

RESEARCH BRIEF

Technology-Infused Approach to Learning Science: An Examination of Students Learning Experiences and Academic Achievement

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Children by nature are curious about their environment. Most teachers believe that Science, as a field of study, is the near-perfect vehicle to help these children understand the world around them (Esler & Esler, 1989). Science concepts are best taught using scientific inquiry approach. It is a systematic approach used by scientists to answer their questions of interest (Lederman, 2009). This approach supported the development of more appropriate understandings of Science and scientific inquiry by encouraging students to ask questions about science phenomena (Haefner & Zembal-Saul, 2004). Furthermore, it stimulates excitement among students for being actively involved in the learning process (Shamsudin, Abdullah, & Yaamat, 2013). In this manner, students better understand how scientists developed the currently accepted body of science knowledge (McBride, Bhatti, Hannan, & Fienberg, 2004).

Mott and Wiley (2009) stated that internet or world wide web-based teaching, of which content management system and learning management systems are parts, generally helps teachers facilitate better their administrative tasks such as distributing documents, making assignments, quizzes, initiating discussion boards, and assigning students to working groups. This made internet-based teaching attractive,

particularly in recent times. Cavus & Alhih (2014) said that it gave birth to modern education that is highly technical-dependent and has redefined the teaching and learning process. In addition, he stated that it is largely applicable to natural sciences as it enabled the representation of phenomena, fostered experimental study, and enabled the creation of models and problem-solving applications.

With the advent of technology in the field of education, several studies have been conducted in line with the use of technology in education. Most dealt on its effectiveness as an instructional tool and majority were conducted among students in higher education. It is in this light that this study was conducted.

This study was done to examine the utilization of technology in teaching Science by determining the students' learning experiences and academic achievement. Utilization of technology in this study deals with the use of a learning management system, Google Classroom, and a content management system, CINCH. Specifically, this study aims to describe the students' learning experiences in a technology-infused approach using the variables instructional design and organization, emotional engagement, behavioral engagement, and cognitive engagement. Furthermore, it aims to describe the

students' academic achievement and how it was influenced by their learning experiences.

Review of Literature

Teaching Science

Science concepts are best taught using inquiry approach (Lederman, 2009). Apart from this, Science as a content-based subject can be taught by integrating it into skill-based subjects such as English (Romance & Vitale, 2001). Another effective strategy in teaching Science concepts is the use of live experiences of students and teachers popularly known as connected Science (Bouillion & Gomez, 2001; Upadhyay, 2006). Questioning or inquiry-based teaching is another key strategy that effectively promotes discussion in problem-based learning such as in dealing with scientific knowledge (Zhang, Lundeberg, McConnell, Koehler, & Eberhardt, 2010; Shamsudin, Abdullah, & Yaamat, 2013). Lastly, for students in the elementary level, the use of direct instruction has been found to be more effective in teaching scientific knowledge as compared with discovery learning approach (Klhar & Nigam, 2004; Cohen, 2008). This part of the review of literature enabled us to determine the appropriate strategies to be used in teaching Science concepts with the integration of technology.

Using Learning Management System and Content Management System in Teaching

Internet or world wide web-based teaching is popularly known as content management system, learning management system, learning course management system, and virtual learning environment. It has benefitted much the teachers on performing their routine or administrative tasks that involve uploading of learning materials and posting of assignments. It became a platform for conducting collaborative activities among students that include online discussions (Mott & Wiley, 2009). With these, the use of internet-based teaching such as the learning management system has become increasingly attractive particularly in recent times. It gave birth to modern education that is highly technical-dependent and has redefined the teaching and learning process. Among the field of studies, it has been widely used in natural

science for natural phenomena in this approach, could be examined without the need to be in its physical state or the need to have the object itself (Cavus & Alhih, 2014).

It also offers flexibilities of time and place, ease of organizing and managing study tasks through the ability to replay and revisit teaching materials, and learn in more visual form (Henderson, Selwyn, & Aston, 2015).

Instructional Design in Learning and Content Management Systems

Learning and content management systems are associated with online learning. Its instructional designs affect the students' engagement with the systems (Rienties, Toeteneel, & Bryan, 2015). A popular instructional design for online learning was generated by Dick and Carey (Dick, 1996). It begins with identifying the instructional goals followed by the development of a criterion-reference assessment to determine the students' progress. Given the instructional goals and criterion-reference tests, the designer is now ready to develop instructional strategies that will help materialized the target goals. Pedagogy relies on the use of high-quality text and, usually, multi-media contents. In online education, Google Docs, Dropbox, and wikis are of primary use in the instructional design activities. These tools allow multiple authors to edit text and owners to manage multiple versions, turning back to previously written work if required. This happens in real time or asynchronously. Collaboration and negotiation are not confined to text. Ideas can be collaboratively created using graphic and mind mapping tools that allow graphic representations of ideas and processes. Beyond this, it may be adaptive to serve the unique learning needs, styles, capacity, motivation, and goals of individual learners. Thus, the instructional design should change and morph in response to individual learners' needs and behaviors.

The next stage of instructional design is the development of an informative evaluation that aims to measure the initial performance of the students and prepare them for summative evaluation. Immediate feedback from the teachers is necessary for the students to track their own performance. The last stage involves

the development of summative evaluation that intends to measure how much the students learned (Anderson & Dron, 2012).

Chen (2014), on the other hand, said that objectivist and constructivist strategies could be used in the design of an intensive online course in the context of the support-based online environment. Objectivist strategies focus on the goals and roles of teachers in teaching while constructivist strategies are the demonstration of knowledge learned by the students.

Online learning platform starts to dominate the higher and postgraduate education, but there seem to be lapses in the instructional design of courses. In the study conducted by Margayan, Bianco, and Littlejohn (2015), they found out that many of the massive open online courses (MOOC) have a low quality of instructional design. This means that there is a need to improve the instructional design of online course to make its implementation more effective.

Students Engagement in Learning Management System and Content Management System

Engagement through online comments on online media is a form of civic participation (You, Lee, & Oh, 2014). Thus, in a classroom setting, online comments and communication among students and teachers are essential for the success of online learning. Current studies conducted in line with this reveal that there are three dimensions on which students engaged in an online learning platform such as those that use the learning management system. These are the cognitive engagement (Richardson & Newby, 2006), emotional engagement (Han & Johnson, 2012; Pentaraki & Burkholder, 2017), and behavioral engagement (Richardson & Newby, 2006).

Instructional designers should also consider the interest, self-efficacy, and self-regulation skills of the learners in designing the contents of a learning management system. The use of online activities and tools such as multimedia and discussion boards may increase the emotional engagement of students but may not necessarily increase their behavioral and cognitive engagements. Teachers, on the other hand, should offer the students strategies for enhancing their self-regulation skills as they deal with learning management system (Sun, 2014). By being actively

engaged in online activities, students develop critical thinking skills in academics and the world of work are enhanced (Resier, 2013).

Students' engagement in the learning management system could be monitored using their activity logs. However, though it may be an effective way of tracking the performance of students, there was no correlation between their log activities and online engagement (Vogt, 2016). On the contrary, discussion fora and assignment activities have a significant degree of correlation to the engagement, motivation, and academic performance of students (Falleiro, 2016). In addition, students' submission of assignments, number of sessions attended, and proof of reading course information packets significantly predict their achievement in online learning platform (You, 2016). Furthermore, the presence of multiple communication channels will strongly correlate to the students' higher engagement in an online learning platform. Such includes communication with student–student and instructor–student (Kahn, Everington, Kelm, Reid, & Watkins, 2017). Though learning and content management systems provide an opportunity for students to learn according to their own pace, teacher interventions still play a significant role to make it more successful (Ladyskewy, 2013; Lwoga, 2014; Chakraborty, 2017). The teachers' presence leads to a positive influence on the students' motivation, affective, and cognitive learning (Chakraborty, 2017). Fostering of a learning purpose, use of scaffolds, and providing opportunities for students to personalize their learning also lead to better engagement of students in online learning platform (Al Mamun, Lawrie, & Wright, 2016).

Emotional Engagement in Learning and Content Management Systems

Emotion is a significant factor in students' engagement in an online learning platform while cognitive and behavioral factors function as antecedents of emotions in online contexts. The inclusion of emotional, cognitive, and behavioral strategies in online teaching can enhance students' engagement and learning experiences in the online classroom (Pentaraki & Burkholder, 2017). However, not all students are able to express and understand the emotions of

other students based on the number of text and audio messages sent during synchronous discussions and therefore, they only develop cohesiveness depending on the management type of interaction provided to them during synchronous discussion session in an online learning environment (Han & Johnson, 2012).

Behavioral Engagement in Learning and Content Management Systems

Behavioral engagement of students in an online learning environment, particularly on the use of learning management system and content management system, is observed through their interaction with one another. Students who are actively engaged in online learning platform outperformed those who do not (Richardson & Newby, 2006). Being actively engaged helps the students gain more experiences from using the learning platform and become more responsible in their learning (Richardson & Newby, 2006). Most likely, the more engaged students are the high achievers. They find the online learning platform more engaging, convenient, and they learn the key concepts better than from the face-to-face classes (Owston, York & Murtha, 2013). This could probably lead to an academic gap between the high and low achievers in the class. To avoid so, a structured representation of online activities should be given to the students for this can influence their meta-cognitive activities and facilitate better understanding (Al Samarraie, Teo, & Abbas, 2013). The teachers scaffolding for interaction in an online learning environment has a significant positive influence on the students' behavioral and emotional engagement (Cho & Cho, 2014).

Cognitive Engagement in Learning and Content Management Systems

Richardson and Newby (2006) defined cognitive engagement as the integration and utilization of students' motivation and strategies while they are learning. They said that as students gain experience with online learning, they come to take more responsibility for their learning. As such, they become more self-regulated as they continue to be in an online learning environment. Opportunities for students to have online discussions and interaction in this mode of learning are critical in constructing new understanding

and knowledge and, thus, improves their cognitive engagement (Zhu, 2006). The effectiveness of online discussion and interaction in an online learning environment to develop critical thinking among students, on the other hand, depend on a balance of task design, facilitation, and scaffolding of their interactions (McLoughlin & Luca, 2000).

Learning Experiences and Academic Achievements of Students

Determining the academic achievement of students in any learning modes is very important for any educational institution. The achievement of students reflects the effectiveness of the implementation of any educational program. Factors that contribute to the improvement of students' academic achievement are important to be considered. According to Ning and Downing (2012), the academic achievements of students in any learning platform could not be directly measured using their learning experiences. It can only be directly measured through mediation of self-regulation skills and motivation of students in the relations between learning experiences and academic achievement. On the other hand, students' motivation along with their learning strategies, cognitive resources, self-regulation skills, and academic achievements are significantly affected by their academic emotions (Pekrun, Goetz, Titz, & Perry, 2002). As such in any learning platform, especially in online learning, quality and variety of interactions should take place. Greater interaction in an online learning environment does not lead to significant improvement on academic achievements of students. However, it has been found that students who interact less in this mode of learning received lower grades (Davies & Graft, 2005). The design of the online course affects the kind and nature of interaction that students experience whether they approach learning in a deep and meaningful manner or not (Garrison & Cleveland-Innes, 2005). The students' expectations on the course are found to be important to the achievement of their goals, which were best predictors of success. Moreover, their experiences with the expertise of the instructors in e-learning along with their counseling and support were best predictors for the learning achievement and course satisfaction in online learning (Paechter, Maier, & Macher, 2010).

The above review of literature enabled us to determine the extent of studies done in line with the learning experiences and academic achievement of students in an online learning platform or technology-infused approach to learning. It provided information on the variables to be examined in this study.

Methods

This study made use of quantitative research design. The respondents were Grade 6 students with a total population of 299. We used the simple random sampling technique in selecting the respondents. The Raosoft Inc. online sample size calculator was used to determine the recommended sample size. The computed sample size of the respondents is 169 with 95% confidence level, 5% margin of error, and 50% response distribution.

The survey tool named, “Open SUNY COTE Online Learning Survey (Spring 2015)” of Dr. Peter Shea (2015) was used to determine the learning experiences of the respondents in using learning and course management systems. Observing the ethical standard of research, permission to participate in the pilot testing of the instrument was gathered from the guardian of each respondent. Only 69 out of 108 target respondents signified their participation in the pilot testing of the instrument. Results of the pilot testing reveal a .88 Cronbach Alpha, which is an acceptable value of internal reliability (Bonett & Wright, 2015). However, using correlation analysis of the items, we found seven uncorrelated items which were then revised for the actual survey. The same procedures were done in line with the participation of the students on the actual survey. Only 72.24% (216) of the total student population participated in the actual survey.

We used the Statistical Package for Social Science or SPSS version 20 in analyzing the data. Descriptive statistics were used to determine the demographic profile of the respondents. Linear regression and correlation analyses were employed to analyze the quantitative data generated from the survey.

The survey tool contains three closed-ended questions that seek feedback from the respondents on the usefulness of Google Classroom and CINCH in studying Science concepts. Responses of the

students were analyzed using content and thematic analyses.

Findings

Data in Table 1 shows that majority of the respondents are 11 years old, 64.40% (150). There were also more male respondents, 50.7% (109), as compared with female. In terms of years of stay in the school, majority of them have been in the school for 5 to 6 years, 49.8% (107). Online resource is not a major concern as well among the respondents for majority of them, 97.7% (211) have online access. Lastly, in terms of academic achievement in Science, majority of the respondents, 38.2% (60), have a grade within 85 to 89.99.

Learning Experiences of Students on using Google Classroom as a Learning Management System and CINCH as Content Management System

Student experiences on using the online learning platforms were determined using the Likert-type frequency scale with 5 as Always, 4 as Oftentimes, 3 as Sometimes, 2 as Seldom, and 1 as Never. The 33 items in the survey tool are clustered based on these themes: instructional design and organization, emotional engagement, behavioral engagement, and cognitive engagement. The instructional design and organization theme has sub-classifications which include instruction, facilitation, and direct instruction. Behavioral engagement includes open communication and group cohesion; and cognitive engagement includes triggering event, exploration, integration, and resolution.

Table 2 shows the summary of responses of the respondents. The mean of the four clusters and their sub-categories was computed. Results reveal that instruction has a mean value of 4.62, facilitation has 4.55, and direct instruction has 4.62. The mean value for instructional design and organization is 4.60. The mean value of emotional engagement is 4.36.

The mean for each sub-category of behavioral engagement was computed. Results reveal that open communication has a mean of 4.41 and group cohesion has 4.25. The mean value for behavioral engagement is 4.33. Lastly, the mean for each sub-

Table 1
Demographic Characteristics of the Respondents

Demographic characteristics	Total Frequency (n=216)	Percentage
<i>Age</i>		
10	39	18.1%
11	150	64.40%
12	12	11.11%
13	2	0.9%
<i>Sex</i>		
Male	109	50.7%
Female	106	49.3%
<i>Years of Stay in School</i>		
1-2 years	19	8.8%
3-4 years	35	16.3%
5-6 years	107	49.8%
7-8 years	54	25.1%
<i>Online Access</i>		
With access	211	97.7%
Without Access	4	1.9%
No answer	1	.5%
<i>Previous Term Grade in Science</i>		
95–100	24	15.3%
90–94.99	46	29.68%
85–89.99	60	38.2%
80.99–84.99	21	13.4%
74.99–80	6	3.8%

Table 2
Summary of Students Responses (n=216)

Dimensions of Online Learning	Mean	S.D.
A. Instructional Designs and Organization	4.60	.45
1. Instruction	4.62	.47
2. Facilitation	4.55	.52
3. Direct Instruction	4.62	.52
B. Emotional Engagement	4.36	.75
C. Behavioral Engagement	4.33	.70
1. Open Communication	4.41	.76
2. Group Cohesion	4.25	.79
D. Cognitive Engagement	4.36	.64
1. Triggering Event	4.30	.80
2. Exploration	4.38	.70
3. Integration	4.43	.68
4. Resolution	4.35	.71

Table 3
Correlation of Students' Demographic Profile and their Learning Experiences (n = 216)

	Correlation Results	p value
Age	-.221	.001
Years of Stay in School	.062	.361
Online Access	-.061	.375
Previous Term Grade in Science	.005	.954

* * correlation is significant at 0.01 level (two-tailed)

category of cognitive engagement was computed. Results reveal that triggering event has a mean value of 4.30, exploration has 4.38, integration has 4.43, and resolution has 4.35. The mean value for cognitive engagement is 4.36. The overall mean of the students' responses to the survey is 4.43.

Relationship of Students' Demographic Profile and Their Learning Experiences in Technology-Infused Approach

A correlation analysis was performed to determine the relationship between the students' age, years of stay in school, online access, previous term grade in Science, and their learning experiences on the technology-infused approach of learning Science with Google classroom as learning management system and CINCH as a content management system. Results in Table 3 reveal that there is a significant relationship between age and the learning experiences of students ($r_s = -.221$, $p = .001$). The direction indicates a negative correlation between the two. However, findings also reveal that no significant relationship exists between the number of years that the students stay in the school and their learning experiences ($r_s = .062$, $p = .361$). With regard to the online access of the students, results reveal that there is a relationship between the two; however, it does not affect each other statistically ($r = -.061$, $p = .375$). The direction indicates a negative correlation between the two variables. In terms of the relationship between the previous term grade of students in Science and their learning experiences, results reveal that there is no significant relationship between the two ($r_s = .005$, $p = .954$).

The academic achievement of the students was determined using their previous term grade in Science. A linear regression analysis was conducted among the sub-categories of the four dimensions of LMS and CMS, and the academic achievement of students. Results in Table 4 reveal that the various dimensions of learning management system and content management system as a form of technology-infused approach do not affect the academic achievement of the students in Science ($r^2 = 8.5\%$, $p = 0.208$). However, Table 5 reveals that Direct Instruction, a sub-category of Instructional Design and Organization, could be a factor in students' learning experiences in using learning management system and content management system that influences their academic achievements ($\beta = 0.295$, $p = .010$).

Discussion

Students Characteristics

Findings in this study reveal that majority of the respondents are 11 years old. Children at this age enjoy interactive activities, especially with the integration of technological resources or gadgets. It is for this reason that using technology as part of their learning activities could be effective and change their attitude towards technology-infused learning. In terms of residency, much of the respondents have been in school between five to six years. This connotes that most of the respondents had been accustomed to the use of technology in learning since it has been the practice of the school for six years. They gained considerable experiences with the online learning environment,

Table 4*Linear Regression Results: LMS and CMS Dimensions as Factors on Academic Achievement of Students*

Factor	Standardized β	Std Error	<i>t</i>	Sig.
Constant		4.63	18.59	0
Instruction	-0.132	0.34	-1.044	0.298
Facilitation	0.002	0.245	0.016	0.988
Direct Instruction	0.295	0.375	2.614	0.010
Emotional Engagement	-0.224	0.314	-1.66	0.099
Open Communication	0.058	0.395	0.512	0.609
Group Cohesion	-0.062	0.292	-0.514	0.608
Triggering Event	-0.04	0.299	-0.288	0.774
Exploration	-0.106	0.388	-0.7	0.485
Integration	-0.012	0.388	-0.078	0.938
Resolution	0.254	0.349	1.684	0.094

R² = .085Adjusted R² = .022

d/f = 10

F = 1.35

Sig. = .208

thus, making them more responsible in their own learning (Richardson & Newby, 2006). On previous term grade in Science, majority of the respondents are in proficiency level, indicating that most of them are averagely performing in the subject. Lastly, majority of the respondents have online access aiding them to become at ease in using online programs. These personal and academic backgrounds of the respondents have been examined in this study to find out its connection to their learning experiences.

Engagement of Students in Technology-Infused Approach

In an online learning platform such as the learning management system and content management system, engagement of students is essential to make their learning experiences meaningful. Results of this study support Pentaraki & Burkholder (2017), on stating that

the inclusion of emotional, cognitive, and behavioral strategies in online teaching can enhance students' engagement and learning experiences in the online classroom. The engagement of students in Google Classroom and CINCH was measured through their behavioral engagement or their online and offline bonding with their classmates, emotional engagement, or their attitude towards online learning platform and cognitive engagement or the opportunities they gain to have a deeper understanding of the lesson through various online learning activities. In the survey conducted, results reveal that behavioral engagement has the lowest mean ($\mu=4.33$) while instructional design and organization has the highest ($\mu=4.60$). Results indicate that the respondents have more meaningful experiences in terms of instructional design and organization of their online learning platforms as compared to their behavioral engagement. It is the part

of the technology-infused approach they experienced in learning Science where teacher-interventions are very evident.

Engagement of Students in Instructional Design and Organization of Technology-Infused Approach

Examining the sub-categories of instructional design and organization dimension, results reveal that instruction and direct instruction have a common mean of 4.62 while facilitation has a mean of 4.55. Design and instruction indicates the significant role teachers play in an online learning platform. It states that teachers should communicate well the important parts of the lesson as well as the learning goals. Moreover, the teachers should be able to explain to the students the ways for them to become more engaged in the lessons and help them become self-regulated by giving reminders about their online and offline tasks. On the other hand, direct instruction describes the teaching style of the teachers. These include the provision of further illustrations, examples, and immediate feedback to help the students better understand the lessons. Since these sub-categories of the instructional design and organization dimension have the highest mean, it only shows that the teachers have successfully performed their role and delivered the science lessons well.

This supports Klhar and Nigam (2004) and Cohen (2008) in stating that students benefit more on direct instruction as compared with other learning approaches. Facilitation as part of instructional design still values the important role of teachers in this mode of learning. It states how the teachers facilitate the lessons amidst conflicts, confusions, and difficulties among students. Having a mean of 4.55 indicates that these were observed by the students on their teachers on most occasions. Instructional design, therefore, affects the students' engagement as stated by Rienties, Toetenel, & Bryan (2015). Pedagogy in online learning should not be confined to text alone but with multimedia contents (Dick, 1996).

Respondents in this study appreciate how the teachers organized the lessons in Google Classroom and the various online teaching approaches used to learn the lessons such as the use of "flipped classroom" where students must watch a video outside class hours then processes it in the classroom. Thus, this affirms

Sun (2014) findings that engagements of students in online learning activities could only be effective in the presence of well-planned instructional design by the teachers.

Emotional Engagement of Students in Technology-Infused Approach

The emotional engagement of students was measured based on the opportunity provided to them to strengthen their relationship with one another. Results of the survey reveal that students had online collaborative activities, and online and offline communications that eliminate the feeling of being "left-behind" that is usually experienced by students involved in an online learning platform. They enjoyed their "class chat" activity where they got the chance to have online interaction with their classmates. This is a situation where students develop cohesiveness in synchronous discussion session in an online learning environment (Han & Johnson, 2012).

Behavioral Engagement of Students in Technology-Infused Approach

The behavioral engagement of students was determined based on their manner of communicating with their classmates and teachers either through the online or offline medium. This dimension has the lowest mean, indicating that the respondents did not experience its presence consistently. Results of the survey reveal that online communication between students to students and students to teachers are inconsistently observed. This part of the online learning platform should be given attention for it forms part of the social interaction of students. Having more engagement opportunities for students to have dynamic communication with one another and with teachers will help them become more responsible for their own learning (Richardson & Newby, 2006; Owston, York & Murtha, 2013). Though this dimension focuses more on the interaction in an online learning environment, the teachers scaffolding for interaction in an online learning environment should be taken into consideration for it has a significant positive influence on students' behavioral and emotional engagements (Cho & Cho, 2014).

Cognitive Engagement of Students in Technology-Infused Approach

The cognitive engagement indicates the opportunity provided to the students to gain a deeper understanding of the lesson using varied and challenging online and offline learning activities. It involves the posting of problems by the teachers that could elicit further motivation, interest, and curiosity from the students about the topics being discussed. It provides opportunities for the students to collaborate among themselves and integrate the new lessons they have learned and had a discussion to formulate solutions to problems posted by the teachers. Opportunities like these allow the students to have online discussion and interaction that are essential in constructing new understanding and knowledge (Zhu, 2006).

These activities were not consistently observed by the respondents and should be given more attention to make the learning experiences of the students in an online learning platform more meaningful. On the other hand, there is the existence of dynamic learning activities that contribute to the cognitive engagement of the respondents. Students consider the uploaded worksheets and handout in Google Classroom as very helpful in learning the Science concepts. The slide presentations of CINCH with comprehensive illustrations were also helpful. They also appreciate the use of Google Forms for assessment that provides immediate feedback about their performance. Furthermore, Google Classroom was highly recommended by the respondents to be used as a learning platform because of its flexibility and ease of use while CINCH was highly recommended for Science lessons because of its informative contents.

Learning Experiences and Academic Achievement of Students in Technology-Infused Approach

The results of correlation analysis to determine the relationship of the students' personal and academic backgrounds to their learning experiences reveal that sex, years of stay in the school, online access, and previous term grade are insignificant factors that affect their learning experiences. On the other hand, results reveal that age has a negative correlation with their learning experiences. This could mean that older students are much observant than the younger ones. As

such, they are more akin to aspire for more dynamic learning experiences than their counterpart.

Results of regression analysis among the sub-categories of each dimension of LMS and CMS reveal that these are not good predictors of students' academic achievement. The learning experiences of the students are not enough to be considered as the only factors that contribute to their academic improvement (Ning & Downing, 2012). On the other hand, results of the regression reveal that direct instruction could be a contributing factor in the academic achievement of the students. This is the part of the technology-infused approach where the teachers assist the students in doing their online and offline tasks and provide additional strategies to make the lesson more comprehensive for them. As such, the support coming from the teachers did contribute to the learning experiences and academic achievement of the students (Paechter et al., 2010).

Results of this study reveal that despite the revolutionary effects that technology gave in the field of education to make teaching and learning easier and fun, teacher interventions still play a significant role to make its utilization more successful (Ladyskewy, 2013; Lwoga, 2014; Chakraborty, 2017). Submission of assignments, the number of sessions attended, and proof of reading course information packets (You, 2016) are not enough to predict the achievement of students in the online learning platform. The presence of teachers leads to the positive influence on students' motivation, affective, and cognitive learning (Chakraborty, 2017).

Conclusion

This study reveals that the four dimensions of the technology-infused approach to learning Science significantly contribute to the learning experiences of the students. Among the four dimensions, it is the instructional design and organization of the learning management system and content management where the students got more meaningful learning experiences.

Furthermore, this study highlights the important role of teacher interventions in improving the students' understanding of Science concepts in an online learning platform. It puts premium emphasis on the significance of well-planned instructional design composed of

varied learning online activities that lead to more engagement of students.

In addition, this study suggests that in integrating technology in the teaching and learning process, the four dimensions should be taken into consideration to make the learning experiences of students more meaningful.

Lastly, this study proves that there is no significant relationship between the learning experiences of the students and their academic achievement. As such, a meaningful learning experience may not necessarily mean a high academic achievement for the students.

Ethical clearance:

The study was approved by the institution.

Conflict of interest:

None.

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