

Efficacy of Padlet Instructional Tool on Students' Engagement and Perception in the Teaching and Learning of some Ecological Concept

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Abstract: The purpose of the study was to examine the efficacy of padlet instructional tool on students' engagement and perception in the teaching and learning of some ecological concept in the Accra Metropolitan of the Greater Accra Region of Ghana. Three research hypotheses guided the study and tested at 0.05 level of significance. A quasi-experimental design was used. A total sample of One Hundred and two (102) elective biology Senior High School students comprising sixty-seven (67) males and thirty-five (35) females were purposively sampled and used for the study. Two instruments were used for data collection in the study, namely; Students' Engagement and Collaboration Checklist (SECC), and Students' Perceptions on Padlet Tool Questionnaire (SPPTQ). The data collected from the study were analyzed using both descriptive and inferential statistics such as mean and standard deviation, Kruskal-Wallis test analysis, chi-square test analysis (cross-tabulation) together with mean and box plots. The result of the study revealed that students in both padlet tool instructional groups 1 and 2 performed better in terms of engagement and collaboration in class during the teaching and learning of the ecological concepts as compared to their counterparts in the conventional lecture-based instructional group. Therefore, padlet instructional approach is efficacious in enhancing students' engagement, participation and collaboration. The study results again indicated that the padlet group students had very positive perception about the use of Padlet as an instructional tool and find it a suitable tool for teaching and learning of ecological concepts. The result further revealed a relationship between the students' perception and their ICT background knowledge (p -value = .019) towards the use of Padlet tool in teaching and learning of ecological concepts. It was noted that almost all the students with good ICT background expressed a very positive/positive perception towards the use of Padlet. From the findings, a conclusion is drawn that the biology teachers and students should be encouraged to use padlet instructional tool in the teaching and learning of ecological concepts.

Keywords: Padlet Instructional Tool, Engagement and Collaborative Skills, Student Perception, Ecological Concepts

Introduction

Activities conducted in classrooms are important to attain learners' understanding and participation in a learning environment. Teaching and learning in the 21st century classrooms are more learner centered than teacher centered. The learning style in 21st century likewise varies, in which learners can learn at anytime and anywhere (Yáñez-Aldecoa, Okada, Palau, 2015).

21st century learning entails four vital learning and innovation skills identified as 4Cs. They are critical thinking and problem solving, creativity, collaboration, and communication (Partnership for 21st Century Learning, 2019). Besides, the 21st century learning is an integral part of future educational rational and planning. Even though technology changes, educators are actively searching for new ways to prepare learners for the future and the educational system has been evolving faster than ever before (Jennifer, 2019). Thus, it is important that learners are enthusiastically involved in classroom activities such as asking questions, participating in discussions, and offering opinions. From these activities, learners are able to acquire new ideas when they share information and knowledge (Zhi & Su, 2016). Learners who do not take part in activities

might be perceived to be unprepared, disinterested, hostile, lazy, or bored (Fuchs, 2014; Thum, 2019). However, the Padlet creates more room for all learners to be involved in the learning process. The web-based instructional tool provides opportunities for learners to work in groups, use more audio-visual learning materials provided by their biology teachers. Therefore, it is seen to highly increase and improve learner engagement, attainment and performance.

It is also realised that, the role of teachers as facilitators is important to enhance learners' responsibility for their own learning (Beltrán-Martín, 2019; Rashid, Yunus, & Wahi, 2019). Based on new learning environment in teaching and learning activities, the quality of teaching is also important because each learner has different learning styles (Thum, 2019).

Learner engagement is a term used to describe an individual's interest and enthusiasm in learning which impacts academic performance and behaviour (Gallup, 2013). There are numerous studies linked to learner engagement and performance factors. Barkley and Major (2010) revealed that the learner engagement is the intersection or connection between two factors such as motivation and active learning



which results in increased performance. Again, according to Becker (2015), the new meta-model of learner engagement is the intercept of motivation, active learning, expectation, and value. Other researchers mention that learner engagement involves the perceived usefulness, perceived ease of use, teaching presence, and self-efficacy (Jung & Lee, 2018). This is very dominant in the use of the Padlet for learning. Additionally, learner engagement also correlates with learners' satisfaction (Garnham & Betts; 2018).

Padlet, an individual online learning tool allows all learners to be engaged at the same time, and to collaborate simultaneously (Fuchs, 2014). Learners are also able to simultaneously demonstrate their learning by answering teacher created questions or completing activities, such as tasks that relate to current content curriculum (Weller, 2013). Incorporation of the padlet which is an online tool for learning will achievably be a good choice since it is a great web 2.0 tool and it can improve learner engagement and deep learning of the study ecological concepts. However, there has never been any published research on using padlet in teaching ecological concepts in schools be it primary, secondary or the tertiary levels in Ghana and Africa at large. It is for this reason that the researchers focused on using padlet in teaching biology in Senior High Schools due of the existing gap in research. The study was therefore guided by the following research null hypothesis:

- H₀₁:** There is no significant difference in students' engagement and collaboration skills during teaching and learning of ecological concepts between conventional lecture-based instructional group, padlet tool instructional group 1 and padlet tool instructional group 2.
- H₀₂:** Students have no positive perception about padlet tool as an instructional tool in teaching and learning of ecological concepts.
- H₀₃:** There is no significant relationship between students' perception towards the use of padlet tool in teaching and learning of ecological concepts and their ICT background knowledge.

Methodology

This study used quasi experimental research design due to non-randomization of research subjects as it was not possible for the researchers to randomly sample the subjects and assign them to groups. Hence, this design was very suitable for this study. Three intact second year biology classes from three different schools were selected and assigned Padlet instructional group 1, Padlet instructional group 2 and control group (Conventional lecture-based instructional group). The groups were randomly assigned to one of the treatments (instructional approaches). Thus padlet instructional group 1, padlet instructional group 2 and control group were randomly assigned to padlet tool instructional

approach who were taught in their school ICT lab, padlet tool instructional approach who were taught from their various home during COVID-19 vacation and conventional lecture-based instructional approach who were taught in their classroom respectively. A total sample of One Hundred and two (102) biology students comprising of sixty seven (67) males and thirty five (35) females were purposively sampled and used for the study. The heads of department, biology teachers and the selected students of the two schools to apply padlet instructional approach were oriented on how to use the Padlet instructional web-based tool. All the three groups were subjected to six weeks teaching and learning period of ecological concepts using their respective assigned treatments (instructional approach).

Generally, two instruments were used for data collection in the study, namely Students' Engagement and Collaboration Checklist (SECC), and Students' Perceptions on Padlet Tool Questionnaire (SPPTQ). Students' Engagement and Collaboration Checklist (SECC) sheet was designed and used to score their rate of engagement, participation and collaboration during the teaching and learning sessions through observation. This helped in examining how the use of Padlet tool in teaching and learning of ecological concepts reflected on the students' engagement and collaboration skills. Students' Perceptions on Padlet Tool Questionnaire (SPPTQ) on the other hand, was used to ascertain the students' perceptions of using Padlet as an instructional approach in teaching and learning of ecological concepts. That is, to assess the students' opinions on how they perceived the padlet instructional approach in teaching and learning of ecological concepts after been engaged with the tool during the intervention session. In doing so, a Kleinsmith's (2017) scale questionnaire titled SPPTQ was used. It was made up of 10-items structured questionnaire with four-point rating scale (4-point Likert scale). This questionnaire was distributed through the padlet classroom using a Google form.

The data collected from the study were analyzed using both descriptive and inferential statistics such as mean and standard deviation, Kruskal-Wallis test analysis, chi-square test analysis (cross-tabulation) together with mean and box plots using Statistical Package for Social Sciences (SPSS) software, version 21.

Results

Research Null Hypothesis One (1)

There is no significant difference in students' engagement and collaboration skills during teaching and learning of ecological concepts between conventional lecture-based instructional

group, padlet tool instructional group 1 and padlet tool instructional group 2.

To evaluate how the use of padlet tool in teaching and learning of ecological concepts reflected in the students' engagement and collaboration skills and its corresponding hypothesis, Kruskal-Wallis test analysis was used to analyse the students' scores in engagement and collaboration skills between the three instructional groups in the teaching and learning of ecological concepts during the intervention session. The outcome of the analysis is presented in Table 1.

Table 1: Kruskal-Wallis Test Analysis on Students' Scores in Engagement and Collaboration Skills in the Teaching and Learning of Ecological Concepts during the Intervention

Instructional Groups	N	Mean Rank
Conventional Instructional Group (In Classroom)	39	42.28
Padlet Instructional Group 1 (In School ICT Lab)	36	55.74
Padlet Instructional Group 2 (At Home During COVID Vacation)	27	59.17
Chi Square = 6.429		
df = 2		
Sig. (p-value) = .040		

Result of Kruskal-Wallis test analysis in Table 1 shows the mean ranking on the level of students' engagement and collaboration skills during teaching and learning of ecological concepts among the three instructional groups. The result showed that significant differences exist among the three instructional groups in their engagement and collaboration skills, because the p value observed is .040 at $df=2$. Since p value observed (.040) is less than .05, the null hypothesis which states that there is no significant difference in students' engagement and collaboration skills during teaching and learning of ecological concepts among the three instructional groups (conventional lecture-based instructional

group, padlet tool instructional group 1 taught in school ICT lab and padlet tool instructional group 2 taught from home during COVID-19 vacation) is thus rejected. The instructional groups' engagement and collaboration skills mean ranking were 42.28, 55.74 and 59.17 for conventional lecture-based instructional group, padlet tool instructional group 1 taught in school ICT lab and padlet tool instructional group 2 taught from home during COVID-19 vacation respectively as shown in Table 1.

This indicates that, students in padlet tool instructional group 2 taught from home during COVID-19 vacation were more involved, engaged and collaborated during the teaching and learning of the ecological concepts making the group recorded highest engagement and collaboration skills mean rank followed by padlet tool instructional group 1 taught in school ICT lab with conventional lecture-based instructional group recorded the lowest mean rank. This means that in all, students in both padlet tool instructional group 1 and 2 did better in terms of engagement and collaboration in class during the teaching and learning of the ecological concepts compared to their counterparts in the conventional lecture-based instructional group and that padlet instructional approach is effective in increasing student engagement and participation and collaboration.

Research Null Hypothesis Two (2)

Students have no positive perception about padlet tool as an instructional tool in teaching and learning of ecological concepts.

To examine the students' perceptions of using padlet as an instructional approach in teaching and learning of ecological concepts, a survey was used to assess the students' opinions on how they perceived the padlet instructional approach after been engaged with the tool during the intervention session. The result of the analysis is presented in Table 2.

Table 2: Students' perceptions of using Padlet as an instructional approach in teaching and learning of ecological concepts

Evaluation Item	Mean	S.D	Kind of Perception
1. I have no difficulty in using the Padlet in the biology classroom.	3.10	1.1	Positive
2. I like to see my classmates share on the Padlet.	3.83	.70	Very Positive
3. Padlet motivates me to interact with my classmates inside and outside of the biology classroom.	3.75	.77	Very Positive
4. Padlet enables me to share ideas with my friends.	3.60	.80	Very Positive
5. I feel less stressed when I use the Padlet to learn biology in class.	3.42	.90	Positive
6. I learned new concepts from the other posts on Padlet.	3.50	.85	Very Positive
7. The materials posted on Padlet were clear.	3.55	.82	Very Positive
8. The materials posted on Padlet were useful.	3.82	.74	Very Positive
9. When I post on Padlet wall, I am careful to check my grammar and use the right ecological terms.	3.35	.93	Positive
10. It is a good idea to use Padlet to learn biology.	4.00	.64	Very Positive
Overall	3.59	.83	Very Positive

With regards to students' perception with the use of Padlet, a survey was used to assess the students' opinions. In doing so, a Kleinsmith's (2017) scale

questionnaire was used, made up of 10-items structured questionnaire with four-point rating scale (4-point Likert scale). This questionnaire was

distributed through the padlet classroom using a Google form. In general, the results indicate that the students had very positive perception about the use of Padlet as an instructional tool and find it a suitable tool for teaching and learning of ecological concepts, given that all the items obtained mean score values higher than 3 with overall mean score of 3.59 (S.D=.83) (see Table 15). More specifically, item number 10 (*it is a good idea to use Padlet to learn biology*) attains the highest value, with a mean value of 4.0 (S.D=.83). Following this, there are six other statements (items) that also recorded higher mean scores. They are '*It is a good idea to use Padlet to learn biology*' (M=4.00, S.D=.64), '*I like to see my classmates share on the Padlet*' (M=3.83, S.D=.70), '*The materials posted on Padlet were useful*' (M=3.82, S.D=.74), '*Padlet motivates me to interact with my classmates inside and outside of the biology classroom*' (M=3.75, S.D=.77), '*Padlet enables me to share ideas with my friends*' (M=3.60, S.D=.74), *the materials posted on Padlet were clear* (M=3.55, S.D=.82), and *I learned new concepts from the other posts on Padlet* (M=3.50, S.D=.85). The results in Table 1, show that there are three statements that scored the lowest mean score though with positive perception. They are; '*I feel less stressed when I use the Padlet to learn biology in class*' (M=3.42, SD=.90), '*when I post on Padlet wall, I am careful to check my grammar and use the right ecological terms*' (M=3.35, S.D=.93) and '*I have no difficulty in using the Padlet in the biology classroom*' (M=3.10, S.D=1.10). This was probably because of Padlet been a new learning tool for them.

Research Null Hypothesis Three (3)

There is no significant relationship between students' perception towards the use of padlet tool in teaching and learning of ecological concepts and their ICT background knowledge.

Chi-square test analysis together with cross-tabulation was used to examine the relationship between the students' perception towards the use of Padlet tool in teaching and learning of ecological concepts and their ICT background knowledge. The result of the analysis is presented in Table 3.

Table 3: Chi-Square Test on Students' ICT Background and their Perception towards the Use of Padlet in Teaching and Learning of ecological Concepts Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.743 ^a	4	.019
Likelihood Ratio	13.454	4	.009
Linear-by-Linear Association	9.806	1	.002
N of Valid Cases	63		

a. 3 cells (33.3%) have expected count less than 5. The minimum expected count is 1.43.

Table 3 showed Chi-Square Test analysis on students' ICT background and their perception towards the use

of Padlet tool in teaching and learning of ecological concepts. The result of the analysis indicated that there was a relationship between the students' perception towards the use of Padlet tool in teaching and learning of ecological concepts and their ICT background knowledge (p -value = .019).

It could be deduced from the cross-tabulation analysis in the Table 4 that none of the students exposed to Padlet tool instructional approach with good ICT background expressed negative perception towards the use of Padlet tool in teaching and learning of ecological concepts. That is, all the students with good ICT background totaling 33 representing 52.2% expressed a very positive/positive perception towards the use of Padlet tool in teaching and learning of ecological concepts. 4 students with poor ICT background representing 6.3% expressed negative perception towards the use of Padlet tool in teaching and learning of ecological concepts which is relatively higher compared to their counterparts with good ICT background (0%) and average ICT background (2 representing 3.2%). This means that students who come with good ICT background have positive perception towards the use of Padlet tool in teaching and learning of ecological concepts. Graphically, the relationship between the students' perception towards the use of Padlet tool in teaching and learning of ecological concepts and their ICT background knowledge is presented in Figure 1.

Table 4: Cross-tabulation of Students' ICT Background and their Perception towards the Use of Padlet in Teaching and Learning of Ecological Concepts

STUDENTS' ICT BACKGROUND		STUDENTS' PERCEPTION TOWARDS THE USE OF PADLET			
		Very Positive Perception	Positive Perception	Negative Perception	TOTAL
Good ICT Background	Count	20	13	0	33
	Expected Count	15.2	14.7	3.1	33.0
	% within STUDENTS' ICT BACKGROUND	60.6%	39.4%	0.0%	100.0%
	% within STUDENTS' PERCEPTION TOWARDS THE USE OF PADLET	69.0%	46.4%	0.0%	52.4%
	% of Total	31.7%	20.6%	0.0%	52.4%
Average ICT Background	Count	5	8	2	15
	Expected Count	6.9	6.7	1.4	15.0
	% within STUDENTS' ICT BACKGROUND	33.3%	53.3%	13.3%	100.0%
	% within STUDENTS' PERCEPTION TOWARDS THE USE OF PADLET	17.2%	28.6%	33.3%	23.8%
	% of Total	7.9%	12.7%	3.2%	23.8%

Poor ICT Background	Count	4	7	4	15
	Expected Count	6.9	6.7	1.4	15.0
	% within STUDENTS'	26.7%	46.7%	26.7%	100.0%
	ICT BACKGROUND				
	% within STUDENTS'	13.8%	25.0%	66.7%	23.8%
Total	PERCEPTION TOWARDS THE USE OF PADLET				
	% of Total	6.3%	11.1%	6.3%	23.8%
	Count	29	28	6	63
	Expected Count	29.0	28	6.0	63.0
	% within STUDENTS'	46.0%	44.4%	9.5%	100.0%
	ICT BACKGROUND				
	% within STUDENTS'	100.0%	100.0%	100.0%	100.0%
	PERCEPTION TOWARDS THE USE OF PADLET				
	% of Total	46.0%	44.4%	9.5%	100.0%

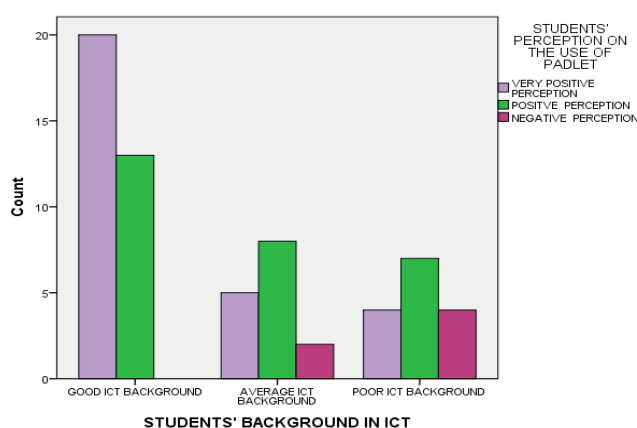


Figure 1: Students' Perception towards the Use of Padlet Tool against Their ICT Background

Figure 1 indicates that students with good ICT background had the highest 'very positive' and 'positive' counts in expressing their perception towards the use of Padlet tool in teaching and learning of ecological concepts. It could be observed that 20, 5 and 4 students with good ICT background, average ICT background and poor ICT background respectively expressed very positive perception towards the use of Padlet tool after their exposure to the tool. In same way, it could be deduced from the graph that students with poor ICT background recorded higher negative perception (4 students) toward the use of Padlet tool compared with their counterparts with average ICT background (2 students). None of the students with good ICT background recorded a negative perception toward the use of Padlet tool.

Discussion

The instructional groups' engagement and collaboration skills mean ranking were 42.28, 55.74 and 59.17 for conventional lecture-based instructional group, padlet tool instructional group 1 taught in school ICT lab and padlet tool instructional group 2 taught from home during COVID-19 vacation respectively as shown in Table 1. This means that in all, students in both padlet tool

instructional group 1 and 2 did better in terms of engagement and collaboration in class during the teaching and learning of the ecological concepts compared to their counterparts in the conventional lecture-based instructional group and that padlet instructional approach is effective in increasing student engagement and participation and collaboration. The reason might be due to the fact that the use of padlet instructional approach allows learners with the opportunity to master their learning, learn at their own pace, and engage anonymously in online discussions. The whole biology class was fully engaged. Learners were seen reading information which the teacher had uploaded on the Padlet, such as videos and other project materials. Aside those, almost all the assessment for learning questions were uploaded onto the Padlet. This made the learners highly engaged, due to the fact that they had to read materials individually and also in groups in order to be able to be part in the classroom Padlet online discussions. Assessments for learning questions were uploaded by the biology teachers to engage the learners as they used the Padlet. This also created the room for the teachers to know how well learners fully understood a particular ecological concept. The impacts of the use of the Padlet are always seen, as learners post and share their answers to teacher's assessment questions. In addition, Padlet encourages students' reflections about their own learning and increase the flexibility of the learning process, since both students and teachers can contribute to the wall anywhere and anytime. Using Padlet as learning tool benefits students in terms of developing new knowledge and sharing the idea, collaborating and interacting with colleagues. The finding concurs with the finding of Morin, Thomas and Saadé (2015), Ellis (2015), England (2017) and Beltrán-Martín (2019) whose findings brought to light that the use of padlet and other online tools promote learners' engagement and collaboration skills. It also supported previous research done by Mahmud (2019) and DeWitt, Alias, Siraj and Hutagalung (2014) who agreed that padlet had brought new knowledge to its users and that it enabled the collaboration and interaction between the users. It is a good learning tool to reduce the communication gap among students, peers and their teachers.

All student participants in the padlet tool instructional groups 1 and 2 completed a perceptions survey at the conclusion of the study. The study results indicate that almost all of the students expressed very positive perception of the use of Padlet as an instructional tool and find it a suitable tool for teaching and learning of ecological concepts, given that all the items obtained values higher than 3 with overall mean score of 3.59 (SD= .83). The study finding concurs with the findings of prior researchers (Kleinsmith, 2017; Md

Deni, & Zainal, 2017; Cydis, 2011; Karaman, 2011; Miller, 2009; Shaffer & Collura, 2009) who also found that students report positive experiences and perceptions while using SRSs, and Padlet as they provide the opportunity for simultaneous engagement in key curriculum content, and the ability to receive immediate teacher feedback.

Also, the result of the analysis indicated that there was a relationship between the students' perception towards the use of Padlet tool in teaching and learning of ecological concepts and their ICT background knowledge ($p\text{-value} = .019$). None of the students with good ICT background exposed to Padlet tool instructional approach expressed negative perception towards the use of the Padlet tool in teaching and learning of ecological concepts. However, most of the students with poor ICT background expressed negative perception towards the use of the Padlet tool in teaching and learning of ecological concepts. This means that students who come with good ICT background had positive perception towards the use of Padlet tool in teaching and learning of ecological concepts and vice versa.

Conclusions

From the finding of the study, it was revealed that the use of the padlet tool was an innovative and more productive than the use of the conventional instructional approach in teaching and learning of ecological concepts and that using the padlet tool has far more positive effect on students' engagement and collaborative skills. Using the padlet tool in biology teaching and learning allowed the teachers to engage in an interactive life virtual session where the students instantly submitted and shared completed class task and group assignments. This in turn, made learning ecological concepts more meaningful, significant and relevant. The outcome of the use of the padlet tool in improving students' engagement and collaborative skills shows that, Information and Communication Technology tool in biology lessons should be given greater attention.

The use of the padlet tool allows the learning process to extend remotely beyond the four walls of the classroom, while enhancing students' levels of attention, responsiveness, interest, engagement and participation. From the findings a conclusion is drawn that biology teachers and students in the study area are now well established in their thoughts that, through the use of the padlet, students are invited to become more than just passive learners.

Recommendations

It is therefore recommended that in order to enhance biology students' engagement, participation and collaboration skills in teaching and learning of

ecological concepts and therefore solve the persistent problem of underperformance in ecological concepts, teachers should be trained and commended to adopt padlet tool instructional approach during teaching and learning of ecological concepts. Government and the Ministry of Education could also consult internet providers to ensure that all Senior High Schools have high level connectivity at subsidized rates to empower teachers and students to access biology information from countless search engines as they use the Padlet tool and web-based applications, as this will maximise learning gains.

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References

1. Barkley, E. F., & Major, C. H. (2010). *Learning Assessment Techniques: A Handbook for College Faculty*. John Wiley & Sons.
2. Becker, A. B. (2015). *A metal-model of student engagement: The roles of student motivation and active learning*. Conference Paper. Ireland International Conference on Education. Dublin.
3. Beltrán-Martín, I. (2019). Using Padlet for Collaborative Learning. *5th International Conference on Higher Education Advances*, 1-8. <https://doi.org/10.4995/head19.2019.9188>.
4. Dewitt, D., Alias, N., Siraj, S., & Hutagalung, F. (2014). *Designing Instruction for Knowledge Management Processes Using a Wiki*. Taylor & Francis Group Netherland, 2-106
5. Ellis, D. 2015. *Using Padlet to Increase Engagement in Lectures*. Paper presented at the 195-XIII. Retrieved from <http://search.proquest.com/docview/1728004496/accountid=1464>
6. England, S. (2017). Tech for the Modern EFL Student: Collaborate and Motivate with Padlet. *Accents Asia*, 9(2), 56-60. Retrieved from <http://www.issues.accentasia.org/issues/9-2/England.pdf>.
7. Fuchs, B. 2014. The writing is on the wall: using Padlet for whole-class engagement. *LOEX Quarterly* 40(4), 7- 9. Retrieved from http://uknowledge.uky.edu/libraries_facpub/240 Gallup, Inc. (2013). U.S. overall: Gallup Student Poll Results. 1-6.
8. Garnham, W.A., & Betts, T. (2018). The Padlet Project: Transforming Student Engagement in Foundation Year Seminars. *Compass: Journal of Learning and Teaching*, 11(2)
9. Jennifer, R. Nichols. (2019). Four Essential Rules of 21st-Century Learning.
10. Jung, Y., & Lee, J. (2018). Learning Engagement and Persistence in Massive Open Online Courses (MOOCs). *Computers & Education*, 122, 9-22.
11. Kleinsmith, C., Lynn. G. (2017). *The effects of using Padlet on the academic performance and engagement of students in a fifth grade basic skills mathematics classroom*. Theses and Dissertations. 2403. <https://rdw.rowan.edu/etd/2403>
12. Mahmud, M. Z. (2019) Students' Perceptions of Using Padlet as a Learning Tool for English Writing. *Journal of Creative Practices in Language Learning and Teaching*, 7(2), 29-39.
13. Md Deni, R. A., & Zainal, I. Z. (2017). I love it but i don't use it: Students' perceptions on the use of padlet as an educational tool for learning. *The Turkish Online Journal of Educational Technology. Special Issue for INTE 2017*, 7-13.
14. Miller, T. (2009) Formative computer-based assessment in higher education: The effectiveness of feedback in supporting student learning. *Assessment & Evaluation in Higher*

- Education*, 34(2), pp. 181–192. doi: 10.1080/02602930801956075.
15. Morin, D., Thomas, J. D. E., & Saadé, R. G. (2015). Fostering problem-solving in a virtual environment. *Journal of Information Technology Education Research*, 14, 339-362. Retrieved from <http://www.jite.org/documents/Vol14/JITEv14ResearchP339-362Morin2031.pdf>
16. Rashid, A. A., Yunus, M. M., & Wahi, W. (2019). Using Padlet for Collaborative Writing among ESL Learners. *Creative Education*, 10, 610-620. Received: January 8, 2019 <https://doi.org/10.4236/ce.2019.103044>.
17. Shaffer, D. M & Collura, M. J. (2009) Evaluating the Effectiveness of a Personal Response System in the Classroom, *Teaching of Psychology*, 36:4, 273-277, DOI: [10.1080/00986280903175749](https://doi.org/10.1080/00986280903175749)
18. Thum, C. (2019). Experimental Learning for Business Law with Padlet in an Undergraduate Classroom. *WEI International Academic Conference Proceedings*, 69.
19. Weller, A. (2013) The use of Web 2.0 technology for pre-service teacher learning in science education. *Research in Teacher Education*, 3(2), 40–46.
20. Yáñez-Aldecoa, C., Okada, A., & Palau, R. (2015). New Learning Scenarios for the 21st Century Related to Education, Culture and Technology. *RUSC. Universities and Knowledge Society Journal*, 12(2), 87. <https://doi.org/10.7238/rusc.v12i2.2454>.
21. Ysseldyke, J., Betts, J., Thill, T., & Hannigan, E. (2004) Use of an instructional management system to improve mathematics skills for students in title I programs. Preventing School Failure: *Alternative Education for Children and Youth*, 48(4), 10–14. doi:10.3200/psfl.48.4.10-14.
22. Zhi, L., & Su, M. (2016). Enhance Collaborative Learning by Visualizing Process of Knowledge building with Padlet. *Proceedings - 2015 International Conference of Educational Innovation through Technology*, 1, 221-225. <https://doi.org/10.1109/EITT.2015.54>.