and its use in learning should be encouraged.

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