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Teachers' Perceived Usefulness on the Utilization of Mobile-Learning Approach in Teaching High School Biology: A Case from the Philippines

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Abstract: Providing quality learning in science during the onset of the COVID-19 pandemic became one of the quandaries of most secondary schools in the Philippines, especially in remote areas. Likewise, high school teachers at Occidental Mindoro State College (OMSC) despite the prominence of technological learning platforms, have still resorted to the use of printed modules as primary learning modality due to the emergence of digital gap among the learners. Thus, the possibility of addressing the gap through the utilization of m-learning approach in teaching science on a distance-learning set-up was explored. Using a developed mobile-learning modular app (MoLMA) by the researcher, the approach was utilized in one of the Grade-7 Science classes of the institution. Following a descriptive-comparative mixed-method research design, the perceived usefulness of m-learning approach was gathered based on the pre-and post-perception responses of the teacher-users before and after the intervention. A focus group discussion was conducted therein after to gather an in-depth response. Results revealed high positive feedback in the utilization of m-learning before and after the intervention. Though both yielded positive responses, t-test results showed a difference between the areas of instructional delivery, enhancement of learning, and flexibility and convenience. Apart from promoting ubiquitous and personalized learning experience, results of FGD showed its cost- and time-efficiency in teaching biology subjects compared to the modular. Technologically speaking, results showed that m- learning is one of the most adaptive and accessible ways of utilizing technology-enabled learning in science at the onset of pandemic. It is recommended that the effectiveness of the approach in increasing students' academic performance shall be also tested.

Keywords: *Biology, mobile-learning approach, Mobile-learning Modular App, perceived usefulness,*

1. Introduction

The advent of technology in the current educational arena has provided a new horizon for its progress and development. It has shaped the perspective on how learning can be effectively delivered to the learners of the 21st century (Georgieva, Smrikarov, & Georgiev,2004). Though

as widespread as it is, technology adoption and implementation have never been fully realized until the outbreak of the global coronavirus pandemic (Tria, 2020). In the onset of the pandemic, educators all over the world are expected to adopt certain pedagogical approaches and to employ effective solutions in extending learning even from a distance (Zhao, Wu, & Hua 2020) Apparently, as the country gear towards the adoption of online instruction and utilization of digital tools, several challenges and risks have emerged on the surface. This includes increasing technological disparity and decreasing equitable access to education between the fast-developing and slow-developing countries (Winthrop, 2020) Consequently, schools in the Philippines particularly in remote areas have difficulty in accessing stable internet connection. Evidently, not all teachers and students own a personal computer at home (Tria, 2020). Interestingly, however, based on APIS conducted by PSA in 2017, more people in the Philippines have access to a cell phone than to a toilet. It could be noted from the survey that of all the electronic gadgets, cellular phones are the most common household appliance in Filipino homes, followed by television. It was noted that 87% of the sample size have cellular phones. 91% of these families are in the higher- income households and 77.7% of these are low-income families who have at least one cellular phone per household (APIS, 2017). The declining price of mobile phones paved the way for more and more people, including those in remote areas, to own and to use mobile gadgets especially for learning (Keskin and Metcalf, 2011).

These reasons open the possibilities of using mobile phones as a tool for instructional delivery and learning, thus the term mobile-learning. Mobile learning is a form of learning dealing with acquiring and obtaining educational content and information, focused on acquiring cognitive skills, or enhancing learning motivation through digital means in personal pocket devices, including smartphones (Keskin & Metcalf, 2011). Evidently, m-learning became a fast-growing trend in educational settings as the development of mobile technologies has enabled learning on the move. As reviewed, most research pertaining to m-learning provide positive feedback on the enhancement of academic performance of the students all over the world. Not only that, m-learning perspectives promote ubiquitous learning, self- paced learning and lifelong learning (Sharples & Pea, 2014).

2. Review of Related Literature

Research on the use of m-learning in science education has started to gain attention since the year 2000 (Crompton et al.,2016). Several studies across the globe have revealed that the use of mobile phones in secondary science classrooms increased learner's conceptual understanding of the abstract concepts. Mobile technology use enhances students' interest/motivation (Zhai et al., 2018; Chang & Hwang, 2019) , positive reactions (Silva et al., 2018) and collaboration (Fu & Hwang, 2018) .

Ubiquitous experience provided by the approach also of great help particularly, in areas of Ecology and Biology, learning opportunities and experiences can be best shaped in relation to the learner's immediate environment in a specific location and time. (Sharples and Pea, 2014).

Though as promising as it is, as observed, this kind of approach was not yet fully adopted by the Department of Education. Though mandated by the constitution and by the recent curriculum changes, integration of m-learning especially in secondary schools in the Philippines has yet to be examined (Marcial, 2018). Aside from unavailability and technical factors, social factors like teacher resistance on its adoption can greatly affects its implementation. Perception of its importance can be attributed to the adoption of the approach (Aubusson et al., 2009; Cushing, 2011). "*Perceived usefulness is defined as 'the degree to which a person believes that using a particular system would enhance his or her job performanc*e" (Davis, 1989). In the context of e-learning, perceived usefulness is defined by Sun et al., (2008) as the perception of how user sees improvement in learning effects through the adoption of the system. Some educators in the Philippines feel that mobile devices cause too much distraction for learners, and or associate mobile device use during lectures with bad behavior (Ally, 2013). Constrains include instructors' lack of technical knowledge, perception on the use of technology and funds for professional development seminar in educational technology (Herro et al., 2013). And so, it is important for all users and stakeholders to understand the system of mobile learning and the necessary pedagogical skills and competencies it could offer (Marcial, 2018). It has been clearly

proven that positive effects of m-learning in the academe based on several literatures, but its usefulness in the context of distance education is yet to be studied.

Hence, the researcher considered these practical gaps in science education of paramount importance to delve on. Thus, the researcher dwelled on the utilization of m-learning approach in teaching Grade-7 Biology to Junior High School students of OMSC using a developed mobile learning modular app (MoLMA). Specifically, the paper aimed to answer the following questions:What are the pre- and post-perceptions of JHS Science teachers on the use of mobile learning approach in distance education in terms of: Delivery of Instruction, Enhancement of Learning, Flexibility and Convenience and Willingness of Adoption?

- Is there a significant difference between the pre- and post-perception survey of teacher-users on the usefulness of mobile learning in distance education?
- What are the significant experiences of the teacher-users in utilizing m-learning approach in teaching science, particularly in Biology?

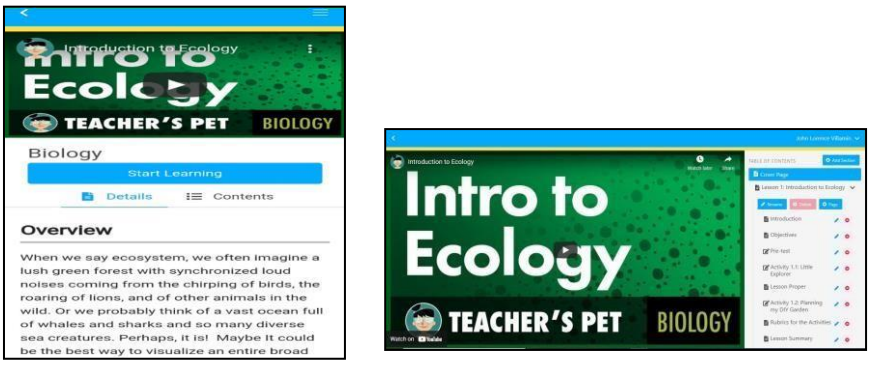
3. Methodology

The study followed a sequential explanatory mixed-method research design in which it involves the use of both quantitative (pre- and post-perceptions survey results) and qualitative (in-depth interviews and focus group discussion) data. an Input-Process-Output (IPO) model was used to describe the undertakings of the study. There are the three main processes that the study sequentially went through. The study started by having a casual conversation with the teachers in the target school regarding the availability of IMs for distance learning set-up. After realizing the absence of such, the researcher decided to review the DepEd Science Curriculum to select the topics to be modularized. The researcher decided to focus on Biology specifically Grade-7 Ecology. Also, reviews on the prominent e-modules and mobile learning apps were conducted prior to this research. The second phase focuses on the development of the app and the implementation of m-learning approach in one of the grade-7 Ecology classes of OMSC.

The application has two major features: first, the downloadable app that can be used and downloaded by mobile android users and can be run by the student's even offline; and second, the alternative learning management system interface added for the creation and uploading of supplemental teaching materials; delivery of instructions; monitoring processes for both teachers and administrators; and flexible communication among the users (see figure 1). The app is considered as hybrid. Hybrid applications are essentially online apps wrapped in a native app shell. Once downloaded from an app store and installed locally, the shell may connect to whatever capabilities the mobile platform gives through an embedded browser in the app content (Dimi, 2017). Prior to the implementation, a pre- perception survey was given to science teachers who digitally observed the process of implementation. After four weeks of implementation, a post-perception survey was given to the observers. This part covers the quantitative scope of the study particularly, descriptive-comparative design.

Meanwhile, the qualitative portion focused on gathering in-depth responses about the learning experience of the students on the perspective of teacher-observers during the implementation. An open- ended questionnaire consists of seven questions tackling the importance and usefulness of m-learning in the different aspects of the teaching-learning process patterned from the NCBTS, 7 domains of learning which is now PPST (DepEd No. 42 s. 2017). Five teacher-observers were invited to an online FGD through zoom. The results from the recording were transcribed, thematically analyzed, and coded using MAXQDA.

Figure 1. User Interface of the Developed App in Both Mobile and Wide-Screen Devices



4. Results

4.1 Demographic Profiles of Teacher Respondents

Part of the process of gathering the pre-perception of the respondents was the collection of their demographic profiles, which were used as a basis in the later results of the study. The demographics include the (1) years of teaching experience, (2) types of learning platforms used in science for distance learning, (3) Utilization of M-Learning Approach before the pandemic, and (4) the extent into which the approach was used.

Table 1. T*eachers' Demographic Profiles*

Description	Category	Frequency
1. Years of Teaching Experience	1 to 3 years	1
	4 to 6 years	1
	7 to 10 years	1
	11 years and above	2
2. Types of Learning Platform/s used in Science for Distance Learning	Printed Modules	4
	LMS	5
	E-materials	4
	Web/Internet	2
3. Utilization of M-learning approach before pandemic	Yes	5
	No	0
	Maybe	0
4. Extent of using mobile learning	Personal Level	5
	In class	0
	In a seminar/ training	0

n=5

Based on the results, most of the respondents are already proficient in their profession having years of experience from 4 to 10 years. Only once is a novice and two are already considered to be highly proficient having 11 years and above experience in teaching. Years of experience can be a contributory factor in technology adoption. According to the study of Andoh (2012) about Factors influencing teachers' adoption and integration of ICT, older teachers frequently use computer technology in the classrooms more than the younger teachers. The major reason could be that the older teachers having rich experience in teaching, classroom management and competent in the use of computers can easily integrate ICT into their teaching. However, further studies revealed that there is no direct relationship between teachers' teaching experience and experience in the use of ICT implying that teachers' ICT skills and successful implementation is complex and not a clear predictor of ICT integration (Granger et. al, 2002). In the second item,

it could be noticed that most teachers do integrate the use of e- learning/digital and printed copy of their modules. All of them also use LMS as main learning platform in their teaching.

Meanwhile, the use of web/internet as primary platform for distance teaching is rarely practiced. This has something to do with weak or poor internet connection in the area. For the third and fourth items, it could be noted that most of them have already experience using the use of mobile devices in teaching however only on a personal level and not during the class discussion. Reasons on how it was personally used was not further explored. Yet, this suggested that all the respondents already recognized the potential use of mobile devices in learning.

4.2 M-Learning Usefulness as Perceived by Teacher-Users

To increase technology adoption and the effective use of its tools, faculty perceptions need to be considered. Positive perceptions among the users means acceptance of the approach. Teachers' perceptions greatly influence students' learning. Learners enjoy more the process of learning when teachers are enjoying the strategies being employed in their classes. With such, a pre- and post- perception survey was conducted to find out whether it changes their perception regarding the usefulness of m-learning approach.

Table 2. *Pre- and Post- Perception Results*

Area	Pre- Average	erception Interpretation	Post Average	erception Interpretation
Delivery of Instruction	4.36	Strongly Agree	4.36	Strongly Agree
Enhancement of Learning	4.12	Strongly Agree	4.76	Strongly Agree
Convenience and Flexibility	4.52	Strongly Agree	4.88	Strongly Agree
Willingness to adopt	4.68	Strongly Agree	4.76	Strongly Agree

Legend: *4.50-5.00-Strongly Agree; 3.50-4.49-Agree; 2.50-3.49-Neutral; 1.50-2.49-Disagre; 1.00-1.49- Strongly Disagree*

The table above prevails the pre- and post- perceived usefulness of m-learning. It can be noted that prior and after the implementation, the average of teachers' perceptions is both positive. Though both the pre- and post- surveys have positive interpretation, there was an increase in the mean rating of some of the areas of the pre-perception results. This includes the *enhancement of learning, convenience and flexibility and willingness to adopt.* Among these three, the Enhancement of Learning aspect has the highest mean rating increase This suggests that the m-learning approach introduced to the class, as observed, and evaluated by the teachers, enhanced the learning experiences of the students in science even from a distance. This supports the second assumption of m-learning where learning becomes more personalized. Students can learn at their own pace and style. This helps them acquire independence and responsibility for their own learning which leads to a strong ownership of learning (Leadbetter, 2005; O'Malley et. al, 2003; Kenny et. al, 2010).

Table 3. *Significant Difference Between Teachers' Pre- and Post-Perception*

	Test	Mean	Std	t-stat	one-tail t-crit	one-tail p-value	Interpretation
Respondents	Pre-	4.42	0.40	-2.56	2.13	0.031	Sig. Diff
	Post-	4.78	0.24				

To find out if there is really a significant difference between the pre- and post-perception responses of the respondents, a paired t-test was used. The table above shows the results of

the aforesaid difference. The p-value of 0.031 is less than the set alpha level of 0.05 which leads to the rejection of the null hypothesis. Therefore, there is a significant difference between the pre- and post- perceptions of the teachers on the use of m-learning after the implementation. Further, the closed proximity between the mean results of the two tests leads to a negative t-stat= -2.555. Nevertheless, it is still higher than the t-crit= 2.132 which supports the rejection of the null hypothesis. Hence, this corresponds to the notion that after the intervention teachers' perception on the usefulness of m- learning becomes even more positive. This is a good start point to evaluate the readiness of the school in infusing such approach in their current set-up

4.3 Results of Mobile Learning Experience Through Focus Group Discussion

The table below shows the thematic analysis of the teachers' responses on the online focus group discussion conducted after the implementation. The table is divided into three columns namely: Theme, Aspects and an example quotation that came from exact words of the respondents. The observation on the use of m-learning were categorically divided on two its usefulness on the learners and it's on the side of the teachers. Additional observations were also added tackling the concerns and hindrances encountered by the teachers while implementing the approach.

Table 4. *Analysis of Teachers' Assessment on the M-learning Approach*

Theme	Aspects	Example Quotation
On the side of the students		
Improved learning achievements	Increased motivation and students' engagement with the subject	'They found the videos really engaging." "There are videos which can be played when the students have access to the internet"
	Highly Interactive	"Mobile app is colorful compared to a plain text making it more realistic and easier to understand unlike the modular approach where the pictures are printed in grayscale or dark-colored ink" "Students become more excited and motivated whenever they use the mobile app.."
	Organization of learning	"Students can see the objectives easily for their specific lesson and click on the desired content unlike the modules that they have turn the page back and forth."
Autonomy and Personalized Learning Experience	Students can monitor their success in learning	'After taking the quiz they can easily check whether they learned the lesson or not because of faster results" "It's easy to give feedback. So, they can easily check their mistakes and the output they haven't submitted yet."
Ubiquitous Learning Experience	Highly Accessible	"The app can be accessed even offline." "what's good about a mobile device compared to other gadgets is highly adaptable. You can download the

		apps and browse the file even offline." "They can easily check concepts by checking their phone. It is easy to bring anywhere"
Adaptability	The App is Suitable to the learners of 21st century	'Learner's today are visual learners; they prefer to watch video rather than reading text from a plain module" "If students could not really understand what is being said in the text, you can watch the video."
Communication	Students Can Reach out their concerns instantly to their teachers. Communication is vital in achieving success in distance education. In the transactional distance theory (TDT), Moore (2007) defines distance education in terms of responsiveness of an educational program to the learners rather than in terms of geographical separation of the teacher to the learners.	"They have the means to communicate easily with their teachers." "It's easy to give feedback through m-learning."
On the side of the teachers		
Efficient Tool for Assessment	Easy Checking of Quizzes, recording and monitoring of students 'performance which makes the grading more fluid and transparent. According to Uribe and Vaughan (2017), instant assessment is critical in distance education set-up due to the asynchronous nature of instructional delivery. An additional effort is required to confirm that students are ready to receive and respond to feedback properly.	"The app done the checking and recording for me.: "I can easily check their output and return it right away. So, it's easy to give feedback." "I can see (easily) if the students are improving, or the scores are getting higher"
Cost and Time Efficiency	The App in mobile is much Easier to operate and to master	"Teachers are not 100% ready for online classes due to unavailability and readiness of the printed modules" "The printing of modules (implemented by most DepEd

		Schools) is very costly and time consuming especially for colored module with so many pages." "The mobile makes it easier for teacher to transfer the modules with less work and money required."
Hindrances and Concerns		
Technical Issues	Freezing and glitching of the mobile devices	"Though minimal, glitching can also interrupt students' learning"
	Lack of internet	"Some areas do not have internet connection and worst have experienced power interruption"
Academic Dishonesty	Authenticity and reliability of students' response in assessments	"Still as of this moment we still lack a specific app that measures the student's academic honesty in answering the test" "Students can use the phone to search for the answers while taking the test" "It requires the presence of internet to check the student's activity on time."

5. Conclusion and Recommendation

Teachers prior to the implementation had already a positive perception regarding the usefulness of m- learning in teaching science from a distance. Yet, it became even more positive after the implementation especially in the enhancement that the approach provided in the learning process of the students. Moreover, a significant change on these perceptions (pre- and post-) were identified when tested statistically. These things are of vital consideration in technology-adoption in education (Ebardo, 2018). Based on their perspectives, m-learning helps in enhancing students' learning in science by providing autonomy and ubiquitous learning experience. M-learning also helps in facilitating faster communication between teachers and students and provide efficiency in assessing students' performance amidst distance. The approach was very suitable to the learners of the 21st century due to their learning styles and familiarity of the technology. These factors are the relevant aspects that one must consider on a distance education backed up by the transactional distance theory (TDT) of Moore (2007). theoretical framework created by Moore. Meanwhile, on the side of the teachers, m-learning is beneficial in decreasing the burden of administrative tasks making it more cost- and time-efficient for the educators. In the end, aside from technical factors, the authenticity of students' responses in the assessment on a distance-learning is still the main challenge that are yet to be solved. With continuous refinement and study, the m-learning has a potential to be a flexible and inclusive learning platform in science on a distance learning set-up.

Since the study is conducted during the earlier phase of the pandemic, health safety of the participants involved and ethical considerations like academic honesty limit the researcher to further investigate its effects on the academic performance of the students in science. Therefore, as the educational system slowly shifts back to the normal face-to-face set-up, it is recommended to implement the approach applying two-tailed analysis using two-group set-up. Moreover, Acceptability among the target users can also be gathered in the long run. In a larger scale, formal integration of m-learning approach in secondary science curriculum in the Philippines must be examined as it offers quality learning experience in delivering Biology lessons to the 21st century learners even from a distance or remote set-up. Its flexibility, accessibility, and ubiquity can also narrow the digital gap among the Filipino learners with diverse economic backgrounds. Future directions of this study will be of paramount importance for science educators to navigate through the intricacies of M-Learning as Philippines slowly reverts from distance to HyFlex to normal learning set-up.

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