Mobile Application Puzzle and Its' Effect to the Learners Learning Outcomes in Earth Science

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Abstract. This study aimed to determine the performance, attitude and interactivity of Grade 11 High School learners in Earth Science before and after the Jigsaw Puzzle Mobile App when utilized as instructional material. This also gathered data on the effect of Jigsaw Puzzle Mobile App and reflections of the respondents. It was conducted at Fisheries and Marine Science High School, Iloilo State College of Fisheries Main Tiwi Campus from August to October 2018. Fifty-two (52) purposively chosen grade 11 learners were the respondents of the study. The quasi-experimental research design was used. Data were gathered using the test, guide questions, attitudinal and reflection. Data were analyzed using the mean and t-test. The result showed that there was an improvement in the performance of the learners as a whole based on their pre-test and post-test scores. The attitude of the learners before the conduct of the study as a whole, as to sex and as to track was "positive" respectively but after the study male and according to the track was "very positive" respectively while a female has "positive" attitude. The interactivity of the learners as a whole was "average", according to sex and track respectively except STEM with "high interactivity". There was a highly significant difference in the performance and the attitude of the learners before and after the jigsaw puzzle mobile app was introduced. The presence of the jigsaw puzzle mobile app in the classroom was found to be useful, enjoyable and challenging. This also let the learners develop their sense of deep concentration, critical thinking skills and psychomotor coordination.

1. Introduction

The introduction of jigsaw puzzle application will become an important educational tool in learning. It makes it possible for students to learn, collaborate, and share ideas among each other with the aid of their smartphones. However, acceptance of this approach among learners and educators will vary. Attitudes towards this mobile application is an essential factor that helps in determining whether or not learners and educators are ready to use this. Such attitudes will serve to identify strengths and weaknesses and facilitate the development of the technology infrastructure. The following variables of interest: attitudes, performance and interactivity in the mobile application of learners when asked to complete the jigsaw puzzle tasks are the reasons why the researcher opted to conduct this study.

This research was anchored on the different learning theories relevant to jigsaw puzzle mobile application—Gestalt Theory which emphasized the importance of sensory wholes and the dynamic nature of visual perception. Learners do not just collect information as is, but they actively process and
reconstruct data in order to understand it. The Information Processing Theory, relating how the mind and the computer work is a powerful analogy. IPT describes how the learner receives information (stimuli) from the environment through the senses and what takes place between them. The learners' brain brings information in, that information is first briefly stored in sensory storage; manipulates it, it will move to the short term or working memory; and stores it ready for future use. It may either be forgotten or transferred to the long term memory.

As to the use of Jigsaw Puzzle Application, the investigation was anchored on Tolman's Theory of Learning. According to him, learning is always purposive and goal-oriented. He has the notion that people are active information processors and not passive learners. Learners do more than merely respond to stimuli, they act on beliefs, attitudes, changing conditions and strive towards goals. It is thought that individuals acquire large numbers of cues from the environment and could use it to build a mental image of the environment. Another theory is the constructivist theory which is a current theory in education and instructional design postulating that learners actively construct knowledge to complete solving and knowledge transfer skills. Technology engaged with this ideology tends to produce results.

2. Methodology
This study applied a quasi-experimental design. This design is an improvement on the pretest-posttest design since it has the advantage of the repeated measurement observation before and after the intervention has been introduced. This study was conducted at Iloilo State College of Fisheries- Main Tiwi Campus, Tiwi, Barotac Nuevo, Iloilo. The ISCOF Main Tiwi has its laboratory School for Junior and Senior High School learners, the Fisheries and Marine Science High School. The respondents of the study were the Grade 11 learners enrolled in Fisheries and Marine Science High School. They were regular students officially enrolled in the first semester of the academic year 2018-2019. Fifty-two (52) or all of the learners completed the puzzle application during the course of the study. When respondents were categorized according to their track, sixteen (16) or 30.77% of them were in STEM, twenty (20) or 38.46% were in HUMMS and sixteen (16) or 30.77% were FET. In terms of sex, thirty-three (33) or 63.46% were male, and nineteen (19) or 36.54% were female.

Development of Computer Program
A mobile application was developed in order to determine the impact when manipulating jigsaw puzzle maps and image. The program presents to the users sixteen map-like jigsaw puzzles to be solved. The puzzle is composed of images based on the lesson. Each puzzle was judged and to be solved when the participant places each piece in a correct location on the mobile screen so that all pieces are joined along the appropriate boundaries. Subjects will have to record their time upon completing each puzzle maps to measure their level of interactivity.

Fig. 1 shows the cellular phone screen that displays the program
The puzzle screen will display this image where learners pressed the green button to start the program while the blue button is used if the teacher wanted other images to be puzzled out by the learners.

![Puzzle Screen](image1)

**Fig. 2** shows the cellular phone screen the first completed puzzle application.

The Puzzle pieces are arranged in two columns and on the left side are the pictures cut in a jigsaw puzzle pieces while on the right side is the exact location of each puzzle pieces. The learner will drag each puzzle piece to the right side of the program window. The puzzle pieces may rotate by tapping it. If the learner attempted to leave a piece in the wrong location, the program would not be completed.

**Fig. 3** shows the cellular phone screen the first completed puzzle application.

![Puzzle Screen](image2)

When all puzzle pieces are correctly in place, the program will confirm that the puzzle is solved with an on-screen message (see Illustration 3). The participant will proceed to the next puzzle. Learners are required to complete the puzzles in the predetermined order, and they will not proceed to subsequent puzzles without finishing an earlier one. The program will record time when subjects finish the puzzle application.
Fig. 4 shows the cellular phone screen of puzzle application from 1 to 16

The Jigsaw puzzle mobile application activity that was used during the course of the study which includes 16 jigsaw puzzle numbered from 1 to 16. The jigsaw puzzle mobile application was reviewed and validated by the five experts in mobile/computer programming. The instruments used to validate the mobile application program was adapted from ISO 9126, the standardized evaluation of software on the mobile application as to functionality with a mean score of 4 (acceptable), as to reliability with a mean score of 4.2 (perfectly acceptable), as to usability with a mean score of 4.8 (perfectly acceptable), as to efficiency with a mean score of 4.2 (perfectly acceptable), as to maintainability with a mean score of 3.8 (acceptable) and as to portability with a mean score of 4.8 (perfectly acceptable).

Description:

5-4.01 = perfectly acceptable
4-3.01 = acceptable
3-2.01 = neutral
2-1.01 = slightly unacceptable
1-0.01 = totally unacceptable

Sampling Technique

In this study, the purposive design was used. This was based on the researchers' knowledge about the study and population. A total population of grade 11 learners of Fisheries and Marine Science High School of Iloilo State College of Fisheries Main Tiwi Campus, were the respondents of this study.

Research Instruments

To gather the data needed for the conduct of this study, the researcher utilized the test and attitudinal.

Test. A 25-item researcher-made multiple-choice test duly validated by the panel of evaluators was used to determine the performance of the subjects before and after the study. The test in the pre-evaluation was the same test given in the post-evaluation. However, there were few alterations or arrangement of items in the options. This alteration was done in order to eliminate familiarity of the subjects on the test items.

The researcher constructed a 50 item multiple-choice test and was pilot tested to the 30 grade 11 senior high school learners of Dumangas National High School. The result of the test was then analyzed. Item analysis was the basis for the inclusion of the test items to compose the 25 items in the instrument. Item analysis involves the item difficulty and the item discrimination adapted from the book of Rosita De Guzman-Santos "Assessment of Learning 1, 2007". In computing for the index of difficulty, the researcher followed:

Table 1. Range of Difficulty Index

| Range of Difficulty Index | Interpretation       | Action                  |
|--------------------------|----------------------|-------------------------|
| 0 – 0.25                 | Difficult            | Revised or Discard      |
| 0.26 – 0.75              | Right Difficulty     | Retain                  |
| 0.77 – above             | Easy                 | Revise or Discard       |

Table 2. Test items with discrimination index

| Index Range | Interpretation                     | Action   |
|-------------|-----------------------------------|----------|
| -1.0 – -.50 | Can discriminate but the item is questionable | Discard  |
| -.55 – 0.45 | Non-discriminating                | Revise   |
| 0.46 - 1    | Discriminating item               | Include  |

Before the researcher constructed the test items, a table of the specification was prepared in order to avoid duplication and to make sure that the test items were representative of every content of the lesson.

Attitudinal. An attitudinal was used in determining the attitude of the grade 11 learners toward earth science. It was composed of twenty (20) items. Five points Likert Scale was used where the respondents were asked to check the column that corresponds to their answers as indicated in the descriptive scale.
with corresponding weight: Almost always (5), generally (4), frequently (3), sometimes(2) and rarely (1). The response "almost always" meant that the respondent is extremely in favour of the idea or situation conveyed by the item "generally" meant that the respondent is in favour of the idea or situation conveyed by the item. "Frequently" meant that the respondent is unsure of the idea or situation conveyed by the item. "Sometimes" meant that the respondent is not in favour of the idea or situation conveyed by the item. "Rarely" meant that the respondent is extremely not in favour of the idea conveyed by the statement. The attitude of the learners in the pre-test and post-test was described using the following scale:

Highly Positive : (61 – 75) Fair : (31 – 45) Highly negative : (0 – 15)
Positive : (46 – 60) Negative : (16 – 30)

The validity of the Instruments

To ensure the validity of the instruments used in this study, a panel of validators which were selected were expert in the field of earth science, research, curriculum and administrator. They checked the instrument as to its content and face value. The validity of the instrument was determined if it measures what it intends to measure.

After the validation process, all the corrections, comments and suggestions were incorporated and came up with the final draft and reproduced it as to its desired number of copies. These instruments were pilot tested to the grade 11 students of the Dumangas National High School, Dumangas, Iloilo, to find out the applicability and suitability of the questions.

The reliability of the test was also determined using the split-half method. In Split-half consistency approach, the scores from the single test were divided into two equal parts and correlated. It involves scoring of two halves, usually odd items versus even items of a test separately for each person and then calculating a correlation for two sets of scores. The correlation between the two halves of the test was computed using Pearson r, and the half-test reliability was determined using the Spearman-Brown formula. The index of difficulty and discrimination were computed. The test items with the difficulty index of 0.00-0.25, which is described as the right difficulty were included in the instrument.

Data Gathering Procedure

Before the conduct of the study, the researcher sought approval of the SUC President II, the Dean of the College of Education and the Principal of the Fisheries and Marine Science High School. The researcher secured the official list of Grade II learners enrolled for the First semester of 2018-2019.

The data needed for this study were gathered using the following:

Administration of pretest and posttest.

The result of the pre-test and post-test were the data needed to describe the performance of the learners who were exposed to the jigsaw puzzle mobile app. The performance of the learners in the pre-test and post-test was described using the following:

0-5 : Very Low 11-15 : Average 21-25 : Very High
6-10 : Low 16-20 : High

Administration of the Attitudinaire.

An attitudinal was administered before and after the exposure of the learners to the jigsaw mobile application. It intended to measure the attitude of the learners towards Earth Science. Before the start of the experimental period, the learners were asked to tell their sentiments about the subject. The same attitudinal was given to measure their attitude towards the subject after they were exposed to the use of the jigsaw puzzle mobile app for instruction.
Gathering Ideas and Opinions. 
Ideas and opinions on the use of mobile app in instruction were gathered using the Focus Group Discussion (FGD). It was conducted after the experimental period. Half of the subjects from each group were considered as participants in the FGD.

Conduct of the Experiment.
The study was conducted for six weeks, equivalent to 18 meetings. It started on the first week of August 2018 until the second week of October 2018. One class period utilized the jigsaw mobile application as an aid in instruction.

Gathering of Reflections.
Every end of the class, the subjects of the study were asked to write their reflections. The researcher explained that their reflections should include what meaningful learning they had achieved about the lesson, what good practices or values they had learned for that particular day, and how would they apply these learning in their day to day activities. The researcher checked the individual reflections by affixing her signature on the notes of the learners. The researcher required the learners to submit their individual reflection.

Data Analysis Procedure
The following statistical tools were used in analyzing the data gathered:

The Mean.
The descriptive statistics used to determine the level of academic performance of the respondents during the pre-test and the post-test.

The t-test.
The t-test is a tool to compare two means, the means of two independent samples or two dependent groups before and after the treatment. Ideally, the t-test is used when there are less than 30 samples, but some researchers used the t-test even if there are more than 30 data samples.

In this study, the t-test for independent samples was used to determine the significant differences in the performance of both groups before the study, after the study, and in the formative evaluation. The t-test for dependent samples was used to determine the significant differences in the performance of two groups before and after the introduction of the jigsaw puzzle mobile application. The data for the inferential statistics were processed through the IBM Statistical Package for Social Sciences (SPSS) 20 software and set at a 5% level of significance.

3. Result and Discussion

Descriptive Data Analysis

Performance of the Learners as a whole and when classified as to Sex and Track before the study.
Table 3 presents the performance of the learners as a whole and when classified as to sex and track. The result revealed that the performance as a whole, according to sex and track was "low" respectively. As a whole, the mean score was 8.0577, when classified as to sex, male had mean score of 7.7273 while female had a mean score of 8.6316. When grouped according to track, STEM had mean score of 8.8125, HUMMS had 6.1500 and FET had 9.6875. This indicates that learners' performance was low due to the unfamiliarity of the topic and lesson to be discussed.

Table 3. Mean Result on the Performance of the Learners classified as a whole and according to sex and track before the study

| Group   | Mean Score | Description |
|---------|------------|-------------|
| Whole   | 8.0577     | Low         |
| Sex     |            |             |
Performance of the Learners as a whole and when classified according to Sex and Track after the Study.

Table 4 presents the performance of the learners as a whole and when classified as to sex and track. The result showed that as a whole the performance was "average" with mean score of 11.0192 when classified as to sex, male was "low" with mean score of 10.9394 and female was "average" with mean score of 11.1579. According to track, STEM and FET were average, while HUMMS was low with the following mean scores: 11.5625 and 12.2500 and 9.6000 respectively. It is expected that the performance of the learners will increase after the conduct of the intervention, which is the jigsaw puzzle application. There was a bit of increase in the performance of the learners with a mean difference of 3.1002 from the result before the jigsaw puzzle application was introduced. Likewise, learners were more participative and eager to learn while the class was ongoing. They were very active in doing the activity especially using their mobile phones doing the jigsaw puzzle in each and every activity and topic. This was supported by the feedback given by the majority of the learners that integration of technology in the form of a game really helped a lot in their learning process. According to the study of Ekaterina Pechenkina et al. (2017), a mobile learning app that uses game elements such as leaderboards and digital badges may have positive effects on student academic performance, engagement, and retention, according to a new study. Researchers developed a fully customizable app that allowed lecturers to push quizzes based on course content directly to their students' devices in order to motivate them, increase their competitiveness, and keep them engaged with the course.

Table 5 presents the performance of the learners before and after the intervention of the jigsaw puzzle mobile app. The result revealed that the subjects' performance was "low" as shown by the mean of 8.0577 before the intervention; but after the study, the post-test revealed that the subjects' performance was "average" as shown by the mean score of 11.0192. It has a mean gain of 3.1002, which shows an increase of 73.14 % from the pre-test. There were studies that teaching using discussion strategy purely may find boring, and once the students get bored, learning is not well delivered.
Table 5. Mean Result on the Performance of the Learners before and after the study

| Group   | Mean Score | Description |
|---------|------------|-------------|
| Pre-test| 8.0577     | Low         |
| Posttest| 11.0192    | Average     |

Description:
- 0-5 Very Low
- 6-10 Low
- 11-15 Average
- 16-20 High
- 21-25 Very High

The attitude of the Learners as a Whole and when grouped according to Sex and Track before the study

Table 6 presents the attitude of the learners as a whole and when classified as to sex and tract. The result revealed that the attitude of the learners before the conduct of the study as a whole, as to sex and as to track was positive, respectively. The mean score as a whole was 55.3077, male was 56.3333 and female was 53.5263, and as to track, STEM was 56.0000, HUMMS was 53.0000 and FET was 57.3077.

The result of the recent study is in conformity with the investigation of learners' attitudes towards studying science which has been a substantive feature of the work of the science education research community for the past 40 years. Development of positive attitudes towards science, scientists, and learning science, which has always been a constituent of science education, is increasingly a subject of concern. According to Oludipe (2008), what has remained the main focus of great concern in the field of science education are the biases and misconceptions about women and science. Many kinds of research had been carried out on gender issues with mixed reports in science education. Girls are being encouraged and sensitized into developing positive attitudes towards science.

Table 6. Mean Result on the Attitude of the Learners as a whole and according to Sex and Track before the study

| Group    | Mean Score | Description |
|----------|------------|-------------|
| Whole    | 55.3077    | Positive    |
| Sex      | 56.3333    | Positive    |
| Male     | 53.5263    | Positive    |
| Female   | 56.0000    | Positive    |
| Track    | 53.0000    | Positive    |
| STEM     | 57.3077    | Positive    |

Description:
- 0-15 : Very Negative
- 15-30 : Negative
- 31-45 : Fair
- 46-60 : Positive
- 61-75 : Very Positive
- 76-90 : Highly Positive

Attitudes of the Learners as a Whole and classified as to Sex and Track After the Study

Table 7 presents attitudes of the learners as a whole and classified as to sex and track after the conduct of the study. The result revealed that the attitude as a whole, male and according to tract was "highly positive" respectively this was shown by the mean score of 61.7308, 63.0000, 62.5625, 61.6000 and 61.7308 while a female has "positive" attitude with mean score of 59.5263.

The result is in agreement with the findings of Depalao and Mclaren (2006), which revealed that improving attitude can increase learning. Likewise, Erdimir & Bakirci (2009), found that attitude does not remain the same, but they change in the course of time and gradually. This study showed that there was a change in the attitude of the subject except for female which was positive, but there was an increase in the mean score of 6 points or increase of 89.92% in their attitude. Therefore, learner's attitude towards earth science will determine his/her eagerness or repulsiveness in this subject. Furthermore, the intervention of jigsaw puzzle mobile application in this study enhanced their understanding of the lesson and were much more motivated to enjoy the lesson.
Table 7. Mean Result on the Attitude of the Learners as a whole and according to Sex and Track

| Group  | Mean Score | Description      |
|--------|------------|------------------|
| Whole  | 61.7308    | Highly Positive  |
| Sex    |             |                  |
| Male   | 63.0000    | Highly Positive  |
| Female | 59.5263    | Positive         |
| Track  |             |                  |
| STEM   | 62.5625    | Highly Positive  |
| HUMMS  | 61.6000    | Highly Positive  |
| FET    | 61.7308    | Highly Positive  |

Description:
0-15 : Very Negative  31-45 : Fair  61-75 : Highly Positive
16-30 : Negative      46-60 : Positive

Attitude of the Learners Before and After the conduct of the study

Table 8 presents the attitude of the learners before and after the conduct of the study. The result showed that during the pre-test, learners' attitude was "positive" with mean score of 55.3077 and after the conduct of the intervention data revealed "highly positive" with mean score of 61.7647, there was a mean difference of 6.457 with 89.55%.

The outcome of this recent study was in favour of the statement of Fasakin (2012) who recognized attitude as a major factor in a subject choice. He also considered attitude as a mental and natural state of readiness, organized through experiences exerting a direct influence upon the individual's responses to all objects and situation with which it is related. Erdemir and Bakirci (2009) also described the attitude as a tendency for individuals who organize thought, emotions, and behaviours towards the psychological object. The study of Parreño (2017) revealed that a change in the attitude of the students before the start of the study and after it had been terminated. Though changes can happen any time, yet changes noted were still positive. The positive and highly positive attitude of the learners toward earth science was also reflected in their journals when they claimed that they enjoyed the class, especially using the jigsaw mobile application as the intervention. The use of this mobile application gives them the reason for doing their activity at the same time participating actively during class discussion. The positive and highly positive attitude was also noted by the observers during the observation period.

Table 8. The attitude of the Learners Before and After the Study

| Group   | Mean Score | Description      |
|---------|------------|------------------|
| Pre-test| 55.3077    | Positive         |
| Posttest| 61.7647    | Highly Positive  |

Description:
0-15 : Very Negative  31-45 : Fair  61-75 : Highly Positive
16-30 : Negative      46-60 : Positive

Mean Result on the Interactivity of the Learners as a Whole and according to Sex and Track

Table 9 reveals the interactivity of the learners as a whole and according to sex and track using the jigsaw mobile application. The result revealed that there was average interactivity as a whole with a mean score of 38.6923 seconds, according to sex and track with a mean score of 39.7576 seconds, 36.8421 seconds, 40.1500 seconds and 46.2600 seconds respectively except STEM with high interactivity with a mean score of 29.3125.

This study agreed with the findings of Lee et al. (2015) in their research which confirmed that perceived interactivity is positively correlated with mobile phone usability. The importance of continued use will also emphasize the extent to which subjects repeatedly return to the same application for performing various tasks according to Furner et al. (2014) when he introduced the concept of 'stickiness' to mobile
The present study revealed that there was high and average interactivity among the subjects that gave them the interest to participate during the course of the study. (Kuo, W. H., & Tsai 1986)

Table 9. Mean Result on the interactivity of the learners as a Whole and according to Sex and Track

| Group | Mean Score | Description      |
|-------|------------|------------------|
| Whole | 38.6923    | Average Interactivity |
| Sex   |            |                   |
| Male  | 39.7576    | Average Interactivity |
| Female| 36.8421    | Average Interactivity |
| Track |            |                   |
| STEM  | 29.3125    | High Interactivity |
| HUMMS | 40.1500    | Average Interactivity |
| FET   | 46.2500    | Average Interactivity |

Description:
0-32 Seconds: High Interactivity
33-57 Seconds: Average Interactivity
58-82 Seconds: Low Interactivity

Inferential Data Analysis

The difference in the Performance of the Learners Before and After the conduct of Jigsaw Puzzle Mobile Application

Table 10 presents the t-test result on the difference in the performance of the learners before and after the jigsaw puzzle mobile application was introduced. The t-test for dependent samples showed that the t(52) = 15.413, p(.000) ≤ .05 before and t(52) = 27.146, p(.000) ≤ .05 after the jigsaw puzzle mobile application was introduced, which means that there was a significant difference in the performance of the learners before and after the jigsaw puzzle mobile application was used as an intervention on the conduct of the study. Thus, the null hypothesis that there is no significant difference in the performance of the learners before and after the use of jigsaw puzzle mobile application is rejected. This result implied that at the beginning of the study, the respondents had different levels of performance as to their knowledge of Earth Science. (Komiya, N., & Eelss 2001)

This result confirmed the findings of Bayogos (2016) that there is a significant difference in the performance of student teachers on multimedia technology which means that the student teachers were more proficient in making audio-visual instructional materials like movie maker application followed by visual instructional materials like PowerPoint presentation application and wavepad application. (Johnson, L. R., & Sandhu 2007)

Table 10. A T-test on the difference in the performance of the learners before and after the jigsaw puzzle mobile application

| Group | df  | n  | Mean Score | t-value | Sig (2-tailed) |
|-------|-----|----|------------|---------|----------------|
| Pretest| 51  | 52 | 8.0577     | 15.413  | .000           |
| Posttest| 51  | 52 | 11.0192    | 27.146  | .000           |

The difference on the Attitude of the Learners Before and After the Jigsaw Mobile Application

Table 11 presents the t-test result on the difference in the attitude before and after the conduct of the jigsaw puzzle mobile application. The attitude before the t-test for dependent samples showed that t(52) = 43.933, p(.000) ≤ .05 learners' attitude before and t(52) = 54.400, p(.000) ≤ .05 learners' attitude after the conduct of jigsaw mobile application, which shows that there was a significant difference. Thus, the null hypothesis that there is no significant difference in the attitude of the learners before and after the use of jigsaw puzzle mobile application is rejected. This means that the attitude of the learners towards Earth Science were not the same before and after the conduct of the study. (Hayes, R. L., & Lin 1994)
This result confirms with the findings of Crawley and Koballa (1994), which says that "a person's attitude towards any object is a function of the beliefs and the person's hold about the object and the implicit evaluative response associated with those beliefs". The positive and highly positive attitude of the students before and after the conduct of the study in Earth Science greatly affected their attitude because of the intervention of the jigsaw mobile application which means that the teaching-learning activity nowadays must be integrated with a mobile application or other instructional materials that would satisfy learners' eagerness to learn (Bass 1985).

Table 11. A T-test on the difference in the attitude of the learners before and after jigsaw puzzle mobile application

| Group            | df | n  | Mean Score | t-value | Sig (2-tailed) |
|------------------|----|----|------------|---------|----------------|
| Attitude Before  | 51 | 52 | 55.3077    | 43.922  | .000           |
| Attitude After   | 51 | 52 | 61.7647    | 54.400  | .000           |

Qualitative Data Analysis

Result of the Use of the Jigsaw Puzzle Mobile App in Instruction

The reflections of the learners were made after they have finished the lesson and puzzling out the Jigsaw Puzzle from one (1) to sixteen (16) puzzles. These puzzle pieces include the following topics: 1. Pangea 2. Continental Drift Theory 3. Plate Tectonic Theory 4. Sea-Floor Spreading 5. Plants, Animals and Fossils Evidences 6. Types of Crust 7. Heat Transfer and 8. Plate Boundaries. (Bass, B. M., & Avolio 1993)

For the respondents, this lesson made them realize that the Earth was one Land Mass based on the theory of Pangea, but it was divided due to the movement of plates that was supported by the plate tectonic theory and the continental drift theory. (Gareis 2012)

Here are some of the learners' reflections:

*The jigsaw puzzle is one of the fun apps. That can help us student to learn more about our lessons. It helps us to have fun while learning. It is a very nice idea to do such a thing. It helps the student to have an interest in their topic. It makes you stretch your mind and have a very good focus in our doings. In the beginning, there are so many pieces, and it is hard to figure out where to start. But you create a plan and start the journey. Many people start a puzzle by doing the outside pieces first. Some will sort the pieces there are, it all started when the first piece in place and the puzzles gets put together one piece at a time. The journey of solving a puzzle sounds a bit like a life journey in that way, doesn't it? Sometimes you're working on a section and can't find the piece to complete that particular section. It can be very frustrating. You shuffle and shuffle the pieces, but you just can't find the special piece. I find it funny that just when I've pretty much given up, the piece seems to reveal itself. But why did I work so hard to find the single piece? Why did I let it cause frustration? The truth is that the piece was there all along, and if I just been patient, I could have had the same result without frustration. Does that sound a bit like life? Doesn't it? Sometimes we push and push for the desired result. We're attached to an outcome. We can't wait. We get frustrated at the lack of results...and then "it's just happening". The answer was there all along, but until we let go, until we surrender, the answer was there all along, but until we let go until we surrender, the answer just doesn't seem to come. Until it does. But frustrations did not hinder my desire to finished the 16 puzzle pieces. Until I've done it all, I have learned to be patient. (SS1, SS7, SS8, SS9, SS10, and SS16)

Whenever I play the puzzle I felt entertained, and I must say that a puzzle is really filed in me as a student, it gave me fun. I feel like I also puzzle every piece of my life. I felt excitement inside me whenever I puzzled/solved it perfectly. As time runs, I suddenly felt that I must/ need to solve it hurriedly to measure...*
my speed. This puzzle also improves my critical thinking and as well as my speed in terms of puzzling. At the same time, my psychomotor skills in dragging the puzzle to its correct location. (SS4 and SS5)

I have learned on those puzzles is all about the topics on earth science which includes the one landmass and turns into different continents. This activity certainly makes me think that science is very good, need to the prior subject, and at the same time it opens up my mind and my heart to love the subject, the earth science. (SS3)

I’ve learned a lot from this activity, such as the continental drift and plate tectonic. The historical events that formed our continents, the geologic time scale where fossils came from, the sea-floor spreading. I enjoy this activity and I love this subject and topics covered in this study. (SS11)

At first, I find it difficult to puzzle up the activity, and it is somewhat complicated because they have the same shape. But in the middle and the last part of the activity, I find it easy and fast to puzzle up each activity. I love doing this puzzle activity, and it makes me feel cool doing this. I have learned a lot from doing this activity. I enjoyed a lot, but I already finished 16 puzzle activity, and I am not satisfied because I wanted more puzzles on this activity.

A puzzle can challenge us mentally, makes us confused to understand difficult shapes. It depends on us on how we are going to solve to find solutions. I learned a lot about the activity given to us, such as how to solve and arrange puzzle pieces. How the different plates were formed and formation of the continents. I did enjoy the time in answering each activity. Wherein I tried to answer each puzzle activity for the shortest time possible. Having this activity makes our learning more fun, quite nervous due to the given time and lastly, I enjoyed a lot. (SS12 and SS14)

Jigsaw puzzles are one of the great sources of entertainment because this kind of activity is so challenging and exciting. It helps to improved my mental speed and develops critical thinking. When I solve or complete one puzzle, I feel accomplished, which boost my self-esteem and confidence. This activity is very commendable to us Grade 11 students wherein we can learn independently and in this technological world for millennials like us. (HS10 and HS12)

I like this jigsaw puzzle activity because it is very much challenging. I’ve learned an in this activity such as the Gondwanaland and Laurasia, fossil, animals and plant pieces of evidence that found in the different continents which prove that the Earth is composed of one landmass, but due to the movement of plates, it turns into different continents. I also find that this activity is a "stress reliever" which teach us how to move, decide, think a lot, understand and be responsible for finishing each and every activity. (HS9 and HS16)

A jigsaw puzzle is excellent brain training and coordination. Working, doing or answering the given jigsaw puzzle by our teacher helps me develop my abilities to reason, analyze each given picture, sequence, deduce, logical thought processing and problem-solving skills. Basically, it becomes my brain teasers that stimulates my mind that makes me thinks very well. (HS1, HS4 and HS8)

The jigsaw puzzle is an effective means to encourage the students like me to think critically, and it makes us naturally curious with a powerful intrinsic motive to challenge and test our knowledge towards the subject, Earth science. Specifically, I was a student of FMSHS Grade 11 under the HUMMS track, I acquire new knowledge and eager to answer or puzzle up each activity. I enjoyed a lot, and I was challenged in each and every puzzle due to the given time. I was endured and very persistent to finished each puzzle pieces. I feel an enormous accomplishment when I have completed the puzzle. I developed a sense of success and satisfaction from this activity and learned to be independent while doing the task.
given by our professor. I am very much happy to have this jigsaw puzzle as an instructional technique used by Prof. Rizza Gumbao. (HS2, HS11, HS13 and HS20)

In this activity, I feel relax, helps me discover and understand about topic in earth science. During the course of the study I develop a deep concentration, clear about some complicated topic on earth science. (HS5)

This jigsaw puzzle mobile application teaches us how to move decide, think, understand each activity shows in the mobile phone screen. It is very advantageous because you can review the topics you least understand as explained by our teacher. This activity can be done anytime and anywhere because it is already installed in your mobile phone. (HS6, HS8 and HS17)

In this activity the Jigsaw Puzzle, when I start the first activity, I am very eager to finish and proceed to the next level of the puzzle application. When I have already done the 16th level of the puzzle, I tried to open the previous activity to test my mental ability if I can shorten my time based on the first attempt I have done. As I go through with the activity, I learned to focus on what I am doing in order to understand the lesson much better. (FS3, FS7, FS11 and FS14)

This jigsaw puzzle activity makes me eager and excited to beat time in order to complete each activity. The good thing with the jigsaw puzzle is that it helps develop our mental ability and keeps our brain active in doing each activity. A combination puzzle or also known as sequential move puzzle which consists of six puzzle pieces can be manipulated into a different combination. As I put each piece together, a certain image of the over-all picture formed. It became my entertainment during my free time because it is already installed on my mobile phone. (FS1, FS7 and FS9)

The Jigsaw is a fun and engaging teaching strategy in teaching earth science. In the beginning, the puzzle pieces were hard to figure out, but later I developed my own technique to finish the activity on my desired time or less. There are no shortcuts because each activity will be opened if you have unlocked the first one. (FS3 and FS10)

Jigsaw Puzzle Mobile Application is suited to our age. Putting puzzle pieces together resulted in a bigger picture which is a good test for my memory. This activity encourages student-led and student-centred learning. (FS16)

The jigsaw puzzle mobile app is an appropriate teaching instructional materials used by the teacher to help us take ownership of the learning process. This is a fun and engaging teaching-learning tool that is used in teaching some topics in earth science. (FS5 and FS13)

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4. Conclusion

Based on the findings, the following conclusions were drawn:

1. Before the study learners' performance was low in all variables tested. This means that the learners were not yet familiar with the topics covered in the study. This is supported with the theory of constructivism, which states that the learner is an information constructor. People actively construct or create their own subjective representations of objective reality. New information is linked to prior knowledge; thus mental representations are subjective.
After the study learners' performance increased when all variables were tested; therefore, the use of the intervention or the Jigsaw puzzles mobile application help increase the performance of the learners. This is related to a programme theory which explains how an intervention (a project, a programme, a policy, a strategy) is understood to contribute to a chain of results that produce the intended or actual impacts. (Funnell, S., & Rogers, P., 2011)

There is an increase in the performance before and after the conduct of the study. Therefore, learners learn best if there is something to be involved or used in order to have a positive influence to the learners. This is supported by Gestalt Theory of learning which emphasized the importance of sensory wholes and the dynamic nature of visual perception. Learners do not just collect information as is, but they actively process and reconstruct data in order to understand them better.

The learners have a positive attitude towards earth science before the study. Therefore, they were open with the things to be used during their lesson or a change in classroom instructional materials. Kübler-Ross (1969) stated in his study that reaction to loss occurs through a sequence of different emotions. Some have even argued that emotions are not discrete but exist as sequences or transitions of affective states (Ortony & Turner, 1990) or as a process in which a sequence of multiple emotional signals are compared and evaluated (Scherer, 2001).

Learners' attitude towards earth science had improved for they learn to love the subject. Therefore, the use of intervention greatly affects not only the learners' performance but also their attitude. This idea agreed with the theory of operant conditioning, positive reinforcement that involves the addition of a reinforcing stimulus which is the Jigsaw. A favourable outcome or positive behavior occurred within the experimental subjects such as the grade 11 students, that particular response or behavior will be strengthened and generate an increase in attitude.

Improvement in attitude towards earth science is comparable. Therefore, exposing the learners in the use of jigsaw puzzle has developed positive attitude such as confidence, determination and accepting failures. According to construct theory, emotion is experienced along dimensions of construing first about invalidation of the self and second about the familiarity of the situation (Kelly, 1955, 1963; McCoy, 1977).

Learners' interactivity in the jigsaw puzzle is average. Therefore, they were very particular and manipulative with the use of the mobile phone. This game is familiar with them for the reason that they could easily grasp with the activity given. The conversational learning theories stated that learning is in terms of conversations between different systems of knowledge (Sharples, 2002) which focus on interaction and doing the activity via mobile phones.

Bringing the instructional technology in the classroom has helped the learners understand better lessons in earth science. Therefore, students' performance is greatly affected by the use of the intervention, which is the jigsaw puzzle mobile application.

There is a positive effect on learners attitude if they will be given a chance to learn the other way. Therefore, this intervention will develop a good result among learners.

Lessons in earth science were applicable and useful for learners daily living wherein the jigsaw mobile application could serve as their stress reliever, for future use and in conserving energy, especially for the Earth science teachers. Therefore the activities conducted improved their motivation, enhanced their self-confidence and developed their critical thinking and psychomotor skills. As a whole, this is a fun and engaging teaching instructional strategy for Grade 11 in Earth Science subject.

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