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Using Padlet to Enhance Year 11 Students Engagement in Learning Genetic

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ABSTRACT

Genetics is difficult for students to understand since genetic processes are intangible. As students have difficulty studying genetic, it is very difficult to retain them engaged in their learning process. On the other side, engagement of students is the focal point of educators. Following this, making use of digital platform to engage students in learning topics that are perceived difficult such as Genetic in biology learning is seen to be an irresistible option. This Padlet visual could be likened to an online notepad that can be utilized to engage students in various ways. The research objective is to explore the use of Padlet to enhance student engagement in learning genetic by focusing on behavioral engagement and perception of students using Padlet. A qualitative research design is used where purposive sampling used to select participants. A total of 6 Year 11 students was selected from a private secondary school in Kelana Jaya, Selangor. Students were introduced to Padlet through briefing session and completed the task assigned in Padlet. Observation, interview, and document analysis is used for data collection. This research concluded that using Padlet has the potential to enhance student's behavioral engagement in learning Genetic through following task-oriented instruction, facilitation of collaboration and sharing knowledge. It was found that various insights from students gained regarding using Padlet in learning genetic that categorized into positive perception that is going to be retained for enhancing student's engagement within the lesson and negative perception that can be improved. This research provides useful records about using Padlet to engage student in learning Genetic as well to surmount the learning challenges of students in biology.

Keywords: Students' engagement, Biology Education, Genetic, Collaboration, Padlet

INTRODUCTION

Genetic is considered as a vital topic in today's civilization (Nurshamsida & Nurizatul, 2014). Students should be fully prepared to make any decisions that interconnected with issues of genetic topic (Nurshamsida & Nurizatul, 2014). However, genetic is deemed as one of most difficult abstract topics in Biology by secondary school students (Altunoglu, Bahattin, Seker, & Metin, 2015). Students, facing difficulty in learning genetic topic, which leads to difficulty in student engagement. This research is intending to study an essential part of student engagement, which is behavioral engagement. Behaviorally engaged students keep on discuss, ask one another, and answer their teacher's inquiries and connecting the examples with their prior knowledge (Fuchs, 2014). Therefore, using technological tools is suggested for teachers to instigate students 'engagement in their learning process. The utilization of technology while implementing Science learning help teachers in instructing as well to enhance student's understanding towards the subject. Thus, well planned, and orderly learning system can give greater quality reality among teachers and students (Mohamed Noh,2017). In this context, Padlet is defined as a tool that helps to engage student throughout their

learning environment (Fuchs, 2014). Using Padlet in learning the most difficult topic, genetic have its own benefits as it is proven to be a perfect tool for discussion, question, and answer method (Nadeem, 2019).

LITERATURE REVIEW

Review of literature initiated with engagement and role of behavioral engagement in an educational setting following on learning difficulties of genetics among students, usage of Padlet in an educational setting and use of technology in enhancing student engagement in learning as their learning styles today influenced by technology integration also reviewed. Overview of the literature review is explained in Figure 1.

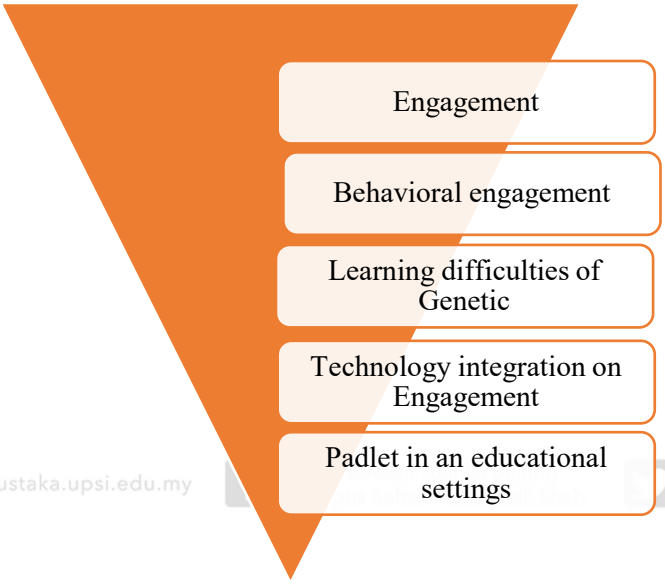

Figure 1: Overview for literature review

Student engagement depends on the statement that once students are encouraged, learning will improve effectively (Hamilton-Hankins & Octavia, 2017). In the context of this study, behavioral engagement of student is focused on the completion of task, participation, and collaboration (Hamilton-Hankins & Octavia, 2017). Students whom behaviorally occupied are those that take part in classes particularly by asking educators inquiries and investing energy in task (Hirschfield, 2011). As the research fields of genetic growing quickly, heredities phenomena are complicated, and the quantity of knowledge associated with development in genetics is endlessly expanding (Didem, 2016). Advancement of genetic field proves to be as important sector that need to be emphasized in school level. However, the news regarding the development of genetic field are very hard for common individual to comprehend (Didem, 2016). This has distressed science teachers as students ought to be supplied with higher understanding of the essential genetic concepts. There is a requirement to consider the genetic topics within the curriculum of school science, as the significance of genetic in daily life are getting increased. Instruction for genetic topic at secondary school level likewise able to provide substantial chance to talk about current issues related to genetic (Didem, 2016). But. learning genetic become very difficult for students as they felt this topic are challenging due to hiddenness and unapproachability of process related with genetic (Gupta, 2019). Genetics need a particular level of logical thinking and conceptual idea and this is one of the reasons representing for the problem of comprehend genetics (Didem, 2016). There is a move in realizing where students utilizing technology tools to pick up knowledge of genetics instead of engrossing the information straightforwardly from the visual portrayal alone (Tippet, 2016). Padlet is one of the technological applications in an educational setting that offers great benefits to students such as collaborating with their peers, flexible

to use as will work on completely different devices despite the situation and time (Beltran-Martin, 2019). This application become an appropriate tool to develop collaborative learning that enhance engagement among student especially in the education settings (Lowe et al, 2018).

PROBLEM STATEMENT

Research has repeatedly shown that genetics was one of the subjects that students found difficult to understand (Kilic, 2016). The genetic topic involves complex and extent terminologies which can confuse students (Didem, 2016). Students also get lost in the jargon of science and unable to make any distinctions in between (Fulya, 2016). For instance, genes are defined small molecules that transmitted from parent to child. Unfortunately, it is not that simple because students are unable to interact with how genes and DNA are connected. They rely on mechanism being taught but in their own uncertainty, they eventually get so lost due to the abstractness of the concept (Fulya, 2016). Moreover, before studying the topic, students already have some perceptions of the topic from the senior. There are positive and negative perceptions from their seniors and the most important thing is that this topic is difficult to learn (Nurshamshida, 2014.When students have difficulty studying genetic subjects, it is very hard to retain them engaged by class instructions. They continued to participate in other tasks that in the classroom as they are not engaged in the learning (Nurshamshida, 2014). These off-task behaviors can cause disturbance in the classroom that affects teacher's instructions too. Therefore, teachers play a big role in enhancing student's engagement if they able to understand the importance and identify the type of tasks which can encourage the concept of engagement among students (Parsons & Nuland, 2014). There are many types of technological tool utilized to empower students to behaviorally engage in the classroom. Padlet board enables students to curate information on virtual newsletters using a simple drag and drop interface that can be used to engage students in various methods (Norziha, 2020). At some point in recent years teachers have recognized that Padlet is a valuable resource for enhancing student engagement (Fisher & Cynthia, 2017). Thus, this study is conducted to have a look into the use of Padlet in enhancing Year 11 student's engagement in learning Genetic topic.

OBJECTIVES OF THE STUDY

The following are the objectives to be achieved in this study:

i. To explore the use of Padlet in enhancing behavioural engagement of Year 11 students in learning Genetic
ii. To investigate the Year 11 student's perceptions of using Padlet in learning Genetic

METHODOLOGY

The study uses basic analysis of qualitative to achieve it intuitions. Six students (4 female and 2 male) of Year 11 from a private secondary school in Kelana Jaya, Selangor were chosen based on the purposive sampling. The purposive sampling was selected based on characteristics of a population and the objective of the study. The selected students are familiar with ICT and has basic exposure of searching information in various websites. Computer skill of participants is also taken into consideration in this study. Besides that, they are also from the same level of grades in the Biology and ICT subject to ensure that their previous achievement won't influenced the outcome. Therefore, all of them should be in same line with the academic grades especially in that two subjects mentioned above. Their grades are verified from the latest midterm assessment in both subjects. The data collection technique used are an observation, interview protocol and document analysis. The researcher explored the students based on three categories of behavioural engagement suggested by Fredricks (2016) which are participation, on task and collaboration.

Initially, the study was planned to conduct in ICT lab of school due to accessibility of internet. However, the observation mode has change to online observation due to Movement Control Order (MCO) which was implemented throughout our country. The observation will be carried out through Zoom meeting. This procedure allowed all the six students to be observed at least 6 session. There were few tasks assigned in Padlet for students during the session.

All observation sessions were recorded into a verbal data which then is transcribed. An observation form was adapted from Mustafa (2014) was used to accomplish the aims of this study. The interview protocol framed according to research questions and adaptation from interview protocol framework by Castillo-Montoya (2016) that tailored four type of questions such as introduction question, transition question, key, and closure questions. Analysis of document is utilised to analyse documentary proof and answer specific research queries and infrequently utilized to triangulate findings congregated from another data collection technique such as observation and interview (Frey, 2018). The observation notes were recorded in the observation form.

By using the same method used for analysis of interview excerpt, data from observations was coded manually. Categorization of the codes done where it is suitable and applicable relating to the categories that exist from the interview analysis. Group interviews were recorded using audio recording devices on the computer and a video recording on Zoom was also done as a back-up measure. Audio were recorded and interview transcriptions were then copied to a Microsoft Word format where the line numbers were applied for better reference and visuals during the next step. These interviews will then be coded manually using a mixture of both word-based and code-based analysis technique.

RESULTS

Findings of the study are described precisely based on the use of Padlet to enhance behavioural engagement of student in learning genetic topic and the perception of the students using Padlet in learning genetic topic. Overview of the findings are showed in Figure 2.

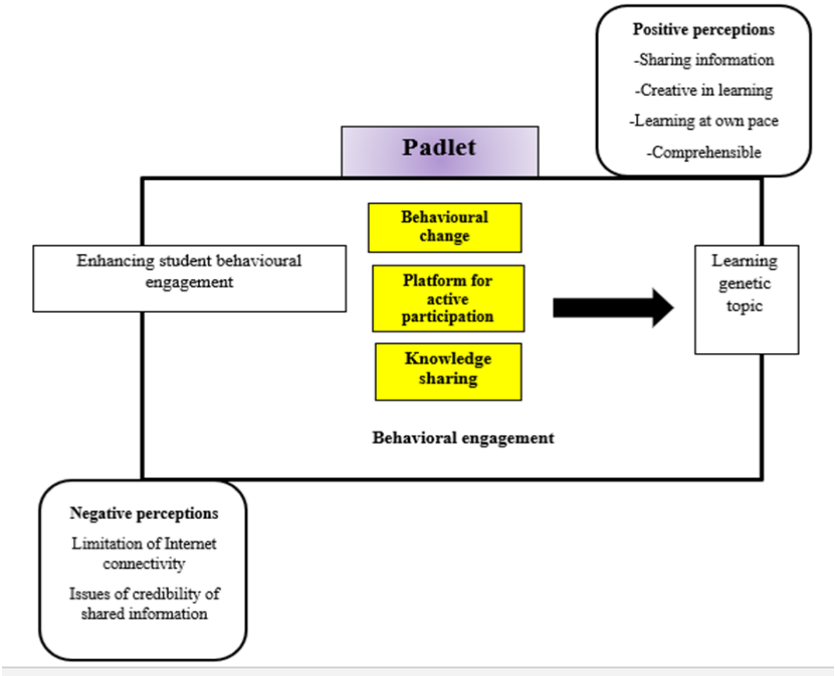

Figure 2: Overview of the findings

Based on the data analysed from observation and document analysis, three themes emerged to explain student behavioural engagement when using Padlet for learning genetic. The themes are i) Padlet enhance students behavioural change ii) Padlet serves as a platform for active participation and iii) Padlet enhance knowledge sharing. Table 1 shows the themes and categories for using Padlet to enhance behavioural engagement of year 11 students in learning genetic topic.

Themes and categories for using Padlet to enhance behavioural engagement of year 11 students in learning genetic topic

Themes	Categories	Definition
Behavioural Change	**Following task-oriented instruction**	Task oriented instruction which inspires students to acknowledge and follow completely different contexts of task that promotes students-centered learning
	Inevitable focused on task completion	Tasks completion that encourages students to do the nature of the outcome they will achieve
Platform for Active Participation	**Facilitating student's collaboration and interaction**	Students learn or attempt to learn working together in small groups in an interactive manner
	Empowerment of peer's feedback	Peer feedback provides students opportunities to learn from each other and involved in an active way in the feedback process with their peers
Knowledge sharing	**Synthesizing of information on Padlet concerning genetic topic**	Creating a new perspective of interlacing information that available on Internet
	Access to acquire new knowledge of genetic topic	Gateway to gain new knowledge of genetic related issues

Following task-oriented instruction

Out of 6 students, four students are observed to be behaviourally engaged throughout the session. Student 1 was able to follow the steps provided in Padlet throughout the lesson. She was actively sharing information (S1, Obs1, L2). Student 1 is seen to be very attentive of the task-oriented instruction. Following the instructor request, she also did a short reflection about what she has already known based on her experience in relation to the topic that being explored in the session. (S1, Obs5, L391). The excerpt taken from the observation: *"Student 1 was actively trying to find related information that needed in the particular assigned task given in Padlet, and upon confirming the validity of the information, shared with fellow peers using, I-pad"* (S1, Obs1, L2)

Student 2 is observed to not be able to answer the questions related to the video posted in Padlet on genetic understanding through pea plants because she seems didn't pay attention to the instructor's direction (S2, Obs 5, L 409). The excerpt taken from the observation *"She did not follow the instructions given by researcher, where students need to record their answers in an audio form and upload in Padlet, as she is not aware of the direction given by researcher"*

Student 3 was seen to be very alert throughout the sessions. He can be recalling a greater portion of the information learned from previous session, when instructed by the researcher. (S3, Obs 6, L519). The excerpt taken from the observation: *"He is seen to be looking attentively in video feed that was describing genome, and how are traits passed from generation to generation throughout the session*" (S3, Obs1,34)

Inevitable focused on task completion

Student 1 was able to complete diagram that illustrates how cloning works or why cloning might be important (S1, Obs1, L18). She was able to analyse and complete the task given about the genome assembly and scaffolds look like based on the images shown in Padlet (S1, Obs2, L110). This ability in concentrating to complete the task also echoed by another student, student 3 who focused in his task completion of an activity (S3, Obs1 l.40). Student 5 despite having some difficulty in completing one of the tasks that require students to explain the process of transcription and translation involved in protein synthesis in cell. He is seen focus to discussing with the researcher until he able to gets a clear picture on completing the task in wall of Padlet (S5, Obs2, L164). Student 6 also face some challenges in completing the task, but he approaches his peers and researcher to clarify his doubts and enhance his understanding towards the content of the topic (S6, Obs2, L182).

Facilitating student's collaboration and interaction

Student 1 is noted to be always ready with the details needed for discussions works with her partners where each pair should do some research into how cloning works on a DNA level (S1, Obs 1, L15). In group she was able to analyse to what genome assembly and scaffolds look like based on the images shown and develop questions that she still has about the genetic mapping after looking at those images (S1, Obs 2, L110). Student 3 also seen active in interacting with his group members about the mind maps and more visual oriented learning material that shared in Padlet (S3, Obs 3, L231). Student 5 was seen attentively listening to his peer's answers during problem solving tasks. Student 5 is observed to be active participant in group discussion (S5, Obs 1, L84).

Empowerment of peer's feedback

Student 1 was actively imploring questions to provide feedback to her peer's post. She is seen to be actively listening to her peer's enquiries, and able to answer the questions even before checking the visual provided as reference (S1, Obs1, L9). Student 1 used her own formed table to jot down her question, and wait until the educator's instruction to finish, to clarify and involve in the discussion. (S1, Obs3, L192). Student 3 is seen to be able to explain about disorder of sex linkage to his peers His explanation construct debates among his peers on the possibilities why certain step was wrong accordingly (S3, Obs3, L144). Student 6 is seen extremely structured, as he is observed to actively sharing her feedback, particularly to strengthen his understanding in the differences of alleles from genes, followed by his own initiative in finding related information.(S6, Obs 1, L178).

Synthesizing of information on Padlet concerning genetic topic

Throughout the session, Student 6 is seeming to jot down his questions regarding the subtopic attentively in well-organized method, compiling the questions and shared in Padlet accordingly for further discussion (S6, Obs 3, L267). Student 5 is seen to repeats the exercise given multiple time to strengthen his understanding towards the genetic topic, and to equip himself with clearer understanding (S5, Obs4, L362).

Access to acquire new knowledge of genetic topic

Student 3 was observed to share her own experiences, hunches, and ideas about the content of genetic related disease and she was able to relate and connect it to one of the genetic cases which she knew among her family members (S3, Obs3, L200). Student 5 also seen to obtaining knowledge on inherited heart disease through Padlet as he enquired the necessity if all the new-borns to be DNA tested for inherited heart disease (S5, Obs6, L549).)

Perceptions of Students towards Padlet

From the interview conducted, various opinions are being voiced out by the students and recorded into a verbal data which then is transcribed. Later, the important words uttered by the students is assigned with codes. From the codes, the researcher classifies the similar codes into categories which then develop themes. The analysis from the source of data which are interview transcripts revealed two main themes emerged to explain the usage of Padlet to enhance behavioural engagement in learning genetic topic. Each of the themes with its categories from data analysis are represented in Table2.

Themes and categories for Year 11 students 's perception of using Padlet in learning Genetic topic

Themes	Categories	Definition
Positive perceptions	**Sharing information**	Information sharing in class discussion refers students can share effectively when they have access to various necessity information.
	Learning at own pace	Students can be versatile as they see fit to their pace and learn at a time that works for them.
	Creative in learning	Students can experience exciting learning process through virtual bulletin board, Padlet.
	Comprehensible	Learning becomes comprehensible through the content provided in Padlet.
Negative perceptions	**Limitations of Internet Connectivity**	Problems arising regarding internet connectivity
	Issues on credibility of shared information	Incorrect information shared by others influencing their understanding and concept towards the topic discussed.

Positive Perception

The first theme is positive perception that describe the development and understanding students attain via using Padlet in learning genetic topic. This is referring to four categories which are sharing information, learning at own pace, creative in learning and learning becomes comprehensible.

Sharing information

From all students interviewed, four students claimed that they were able to share when they have access to various necessity information that makes them well equipped facing a topic and thus increase the quality of the discussion made in Padlet. This can also be observed during the lesson where Student 1 always active in sharing information with their friends regarding genetic issues. Student 1 was actively trying to find related information that needed in the assigned task given in Padlet, and upon confirming the validity of the information, shared with fellow peers. (S1, Obs1, L2). Below are the statement by Student 1:*"Using Padlet gave chance to share information and thoughts with my friends. It's like we are sharing a wall of information to each other. I can add electronic post its notes"* (S1, I1, L161). Through Padlet, Student 3 believed that these tedious processes are cut short, as they just share the links, and all their friends and himself can read it, watch it, listen to it and absorb it in our own way (S3.I1, L203).

Learning at own pace

From the interview data, the students stated that they are learn better on genetic topic in Padlet at their own comfort space. Student 1 mentioned that she gets to learn everything at the comfort of her own space (S1, I1, L165). Besides that, Student 3 claimed that he felt more productive, since his learning time is not restricted and he also doesn't need to use the conventional way of using books on the table, but he can bring the technology gadget practically anywhere (S3, I1, L218). Student 6 also echoed the same perception as she really prefers to use Padlet as it enables her to adjust own pace of learning. (S6, I1, L296).

Creative in learning

Student 3 reported that using Padlet in learning genetic topic that consist of many methodical process such as translation, transcription, protein synthesis provide opportunity to be creative as he can choose to type his answers or he can break out of the point (S3, I, L209). According to Student 4, he mentioned that he can display information or answers in a range of ways such as colourful infographics, any animated videos (S4, I1,234). Student 5 felt that Padlet screens not just as machines for the details, but also as a new way to develop and communicate innovative concept (S5, I1, L259).

Comprehensible

Student 3 reported that the links posted in Padlet such as YouTube video tutorial help to better understand the genetic concept (S3, I1, L263). Below is the statement from Student 3: *"I agree to a certain extent, that it is easier as there's a visual treat for me there. can easily imagine the content and make connections with his previous knowledge through the text presented in visual. Therefore, the information can be accepted easily* "(S3, I1, L380)

Negative perceptions

This theme explains about the challenges that the students faced when using Padlet in learning genetic topic from the perspective of Internet connectivity limitation. Two main categories emerged from this theme which are Internet connectivity limitations and issues on credibility of shared information.

Limitations of internet connectivity

Student 2 complaint that she felt stress while using Padlet as faced connection issue when using Padlet, she needs refresh few times. When she was unable to follow the lesson, she felt like she is lost and took long time to grasp the content. (S2, I1, L401). This followed with complaint from Student 4 who mentioned he felt down when internet is slow. It is very hard to search for the information. (S4, I1, L251).

Issues on credibility of shared information

Student 6 criticized that his answers might be misused in Padlet. He agreed that although Padlet provides them with the opportunity to share our thoughts and ideas without any boundary, he feels it also easy up plagiarism process. Although he doesn't know how accurate the answers and his thoughts are, he thinks in this platform, since there's no anti-plagiarism device, it's just easy to check all the answers posted and copying it exactly (S6, I1, L417). Student 4 also complaint that although it is interesting when they get to see many insights from fellow friends in Padlet, but sometimes he felt he have been led to a different direction with misconception (S4, I1, L401).

DISCUSSION

Science educators are proposed to derive out from communal pedagogical practices and assess their ability in by means of selected technological tools as a replacement platform for student's learning environment (Cetin-Dindar & Geban, 2017). This study supports the previous studies in integrating technology in science classroom. Integration of interactive software can also be used as material self - learning by students and is suitable for teaching aid in Science subject (Abdullah, N, 2017). Beltran-Martin (2019) agreed that Padlet offers great advantages to students like collaborating with their peers, versatile to use as it can work on different devices regardless of the location and time. In traditional classroom method, students are repeatedly encumbered with theories and facts which lead to most students usually employed with very little or no knowledge at all (Cetin et al, 2017). The recent genetic analysis on medication, production of food and health related issues are significant, and it can be agreed that every member of society must have some level of understanding towards the genetic issue evolved around us (Gupta, 2019). Nevertheless, reviews of literature about students in learning genetics ends up in the inevitable conclusion that students think about genetic subject as tough to be told and plenty of misconceptions and misunderstandings will happen (Didem,2016).

This study suggests that by using Padlet, teachers can boost student's participation, inspiration, and time of instructional. This can be supported by claims from Kimura (2018) that said Padlet is defined as powerful brainstorming tool to bring great excellence of a computer-generated interaction wall based on the specified instruction task which beneficial for learning process. This is also consistent with Humphrey (2017) that Padlet application become an appropriate tool to develop collaborative learning that enhance engagement among student.

The findings in this study showed behavioural change among the students was ignited by utilizing Padlet in learning genetic topic. This can be strongly suggested in student's behavioural engagement enhanced through students following task-oriented instructions and inevitable focus on task completion. This is also supported by Adiantika (2018) that claimed task-oriented instruction enable students to follow learning steps effectively. This study suggested that task-oriented instruction is an instructional method that can be utilized to encourages students to have an abundant interaction while learning genetic topic in Padlet. This is supported by McCrudden (2017) that claimed it is crucial that educators consider how learners engage with meaningful learning as they create the instructional materials. This study's findings suggested on student's participation is not restricted from aspect of timeline to find relevant answers at least hint at they need longer to think and re correct their answers in their peer's post in Padlet to boost their understanding.

This also aligned with Farahidatul (2017) that learners gained for an equal aspect of participation and time consideration to update their posts in wall of Padlet. Accessibility of Padlet that enable collaboration enhanced the implementation of a collaborative learning atmosphere. The findings are in line with Beltran (2019) who agreed that Padlet's feature facilitate collaboration among students to overcome the challenges they encountered during discussion with their educators. This also affirms the concept of Padlet as great platform coined by Ellis (2015) that collaboration with their peers able to engage students in learning the topic. This study also suggests that Padlet as an essential tool to initiate collaboration among students in learning genetic attributable to fascinating and easy options of Padlet. This is also aligned with Dewitt (2015) that claimed the usability of Padlet for collaboration specified that students may acquire new thoughts that applied to facilitate collaboration. This study also found peer feedback for learning genetic through Padlet enhance behavioural engagement of students as they have no pressure to quickly respond compared with oral comments in person. This is consistent with Christina (2020) that claimed peer feedback has proven to be a crucial and influential that helps them evaluating their own learning. Carless (2018) also agreed that peer feedback seeming benefits the learning process. Using Padlet on learning genetic issues also served as knowledge sharing tool to enhance student's behavioural engagement. This is supported by Simpson (2016) statement that obtaining feedback from their peers assist them to boost their learning task in a very purposeful and effective method.

The findings in this study pointed out that the students are having various perceptions on using Padlet in learning genetic. Padlet platform offers students a chance to share their work without taking the instructional time to speak in front of the class one at a time. This finding is supported by Tom (2018) statement that Padlet is a piece of 'Social Software' which like blogs for collaborative content sharing and editing. Findings of the study showed this tool allows students to explore more information regarding lessons on their own. The outcome of this study showed when creativity is combined with asset of technology, it became an assest for an interactive learning experience. Students become more engaged while using ICT tools such as Padlet in their learning. It is in line with Charaya (2017) that current generation of teenagers as living and operating in a digital world where they are fan of multimedia learning that can implemented through route of education.

Internet access made broadcasting of any news within seconds and often considered as the fastest way to gain information (Geeevargese, 2017). There is no denying that stable Internet connectivity can improving the standard of the student learning especially in an online learning environment. Findings showed that the students encountered internet connectivity issues. Bandwidth problems make it hard for them to have quick and effective access to the topic and discussions. Connection limitation became the biggest complaint among students. It is coherent with the work of Geeevargese (2017) which stated that when unstable connection happened, it leads to frustration among the students during the process of learning genetic. Next, students facing issues on credibility on information that shared through Padlet. Information credibility in this study reflect on the trustworthiness of the information that student received. (Ruohan, 2015). In general, information obtained from any website sources usually lack gatekeepers to display the content (Ruohan, 2015). Findings of this showed that though Padlet may be a platform for students to share concepts and response, generally they feel that the incorrect information shared by others influencing their understanding and concept towards the topic discussed. Students also revealed that they are not comfortable in posting their answers on the discussion board as they felt their peers might just copying their ideas. These findings are supported by Ruohan (2015) statement that focus on the method to monitor the credibility of information on digital platform as it become huge concern among information seekers.

CONCLUSION

As conclusion, Padlet has potential to enhance student's behavioural engagement in learning Genetic through following task-oriented instruction, facilitation of collaboration and interaction, and knowledge sharing. Various perceptions of the students regarding the use of Padlet in learning genetic that categorized into positive perception that is going to be retained for enhancing student's engagement within the lesson and negative perception that can be improved. This study contributed Padlet to the list of instructional strategy that is possible to tap importance of digital platform in educational settings specifically for learning genetic. Findings on the usage of Padlet to enhance student's behavioural engagement contributes to the body of literature regarding the behavioural change of students that happened when using Padlet in learning genetic. Apart from that, the usage of Padlet in this study gave a framework on how digital platform such as Padlet can be executed in learning difficult topic that perceived by biology students. The elaboration learning activities that provided in Padlet gave an overview how the genetic topic and its content can be organized and scaffolded in framing future researches that intend to investigate engagement and genetic learning.

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