THE PERCEPTION OF UNDERGRADUATES DIPLOMA STUDENTS TOWARD "HEXAPODX GO!": A GAME BOARD APPROACH OF GAMIFICATION ON ENTOMOLOGY

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ABSTRACT

Hexapodx Go! is an educational board game which focuses on the different order of insects. The main objective of this board game is to provide an education on insects through entertainment. The number of players for Hexapodx Go! are ranging from two to six players, aged eight year old and above. The main goal of this game is for the players to collect as many insect cards as they can and to answer the Question Card and ultimately, reach the last pit stops. Hexapodx Go! gets its name from Hexapoda, a class of organism which possesses six legs. The board game consists of 127 hexagonal units where the outermost hexagon layer units of Hexapodx Go! contains ordinary insects with the lowest points and the innermost hexagon layer units of Hexapodx Go! contains rare species of insects with the highest points. One of the advantages of Hexapodx Go! is, it uses the entertainment aspects of the game for teaching and learning processes that can be used either in school or at home. This edutainment game also can increase competition among students and can be used as a helping tool in preparation for science subjects. In terms of the novelty of the Hexapodx Go!, there are fewer board games in the shape of a hexagon available and none are related to insects. A pilot study was conducted to determine the perception of the undergraduate diploma students toward Hexapodx Go! where most of the items received more than three on the average score, indicating positive feedback from the students. Meanwhile, in terms of recognition and award, this game board has been awarded with the Bronze Medal during Sarawak Invention, Innovation and Design Expo in 2019. Furthermore, in 2020, this game board received a gold award and the best poster award in the National Seminar on Research and Innovation in Education 2020 (e-SPeDIP2020). Therefore, Hexapodx Go! offers great possibilities for commercialization especially for the school and university students who have vast interest in insects.

Keywords: Hexapodx Go!, entomology, learning, educational board game, education, edutainment

ABSTRAK

Hexapodx Go! ialah permainan papan pendidikan yang memfokuskan kepada kumpulan serangga yang berbeza. Objektif utama permainan papan pendidikan ini adalah untuk memberi pendedahan mengenai serangga melalui konsep hiburan. Bilangan pemain untuk *Hexapodx Go!* adalah terdiri daripada dua hingga enam pemain yang berumur lapan tahun ke atas. Matlamat utama permainan ini adalah untuk pemain mengumpulkan kad serangga sebanyak mungkin dan pada masa yang sama menjawab soalan-soalan berkaitan serangga seterusnya mencapai kemenangan di hentian terakhir. *Hexapodx Go!* mendapat namanya daripada terma Hexapoda iaitu kelas organisma yang memiliki enam kaki dan papan permainan ini terdiri daripada 127 unit heksagon. Unit heksagon yang paling luar *Hexapodx Go!* mengandungi serangga yang biasa dijumpai dengan nilai markah yang paling rendah dan unit heksagon di bahagian paling dalam *Hexapodx Go!* mengandungi spesies serangga yang jarang dijumpai dengan markah yang tertinggi. Salah satu kelebihan *Hexapodx Go!* adalah ia menggabungkan aspek hiburan dalam permainan untuk proses pengajaran dan pembelajaran yang boleh digunakan samada di sekolah atau di rumah. Permainan ini juga dapat meningkatkan persaingan di kalangan pelajar dan dapat dijadikan alat bantu dalam pembelajaran mata pelajaran Sains. Aspek novelti *Hexapodx Go!* boleh dilihat dari segi reka bentuk heksagon yang tidak terdapat dalam mana-mana permainan berkaitan serangga. Satu kajian awal telah dilakukan untuk mengetahui persepsi pelajar pra-siswazah peringkat diploma terhadap *Hexapodx Go!* di mana kebanyakan item soalan telah mendapat skor lebih daripada nilai purata tiga yang menunjukkan maklum balas positif daripada pelajar. Sementara itu, dari segi pengiktirafan dan penghargaan, papan permainan ini telah dianugerahkan dengan Pingat Gangsa semasa *Sarawak Invention, Innovation and Design Expo* (SIIDex) pada tahun 2019. Selanjutnya, pada tahun 2020, papan permainan ini telah mendapat anugerah emas dan anugerah poster terbaik di Seminar Penyelidikan dan Inovasi dalam Pendidikan Peringkat Kebangsaan 2020 (e-SPeDIP2020). Oleh itu, *Hexapodx Go!* menawarkan peluang besar untuk dikomersialkan terutama dalam kalangan pelajar sekolah dan universiti yang mempunyai minat yang tinggi terhadap serangga.

Kata kunci: Hexapodx Go!, entomologi, pembelajaran, permainan papan pendidikan, pendidikan, didik hibur

INTRODUCTION

The turn of the new century has brought in more challenges into the education system, both in primary education, secondary education and including tertiary education. Over the past few decades, we have seen the changes in teaching and learning at the schools, colleges, and universities. Therefore, to supplement the traditional method of lectures, assignments and tutorial sessions, game-based learning has been a proven tool to increase the motivation, engagement, and the participation of the students as well as encouraging and strengthening the process of learning in higher education level worldwide (de Freitas 2006; Papastergiou 2009; Pivec et al. 2003; Tan et al. 2018). There are various game-boards related to other animals that are currently available in the market, however, there were few game-boards focusing on insects or the field of entomology for higher learning education (Hinebaugh 2009).

Learning entomology or study of insects requires students to remember various names of insects which are divided into different groups, taxa or insect orders. Conventional learning methods such as reading from lecture notes, slides, etc. need to be supported by interactive learning of education and entertainment. Therefore, Hexapodx Go! was developed to be one of

the educational boards developed as part of the strategies to inculcate the Science, Technology, Engineering and Mathematics (STEM) initiatives in Malaysia. This board game gets its name from Hexapoda, a class of organism which possesses six legs, for instance; insects. Aptly, the mainboard is hexagonal shaped.

Hexapodx Go! consists of 127 hexagonal units, a six-sided dice, a token that represents the player, hexagonal insect card with its point, question cards which denote a question mark and action cards which denote exclamation mark. The board is divided into six areas which represent the six important orders of insects; Coleoptera, Lepidoptera, Hymenoptera, Hemiptera, Diptera, and Odonata. The main objective of this board game is to provide an education on insects through entertainment. Additionally, the other objective of this edutainment board game is for the players to collect as many insects as they can and at the same time reaching for the last pit stop to be the winner of the game. One of the advantages of Hexapodx Go! is, it uses the entertainment aspects of the game for teaching and learning processes that can be used either in school or at home. This edutainment game also can increase competition and enhance healthy collaboration among students and can be used as a tool in preparation for science subjects. Therefore, Hexapodx Go! offers great possibilities for commercialisation especially for school and university students who have a vast interest in insects.

MATERIALS AND METHOD

Games and Learning
According to Kapp (2013), learning through games or also referred to as gamification, can be defined as "using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems". Although the use of mobile apps or digital technology is getting much popular recently, it does not mean that the term gamification is limited to digital technology, instead it is also applicable to any games that can promote motivation, engagement and participation in learning (Taspinar et al. 2016).

The educational board game is referring to any form of portable surface marked board with the purpose of education and learning at the same time and where it involves a various number of players that compete or collaborate depending on the objective of the development of the game board. Game board is one of the most popular teaching tools that can be integrated in the teaching and learning activities for the students ranging from pupils in the primary education and to the students in the tertiary education because it is very flexible and convenient. Game board can be used even in rural areas since it does not require sophisticated gadgets and devices such as the smart phones and the internet connection like what is normally required of the mainstream's mobile apps.

Aside from its entertaining characteristics, board games can also help facilitate face-to-face interaction between various individuals (Gauthier et al. 2019). The feedback given by the students indicated that the game helped them improve their social skills and increased their enthusiasm for the course (Martin-Lara & Calero 2020). However, there are some potential barriers of game board learning such as it requires creativity and effort to design and develop and also time consuming (Yaacob et al. 2019). In addition, other difficulties encountered in playing a game board are the amount of information required to play and the building of a strategy prior to game employment (Cosme et al. 2020).

Collaborative vs Competitive Learning

There are many words which can describe collaborative learning, such as "joint intellectual effort", "teamwork, "sharing", "goal", "group learning", "active learning", "involvement", "participation", "social interaction" and "responsibility" (Smith & MacGregor 1992). The activities involved in collaborative learning vary widely because of the different disciplinary backgrounds and teaching tradition, however, most of the activities are student-centered rather than the teacher or lecturer-centered (Smith & MacGregor 1992). Everyone in a group will help each other to find out the best solution and then resolve the problems or tasks given to them.

On the other hand, competitive learning is referred to as "a method of education that relies on competition among students (for grades or other rewards) as a way of enhancing motivation" (Shamma 2015) which involves activities such as quizzes, contests, and board games. However, the pros and cons of collaborative learning and competitive learning are still on-going debates among educators around the world (Sailer & Homner 2020; Shamma 2015). In the medical field of studies, competitive learning was found to be better than collaborative learning by improving the academic performances of the students (Corell et al. 2018). However, in STEM education, collaborative learning outweighs competitive learning, especially in a problem-solving task (Gardner & Walters 2015) based on Bloom's taxonomy level. Therefore, another suggestion to improve learning outcomes from gamification approach is by including the game fiction with a combination of competition and collaboration (Sailer & Homner 2020).

Related Learning Theories

Generally, games that are available in the market are intended for entertainment, family gathering and bonding or for leisure and fun. However, gamification for learning should be incorporated with the learning pedagogy in its development. Lacking such criteria makes the games not worthy from the academic point of view. Playing board games encourages collaboration among students. This strategy helps develop a social support network for learners and helps motivate them in specific curriculum (Yaacob et al. 2019).

Therefore, various theories that are associated with gamification in learning should be integrated into the development of the games which cover the cognitive aspect, the social aspect, the psychomotor or skills aspect and the cultural aspect (Turkay et al. 2014). Furthermore, the specific theory on gamified learning has been outlined by Lander (2015) where more effective gamified learning experience enables participants to change their attitudes, behaviors, and learn from their experiences. In addition, the gamification approach is not intended to replace the instructional content such as lectures, but to improve the learning outcomes of traditional learning. Besides that, successful gamification learning outcomes require effective instructional content before its implementation. Besides the learning theory, psychological theory such as self-determination theory has been widely applied in gamification (Ryan & Deci 2002). With gamification, this stimulates and affects learning outcomes due to the enrichment of learning environments (Sailer & Homner 2020).

Gamification Related to Entomology

Currently, the most widely available game-board related to entomology is Bug-Opoly, a creeping, crawling, property trading game which involves selling and trading players' favourite insects among the players. Besides that, another game board known as Lucy Hammett Games Bug Bingo Board Game is related to an educational and fun twist of Bingo. This game-board contains six unique Picture Boards, 42 Informative Cards and Bingo chips. Apart from focusing

on insects as the main attraction of the game-board, the concept of using insects for the development of game board is also being utilised to improve the pupil's vocabulary as shown in Bug's Life Board Game (Yaacob et al. 2019). Furthermore, Insect World is a game made up of 288 cards, each of which has a subject area that explores the various facets of insects' behavior. The game also consists of five different cards namely "monster-cards" that describe the order and family of an insect, their morphological traits, and their power level. Other cards include: trap-cards, gadget-cards, ritual-cards, and place-cards (Cosme et al. 2020).

On the other hand, besides a mechanical board game, there were plenty of mobile apps that are related to insects which were also developed as a video game (Shelomi 2019) and Mobile Insect Learning System (MILS) (Su & Cheng 2013). In Asian countries, Japan was known for being actively involved in the development of plenty of video games featuring insects (Hoshina & Takada 2012). Interestingly, *Pokémon* GO! was developed in 1996 by Satoshi Tajiri, an amateur entomologist that was inspired by his passion for insects (Acorn 2009; Kritsky & Smith 2018). There are 18 types of *Pokémon*: Normal, Grass, Fire, Water, Electric, Ground, Rock, Flying, Fighting, Psychic, Dragon, Poison, Ghost, Ice, Dark, Steel, Fairy, and Bug. *Pokémon* Bug consist of 79 Bug *Pokémon* with the following characters: Caterpie, Beedrill, Heracross, Ribombee, Ninjask, Yanma, Durant, Pheromosa, Leavanny, Ledian, Buzzwole which is referring to insect caterpillar, wasp, rhinoceros beetle, honey bee, cicadas, dragonfly, soldier ant, cockroach, leaf insect, ladybug and mosquito respectively. The *Pokémon* GO! has provided excellent entomology outreach in the social media or the netizen with the integration of learning of insect biology to the layman through mobile apps (Schmidt-Jeffris & Nelson 2018). Even though its popularity slowly declined since 2016, the *Pokémon* GO! remains one of the most downloaded apps worth $600 million in global revenue (Lee 2016). Another mobile apps that was inspired from *Pokémon* GO! is Insects GO with the aim to expose the students with outdoor activities by taking real photos of insects (Wommer et al. 2021).

Looking at the potential of the game board or mobile apps featuring insects, and since there is little known for a game-board related to insects has been recorded and marketed in Malaysia, therefore, it offers a huge opportunity for all educators with a background in entomology to explore gamification related to insects. Malaysia should become the prominent player of the insect industry since it offers tremendous opportunity in the world (Said & Bae 2019).

Game Resources
There are two main components of Hexapodx Go! as an edutainment approach. Firstly, is the set of the game and secondly, the role of the educator. The game itself consists of the following features: a mainboard in hexagonal shape comprises of 127 hexagonal units (Figure 1), a six-sided dice, a token that represent the player, hexagonal insect card with question and points to be collected, and the action cards denoted with (!) (Figure 2) with question and instruction for next movement to the player. The board contains an outer layer of hexagon units of the ordinary insects with the lowest points while the innermost hexagon layer of Hexapodx Go! contains rare species of insects with the highest points as shown in Figure 1. The number of players for Hexapodx Go! are ranging from 2 to 6 players, aged 8 year old and above.

Figure 1.   Hexapodx Go! with explanation of figures

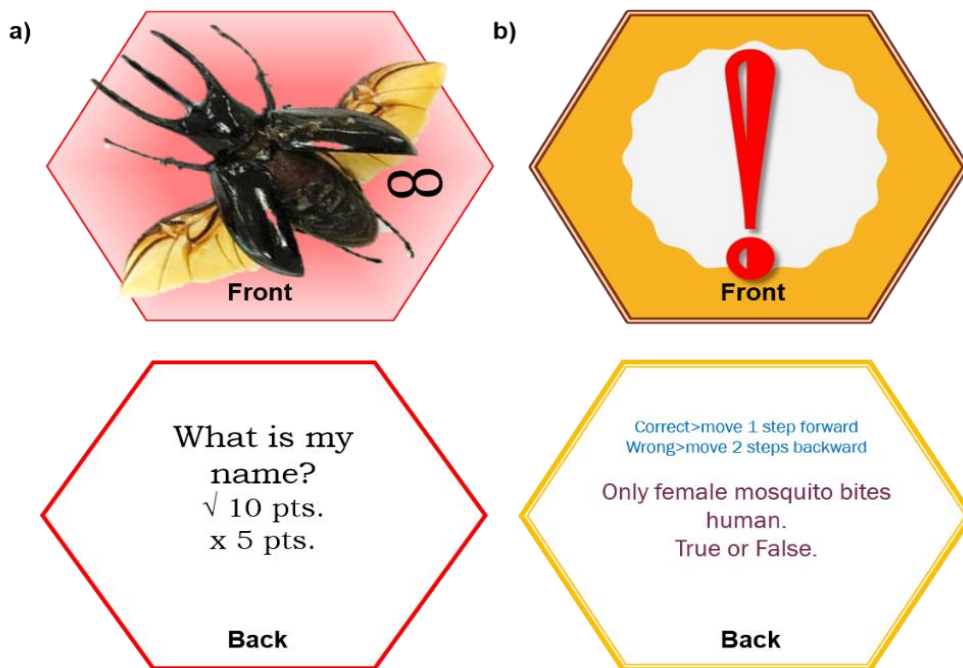Designed by Yahutazi C. & Suffina L.

Figure 2.   The Game Card of Hexapodx Go! with explanation of Figures a) Insect Card b) Action Card with question

Designed by Yahutazi C. & Suffina L.

Pedagogy

The pedagogical approach of game development in education for Hexapodx Go! is following the concept that was proposed by Garris et al. (2002) and Ibrahim & Jaafar (2009) which include the learning outcome aspect, the syllabus matching, scaffolding learning strategies, the assessments criteria and student's self-learning.

The development of Hexapodx Go! is consistent with the course learning outcome (CLO) and the syllabus matching for the two courses that are related to insects for the undergraduates diploma students in the Faculty of Plantation & Agrotechnology, Universiti Teknologi MARA, Sarawak Branch, Mukah Campus, namely AGR244 and AGR254. The students for AT110-Diploma in Planting Industry Management and AT112-Diploma in Herbal Production were taught with AGR244-Pest Management and AGR254-Entomology respectively. Table 1 below shows the selected course learning outcome (CLO) and the syllabus content that matched with the development of Hexapodx Go!

Table 1 Selected course learning outcome (CLO) and the syllabus matching with Hexapodx Go!

1.	Course	AGR244 – Pest Management	AGR254 - Entomology
2.	Course Learning Outcome (CLO)	Describe the characteristics of common pests and diseases of plantation crops	Describe the concept of entomology, classifications of insects, common insect pests and relate the importance of insect structures and morphology as factors influencing their development to pest status in agriculture
3.	Syllabus matching	General principles of insect management	Classification of the phylum Arthropoda and chief characteristics of the class Insecta/Hexapoda

Along with the learning outcome and syllabus matching, another pedagogical approach of Hexapodx is the scaffolding learning strategies which are integrated in Hexapodx Go! through facilitative methods such as the preparation of procedures and the instructional manual as well as the hints and clues of each of the insect's photos that are displayed on the board game. Before the game begins, the instructor will explain to the players over the rules and procedures of the Hexapodx Go! to provide clear information to the players. Besides that, the development of the Action Card as well as Insect Card was also developed by following the scaffolding learning strategies. The strategies were included by designing the game board with different difficulty levels through a set of questions. In the beginning of the game, the students will answer easier types of questions which are located at the outermost hexagon layer units of the board game. However, the questions will gradually become more difficult when the player reaches the inner layer of the hexagon units of the board game and the questions will become

much tougher when the player reaches the final pit stop which is located in the middle of the board game.

In addition, the assessment criteria in Hexapodx Go! can be obtained through its Insect Card and Action Card. The set of questions in this game board that need to be answered from the Action Card were following Bloom's taxonomy level which only focuses on cognitive assessment especially C1-knowledge and C2-comprehension level to assess the student's knowledge ranges from fill in the blank (FIB), short answer (SA) and true and false (TF) type of questions respectively. This Bloom's taxonomy levels (C1-C2) set of questions were used to maximise the excitement, thus, sustaining the level of fun for the players due to the time constraint while playing the game. Moderate to higher level (C3-C6) type of questions were not integrated in the set of questions due to their level of difficulties that could possibly prolonged the duration to complete the game and possibly reduce the excitement and fun during the game. Besides direct cognitive assessment, Hexapodx Go! could be indirectly utilise to enhance the affective or emotional domain and the psychomotor domain among the students such as the attitudes, enthusiasms and motivations, perception and readiness to take action and the guided responses while playing the game.

The final pedagogical aspect of Hexapodx Go! is the student self-learning. Due to various learning approaches among students, playing Hexapodx Go! can be considered as one of the means for Student-Centered Learning (SCL) where the students are responsible for their own learning. Playing Hexapodx Go! also can be regarded as part of self-improvement activities where the student is required to recall specific facts and information in order to answer the question in the Action Card and Insect Card properly.

Game Preparation and Playing

To play this game, the hexagonal board game is placed on the flat surface such as a table with the Insect and Action Cards are systematically stored in a storage compartment. The game starts by the rolling of dice and the moving of the token as per number on the dice by Player 1. Once the token lands on the specific number or insect, Player 1 can collect the card if the player is able to answer the question provided at the back of the Insect Card and Action Card.

For the Insect Card, the players need to answer a simple question on the insect picture shown on the game board that their token landed on. The player who can answer the right question will be rewarded with the point as stated on the Game Card. After Player 1 turn is complete, Player 2 can repeat the same procedure as Player 1. If Player 2 lands on (!) area, Player 2 needs to answer the question and follow the instruction movement as stated on top of the question. For example, if the answer is correct, the player needs to move one step forward, however, if the answer is wrong, the player needs to move two steps backward. The player's movement is subject to the instruction stated on the card. This procedure is repeated by the subsequent players by rolling the dice. If the player lands at the end of *Bee Buzz Line* (Figure 1), the player needs to follow the line. The first player who reaches the final pit stop with the highest point will be considered as the winner for this game board.

The educator plays an important role in this board game to facilitate the process of learning by providing brief information on broad topics such as insect common name, scientific name, insect morphology, and anatomy, etc before the game session. After the game ends, the educator will discuss some questions in the game card the players have collected. Finally, as a token of appreciation, the special reward is given to the winner and each player of the game to boost up their motivation.

The Students' Perception Towards Hexapodx Go!

A pilot study was conducted to determine the perceptions of undergraduates diploma students towards Hexapodx Go as an educational game for learning purposes to study insects. The study was conducted through a set of questionnaires that were designed to measure student's attitudes and expectations. There were 81 diploma students from two programmes namely AT110 - Diploma in Planting Industry Management and AT112 - Diploma in Herbal Production from the Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA Sarawak Branch, Mukah Campus, Malaysia who participated in the survey. The two programmes were selected since both programmes were taught with insects related courses namely AGR244-Pest Management and AGR254-Entomology.

A set of questionnaires were adapted and modified from Covaci et al. (2018) which consists of two additional questions thus making it a total of 10 questions with the aim to get the feedback of the students towards Hexapodx Go! on the improvement of students' understanding of the concept taught in the course, the integration of the Hexapodx Go! during related classes, the hands-on and the practical experience of the course, the attractiveness of the board game with regards to its colour and design and the rewards given to the students after the completion of the game. The details of the question numbers and their statements are shown in Table 2.

The responses to Q1 to Q9 were scored on a Likert scale of 1 to 5, with 1 being strongly disagree, 2 being disagree, 3 being neutral, 4 being agree and 5 being strongly agree. To check for potential inconsistencies, the answers to the control questions were ranked according to their negative forms. Question 10 is an open-ended question that is intended to receive some comments and suggestions from the students for future improvements of the game board. The descriptive statistical analyses were used which include the percentage, mean and standard deviation.

RESULTS & DISCUSSION

Figure 3 below shows the percentage of the students who participated in the survey on the students' perception towards Hexapodx Go!. Majority of the respondents were from AT110-Diploma in Planting Industry Management students with 63 students (77.78%) while there were 18 students (22.22%) from AT112-Diploma in Herbal Production programme.
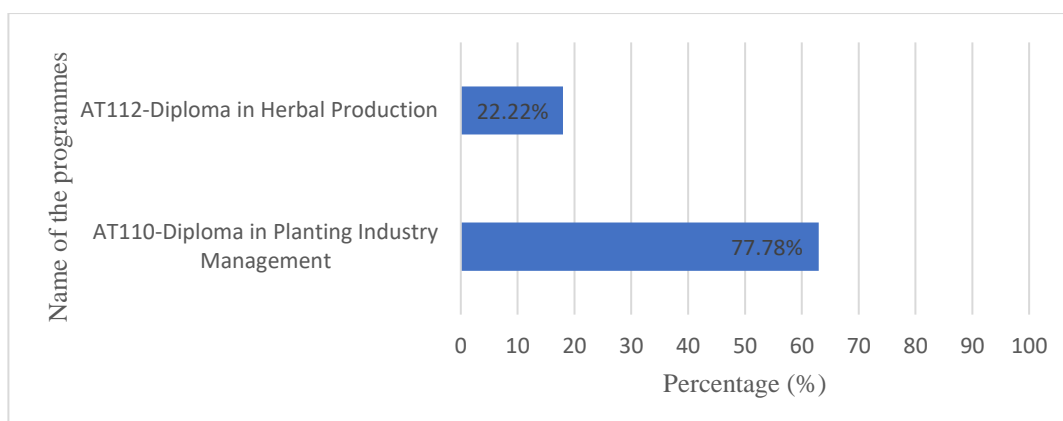

Figure 3.   The percentage of the students participated in the survey from two programmes AT110-Diploma in Planting Industry Management and AT112-Diploma in Herbal Production

Meanwhile, in the following Table 2 and Figure 4 revealed the mean score estimation of the students' feedback towards Hexapodx Go!. 79.51% students agree that the Hexapodx Go! could be used to improve the understanding of the related concepts taught in the class with the mean value 3.98 (Question No.1) while 78.02% of students perceived that the Hexapodx Go! could be used to assimilate the concepts taught in the class with an average score 3.90 (Question No.2).

Table 2.   The mean value, standard error and standard deviations of the students' perception towards Hexapodx Go!

Question No.	Statement	Percentage (%)	Mean Value & Standard Error	Standard Deviation
Q.1	The Hexapodx Go! experience helped me to better understand the related concepts taught in the class.	79.51%	3.98±0.07	.67
Q.2	The Hexapodx Go! experience helped me to better assimilate the concepts taught in the class.	78.02%	3.90±0.07	.66
Q.3	The Hexapodx Go! experience did not improve my learning experience.	41.23%	2.06±0.10	.90
Q.4	The Hexapodx Go! experience helped me to better understand the practical experience of the learning process.	80.99%	4.05±0.08	.71
Q.5	I enjoyed the Hexapodx Go! to be integrated during the class.	80.99%	4.05±0.08	.72
Q.6	The Hexapodx Go! effects were disturbing for me during the class.	42.47%	2.12±0.12	1.05
Q.7	I would like to have more classes/labs/courses that include Hexapodx Go! experience.	79.51%	3.98±0.09	.84
Q.8	The colour and design for Hexapodx Go! is interesting.	84.44%	4.22±0.08	.72
Q.9	The rewards after the completion of Hexapodx Go! is satisfactory.	82.47%	4.12±0.08	.68

There were four statements from the questions that received more than 80% from students who agree on the statements. The students considered Hexapodx Go! can be used to improve the practical experience of the learning process in the class (Question No. 4), offers the opportunity to be integrated during the class (Question No. 5), the design of the Hexapodx Go! is creative and attractive (Question No. 8) and the students also satisfied with the rewards after the completion of the game (Question No. 9) with the mean value 4.05, 4.05 and 4.22 and 4.12 respectively where question no. 8 received the highest percentage value (84.44%), followed by question no. 9 (82.47%). Meanwhile, Question No. 4 and No. 5 received a similar percentage of students' feedback which is 80.99%. On the other hand, the two controlled questions (Question No. 3 and No. 6) show mean score below average, 2.06 and 2.12 respectively, which are consistent with the negative form of the questions.
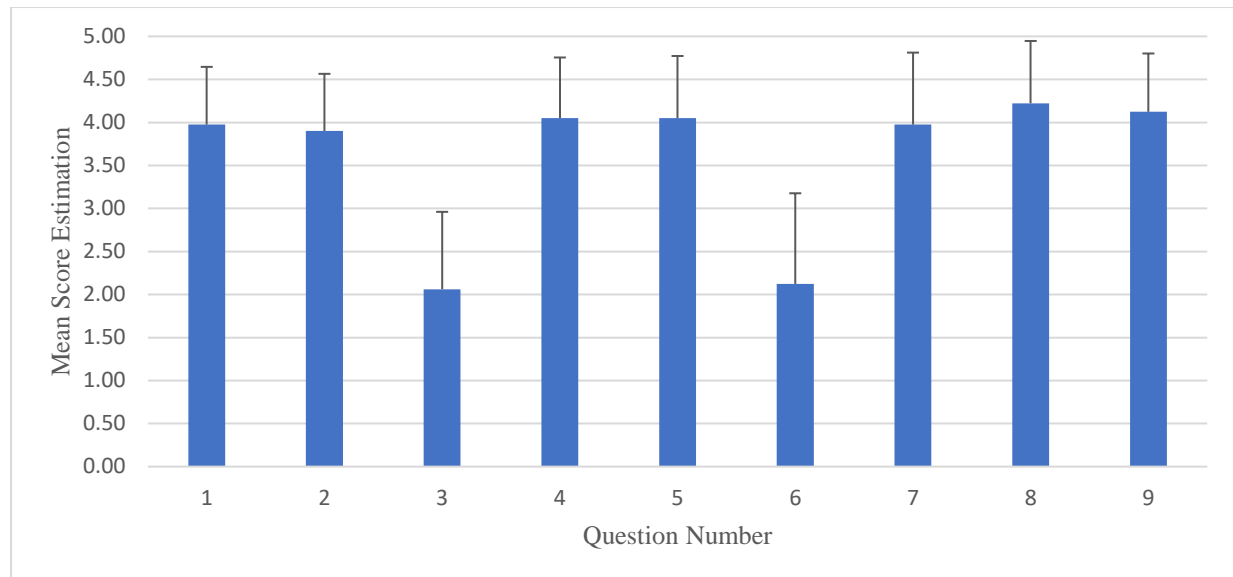
Figure 4   Mean score estimation of the students' feedback towards Hexapodx Go!

All comments in the open ended question (Question No. 10) received positive feedback from the students. Comment such as "*Good*", *"It looks super fun!"* and *"Learning through gamification will be fun"* are among brief comments left by the respondents. Some students perceived Hexapodx Go! as an efficient way in facilitating teaching and learning with the following comment *"Hexapodx Go! is a truly efficient way of learning for those who cannot afford to fully understood the straight note. So by amusing thus interesting way of explaining details are for me, is truly helpful in many ways".* Other student also wrote positive comment on how Hexapodx Go! can be useful to inculcate the interest of kids towards insects with this feedback "*Hexapods Go! will really help with student who takes entomology related course. For kids, this game surely will enhance their knowledge about insects which will help when they grow up soon".* This comment was consistent with the positive feedback from the kids during public demonstration in the two series of the STEM Playground program as shown in Figure 5.

Besides that, some students suggested that the game to be used to increase the attention of the students during lecture with this suggestion "*This board game can improve the study of the student that might having problem focusing in the class. I am excited to see further development towards this high potential educational game. Perhaps it would greatly help us students through tough ODL where we need to pay a lot of attention".* Furthermore, in addition to improve the conveniences of the game with the latest technology, one student recommended the game to be developed into a mobile apps game with this recommendation "*In my opinion, the developer should develop Hexapodx Go! as an apps in a Play store or Apple store to cater mobile gamer. I believe if this board game is available on the smart phone, it is easier for players to play the game as they can play it anywhere. For example, they can play Hexapodx Go! while waiting for their takeaway food or while in the queue".*

Figure 5   The students from both primary and secondary school enjoy playing the Hexapodx Go! during STEM playground exhibition in Sibu, Sarawak on 11th - 12th August 2018

The positive feedback received from the students toward Hexapodx Go! showed that this board game can be used to enhance the learning experience among the students with more than 70% students and our finding is similar with Cosme et al. (2020), Covaci et al. (2018), Taspinar et al. (2016) and Yaacob et al. (2019). The perception on the colour and design for Hexapodx Go! received the highest percentage probably due to the game materials that are interactive with various colours and the photos of insects. The board game developed by Cosme et al. (2020) also received the highest score in terms of game design and colour. A colourful board game design and its resources also can retain players' attention and avoid disinterest (Yaacob et al. 2019). This finding suggests that a game board designed to enhance student's learning experience related to insects should be considered to be developed with a variety of colours and to avoid plain colour since it can lead to boredom and disinterest of the players toward the accomplishment of the game. Another criteria that needs to be considered by the board game developer is pertaining to the rewards after the completion of the game as outlined by Garris et al. (2002). Rewards factor is also important since it can enhance the motivation among the students (Shamma 2015).

Hexapodx Go! Recognition and Awards
In terms of recognition and award, this game board has been awarded with a Bronze Medal during the Sarawak Invention, Innovation and Design Expo (SIIDEx) in 2019. Furthermore, in 2020, this game board received a gold award and the best poster award in the National Seminar on Research and Innovation in Education 2020 (e-SPeDIP2020) as shown in Figure 6.

Figure 6.   Certificates of award given to Hexapodx Go! from various innovation competitions

CONCLUSION

In conclusion, Hexapodx Go! was developed with the gamification approach to increase motivation, participation, and engagement of the students in the learning of entomology as part of the blended learning concept and interactive learning thus hindering the boredom in the class. It is important for those people involved in the teaching profession whether you are a teacher, tutor or lecturer, to find out not to say the best learning activities, but the most learning activities that will enhance the understanding, participation, and engagement of students towards the subject matter. Previously, gamification has been dominated by primary education, especially for children's learning. However, there is a trend recently that gamification has also been widely developed for tertiary education for better students' motivation, engagement, and participation towards the subject matter. The development of this game board is not intended to replace the traditional learning approach but as a medium to diversify learning approaches among educators and students.

ACKNOWLEDGEMENT

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