Utilization of Stellarium-Based Activity: Its Effectiveness to the Academic Performance of Grade 11 STEM Strand Students

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Abstract. This study was carried out to understand and bring to fore if a simulation-based activity is effective on the academic performance of the students which has a general outlook to enhance meaningful science learning. This study focused on effectiveness of the stellarium-based activity on the academic performance of Grade 11 STEM Strand students of Sotero B. Cabahug FORUM for Literacy, School Year 2017 – 2018. The respondents of this study were composed of 28 students. The data pointed out that data analysis results shows that by conventional criteria, the differences of the scores on the different competencies is considered to be extremely statistically significant Results revealed that the stellarium-based activity is effective in teaching the cycles of the sky. Statistical results showed that the academic performance of the respondents improved when taught using the stellarium-based activity. Thus, it is best to learn astronomy using simulations. Computer simulations have demonstrated the potential to facilitate this process by highlighting students' misconceptions and presenting plausible scientific conceptions. From the results, students are recommended to use stellarium, where the process often involves open-ended investigations into a question or a problem, requiring them to engage in evidence-based reasoning and creative problem-solving, as well as problem finding. Furthermore, science educators are encouraged to use stellarium in teaching the cycles of the sky and as anchors of the future teachers must always come equipped for these challenges charged on them, thus engaging students to learn and develop the potentials needed from them to take part for the betterment of today's world. Most importantly, future researchers are commended the development of a localized stellarium-based activity will greatly affect the academic performance of the student will surely boost their interest in learning astronomy education.

1. Introduction

A hurdle to effective astronomy education in schools is often the lack of ready-to-go teaching materials [5]. Teaching astronomy in the 21st century education requires relevant materials with effective use and implementation so that meaningful learning will occur, thus, unleashing students' potential towards the concept, boosting their engagement in learning, and applying the knowledge into skills.

Given the fact that astronomy deals with the study of celestial objects and phenomena that originates outside the Earth's atmosphere then effective astronomy education can be achieved by using applicable simulations. Computer simulations make these types of interactive, relevant, authentic, meaningful learning opportunities possible. Stellarium, a computer program, is one of the applicable and relevant teaching resource that can be utilized to teach the basics of astronomy.

Broadly defined, computer simulations are computer-generated dynamic models that present theoretical or simplified models of real-world components, phenomena, or processes. They can include animations, visualizations, and interactive laboratory experiences [2].

It is reported that today we are rapidly approaching an era in which the majority of the world's information is digitally stored and searchable. Schools have arguably been affected by technology less than any other aspect of society. In certain respects this is appropriate; schools are conservative institutions, so will be less subject to fads and shifting educational cycles [3]. However, it is clear that the digital revolution is anything but temporary - it is a permanent change that is affecting all of society.

Being a major country in the Southern Asia, Philippines can play a vital role in astronomy. Together with the United Nations Educational, Scientific and Cultural Organization (UNESCO), in 2009, the International Astronomical Union (IAU) declared it to be the International Year of Astronomy (IYA) with which a global program for space education was launched in participation of more than a hundred nations. In fact the IAU have prompted a decadal blueprint in promoting public awareness in accordance with astronomy especially in developing countries. However, despite taking part in the International Astronomical Union 2009 Celebrations, the impingement of the IYA touched only few individuals in the urban areas on the Philippines. The general public and even the major parcel of the academia was oblivious to the latter events of the IYA. With this regard, the country have missed a huge juncture for developing space education [7].

Aside from being one of the underdeveloped fields in the Philippines, the country itself as well is crawling when it comes to astronomy education, and research and development for a science which is both highly technological and at the same time galvanic given that there exists only few astronomers in the field and are mainly done by the physics departments of different universities.

Despite adversities, there is a steadily incremental interest in astronomy among primary and secondary schools. The existence of amateur astronomy societies across the country are actively administering lectures and telescope viewing sessions is a head start for the country's brighter space education.

With the concept of utilizing a stellarium-based activity, the core of this research, will serve as an avenue for students to learn the basics of astronomy. Through this, they will collaborate with their classmates and discuss their findings that will stimulate deep understanding and interest towards learning astronomy. Teachers, on the other hand, will have exposure also in facilitating the activity which promotes inquiry-based learning and could observe evident impact of the effectiveness of the activity. Along with today's rapid evolution of diversity above fast-paced technology run, presets the dire need of flexibility amongst us, educators. Nevertheless, questions and concerns still beset us how. First, how should be the essential aptitude and attitude be instilled to students to obtain excellence not only across the coursework, yet through time? Then how can we be able to transform them from being the passive recipients of information to become the knowledge builders and problem solvers themselves? Also, how can we equip the students with the integral knowledge, the fundamental skills, and the imperative dispositions to unravel the ubiquitous conundrum of the society? But as anchors of the future we must always come equipped for these challenges charged on us, thus engaging students to learn and develop the potentials needed from them to take part for the betterment of today's world.

2. Theoretical Background

This study is anchored on Vygotsky's Human Cognition Theory [8] which advocates that human beings and human cognition in specific, can generate and utilize tools that affect how people think and interact with the world and in turn, is created by those tools [1]. Moreover, this study highlights the pedagogical approach to transforming educational practice towards 21st century education, the inquiry-based learning approach. Inquiry-based learning is an approach to teaching and learning that places students' questions, ideas and observations at the center of the learning experience. Educators play an active role throughout the process by establishing a culture where ideas are respectfully challenged, tested, redefined and viewed as improvable, moving children from a position of wondering to a position of enacted understanding and further questioning [6]. Underlying this approach is the idea that both educators and students share responsibility for learning. For students, the process often involves open-ended investigations into a question or a problem, requiring them to engage in evidence-based reasoning and creative problem-solving, as well as "problem finding." For educators, the process is about being responsive to the students' learning needs, and most importantly, knowing when and how to introduce students to ideas that will move them forward in their inquiry. Together, educators and students co-author the learning experience, accepting mutual responsibility for planning, assessment for learning and the advancement of individual as well as class-wide understanding of personally meaningful content and ideas [4].

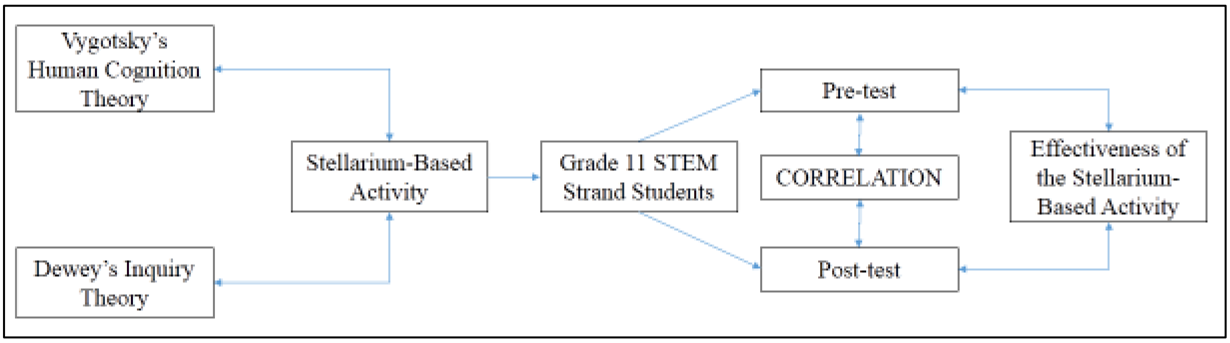

Figure 1. The Conceptual-Theoretical Framework of this Study

3. Methods

3.1 Target Group

The target respondents of the study were the 27 Grade 11 STEM Strand students of Sotero B. Cabahug FORUM for Literacy. These are the chosen respondents in order to determine the effectiveness of a stellarium-based activity to their academic performance.

3.2 Methods of Inquiry

The quantitative and qualitative research approach for this study employed a correlational design. It aimed to determine if a correlation exists between the stellarium-based activity and their academic performance. This type of study involved determining if a relation exists between two or more variables, and to what degree, with an attempt to discover a connection. This approach was appropriate because the variables of included in this study are scale variables, and the study sought to understand if the stellarium-based activity aided the students with regard to their academic performance.

In conducting the research study, the researcher adapted a stellarium-based activity with the author's permission. Moreover, the construction of pre-test and post-test followed and were administered respectively to selected students which are not the respondents of this. After the administration of tests, it underwent the test of reliability and validity. Subsequently, pursuant to the reliability and validity results, the tests were revised for minor errors with the help of experts. After that, the pre-test was administered to the respondents then followed by the implementation of the stellarium-based activity. After a week, the researcher administered the post-test to check student's level of understanding of the stated competencies. For the final phase of the study, the results of the administered tests were analyzed using the statistical tools set with the aid of a statistician. Through this, the correlation between the two tests will be gotten to check the effectiveness stellarium-based activity.

4. Results and Discussion

The entry competencies of Earth Science among Grade 11 STEM Strand students are not evident as shown in Table 1. This implies that the respondents possess no background about the concept of cycles in the sky. The respondents were asked to complete a perception survey questionnaire about cycles in the sky and found out that no prior knowledge are evident.

Table 1. Entry Competencies of Earth Science Grade 11 STEM Strand Students.

Entry Competencies	Not Evident	Evident
1. Describing the motions of the Sun, Moon, and stars as they rise along the eastern horizon, move across the sky, and set along the western horizon;	☑	
2. Recognizing the kinds of fixed patterns of stars called constellations;	☑	
3. Explaining why the different constellations are visible at different times of the year;	☑	
4. Defining the cycles of the Sun, Moon, and stars that are basis for the day, month, and year.	☑	

The data in Table 2 displays that the respondents' pre-test scores are low with only 7 (26%) who passed the first competency which is describing the motions of the Sun, Moon, and stars as they rise along the eastern horizon, move across the sky, and set along the western horizon.

For the second competency - recognizing the kinds of fixed patterns of stars called constellations, only 6 (22%) respondents passed the test. In addition, in explaining why the different constellations are visible at different times of the year, there are 6 (22%) respondents who also passed. The last competency, defining the cycles of the Sun, Moon, and stars that are basis for the day, month, and year, only 9 (33%) respondents passed the test. This implies that majority of the respondents got low scores during the pre-test and indicates that they were not able to achieve the competencies provided.

After the implementation of the stellarium-based activity, the respondents took the post-test and the data in Table 2 shows the results. The scores of the respondents marked a success due to their high scores. For the first competency, describing the motions of the Sun, Moon, and stars as they rise along the eastern horizon, move across the sky, and set along the western horizon, there are 22 (85%) respondents passed the test. Adding up, there are 27 (100%) respondents passed the second competency - recognizing the kinds of fixed patterns of stars called constellations.

For the third competency, explaining why the different constellations are visible at different times of the year, 24 (89%) of the respondents passed. Lastly, there are 26 (96%) respondents passed the fourth competency which is defining the cycles of the Sun, Moon, and stars that are basis for the day, month, and year.

Table 2. Pre-test and Post-test Scores of Grade 11 STEM Strand Students.

Competencies	Pre-test Scores				Post-test Scores			
	Failed		Passed		Failed		Passed	
	n	Percentage	n	Percentage	n	Percentage	n	Percentage
1. Describing the motions of the Sun, Moon, and stars as they rise along the eastern horizon, move across the sky, and set along the western horizon;	20	74%	7	26%	4	15%	22	85%

2. Recognizing the kinds of fixed patterns of stars called constellations;	21	78%	6	22%	0	0%	27	100%
3. Explaining why the different constellations are visible at different times of the year;	21	78%	6	22%	3	11%	24	89%
4. Defining the cycles of the Sun, Moon, and stars that are basis for the day, month, and year.	18	67%	9	33%	1	4%	26	96%

To determine the difference between the pre-test and post-test scores, data analysis results shows that by conventional criteria, the differences of the scores on the different competencies is considered to be extremely statistically significant.

Table 3. T-test Result of Pre-test and Post-test scores for Earth Science Competencies.

Competencies	Pre-test		Post-test		Statistical Results	
	Mean	SD	Mean	SD	T-Value	Remarks
1. Describing the motions of the Sun, Moon, and stars as they rise along the eastern horizon, move across the sky, and set along the western horizon;	1.59	1.19	3.74	1.06	-7.0216	Significant
2. Recognizing the kinds of fixed patterns of stars called constellations;	1.63	1.11	4.11	0.85	-9.2098	Significant
3. Explaining why the different constellations are visible at different times of the year;	1.63	1.18	3.74	0.98	-7.1336	Significant
4. Defining the cycles of the Sun, Moon, and stars that are basis for the day, month, and year.	2.04	0.98	4.11	0.89	-8.1352	Significant

Table 3 shows the t-value of the first competency is -7.0216 and the two-tailed P value is less than 0.0001. The result is significant at $p < 0.05$. This difference is considered to be extremely statistically significant, thus the null hypothesis was rejected. There is a significant difference between the pre-test and the post-test scores of the respondents in describing the motions of the Sun, Moon, and stars as they rise along the eastern horizon, move across the sky, and set along the western horizon.

Likewise, the data shows that there is a significant difference between the pre-test and the post-test scores of the respondents for the second competency which is recognizing the kinds of fixed patterns of stars called constellations with the t-value -9.2098 and a two-tailed P value of less than 0.0001. The result is significant at $p < 0.05$. This is considered to be extremely statistically significant, thus the null hypothesis was also rejected.

Furthermore, there is a significant difference between the pre-test and the post-test scores of the respondents in the third competency which focuses on explaining why the different constellations are visible at different times of the year as shown in Table 6 with a t-value -7.1336 and a two-tailed P value of less than 0.0001. The result is significant at $p < 0.05$. This is considered to be extremely statistically significant, thus the null hypothesis was rejected.

Lastly, the data shows that the t-value for the fourth competency is -8.1352 and the two-tailed P value is less than 0.0001. The result is significant at $p < 0.05$. This difference is considered to be extremely statistically significant, thus the null hypothesis was rejected. There is a significant difference between the pre-test and the post-test scores of the respondents in significant difference between the pre-test and the post-test scores of the respondents defining the cycles of the Sun, Moon, and stars that are basis for the day, month, and year.

This implies that the stellarium-based activity is effective in teaching the cycles of the sky. Statistical results showed that the academic performance of the respondents improved when taught using the stellarium-based activity.

5. Conclusion

With the findings and results obtained in this study, the utilization of stellarium-based activity improved the academic performance of the students in (1) describing the motions of the Sun, Moon, and stars as they rise along the eastern horizon, move across the sky, and set along the western horizon, (2) recognizing the kinds of fixed patterns of stars called constellations, (3) explaining why the different constellations are visible at different times of the year. Thus, the stellarium-based activity is effective in teaching the cycles of the sky. It is recommended that future researchers should pursue the development of a localized stellarium-based activity that will greatly affect the academic performance of the student and will surely boost their interest in learning astronomy education.

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