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Overcoming Students' Misconception on Moon Phases: A Classroom Action Research

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Abstract

Computing technology plays a pivotal role in 21st-century education, particularly in Science subjects, by integrating STEM (Science, Technology, Engineering, and Mathematics) to solve problems. One common area where misconceptions arise is the topic of Moon Phases. To address this challenge, an innovative project titled MoonCix intervention was developed. The aim of MoonCix is to enhance Year Five students' understanding and motivation of Moon Phases by leveraging computing technology. This initiative focuses on creating an interactive classroom environment using technological tools for teaching Moon Phases. An action research study was conducted to evaluate the effectiveness of MoonCix as an intervention. The study involved 50 students, with 25 students forming the treatment group and another 25 students forming the control group. MoonCix was developed using Scratch programming, incorporating a compelling storyline and gamification elements to engage students. The treatment group experienced the MoonCix intervention, while the control group received traditional teaching methods. The findings of the study demonstrated that the MoonCix created through Scratch programming, improved students' understanding and motivation of Moon Phases. The incorporation of interactive story-line content and gamification elements in MoonCix not only effectively addressed misconceptions among the students but also showcased the transformative potential of utilizing Scratch programming in teaching and learning. By engaging in immersive narratives and game-based activities, MoonCix not only enhanced their scientific understanding but also successfully dismantled existing misconceptions. This highlights the power of innovative educational technologies, specifically Scratch programming, in not just teaching science but actively overcoming barriers to learning, making the educational process more engaging, effective and impactful.

Keywords: Moon Phases, Scratch Programming, Misconception, Science Education

1. Introduction

Science education is the cornerstone of progress and development in Malaysia. As a diverse and rapidly advancing country, Malaysia recognises the pivotal role that science education plays in shaping its future. Based on the curriculum in Malaysia, children are first introduced to Moon Phases at Year 5 in primary school. Early exposure to astronomy can inspire students to pursue further studies and careers in science, technology, engineering, and mathematics (STEM) fields. Research has shown that providing undergraduate and high school students with an experience of the processes of scientific research as close to what they might expect in the field can inspire them to continue to pursue science in their education and careers (Freed, 2018) [10]. However, misconceptions related to the phases of the moon are prevalent among students, and some efforts need to be made to address and overcome these misconceptions. The most significant research in scientific education focuses on identifying the many kinds of misconceptions (Ning & Chongo, 2023) [18]. According to Chen *et al*. (2019) [6], misconception may affect the understanding and performance of students. These misconceptions among the students cannot be neglected as according to Engelmann and Huntoon (2011) [9], the misconceptions need to be addressed before students can learn scientific concepts correctly.

Several misconceptions about the Moon Phases were outlined by Stahly, Krockover and Shepardson (1999). Firstly, there is a misconception that clouds obscure the unseen part of the moon. Second, students may erroneously believe that planets cast shadows on the moon's hidden side. Third, some think the sun's shadow obstructs our view of the moon entirely. Fourth, the mistaken notion that Earth's shadow blocks our view of the moon is prevalent. According to L. Ananda and S Syuhendri (2023) [16], students may also confuse the terms like waxing and waning, crescent and gibbous, which refer to the increasing and decreasing illumination of the moon respectively. Plus, according to the research of Yetter *et al*. (2017) [28], students may mix up the order of phases of the moon which include the new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, third quarter and waning crescent. Lastly, there is a misconception that moon phases are explained based on the visible portion of the illuminated side as observed from Earth (Olson, 2007) [22].

Scratch coding is the process of creating and running programs using Scratch, a free programming language and code editor designed to facilitate the comprehension of coding logic among young learners. It enables users to blend animation, computer games and other projects utilising visuals and sounds. This offers teachers a new and excellent teaching platform by developing interactive multimedia such as tales, animations, quizzes and puzzles (BasuMallick, 2022) [4]. Animation and quiz about the Moon Phases will be presented to students by using Scratch. Scratch application can be used in both physical and online classrooms. The purpose of this research is to identify the use of Scratch in increasing Year 5 students' motivation and achievement in the topic Moon Phases. There are two research questions which are: (1) Does Scratch increase Year 5 students' motivation towards the topic Moon Phases? (2) Does Scratch increase Year 5 students' achievement towards the topic Moon Phases?

2. Literature Review

In the field of education, two international scholastic assessment programs have produced trend data over a sufficient length of time which are TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme of International Student Assessment) (Meisenberg & Woodley, 2013) [17]. Malaysia, as one of the countries from southeast Asia, is also enrolled in TIMSS and PISA. Malaysia's TIMSS score has risen from 426 in 2011 to 471 in 2015 whereas Singapore and Japan scored 597 and 572 respectively in TIMSS 2015 (Nur Sahrizan *et al*., 2020) [20]. This result has made Singapore and Japan to be reported as 1st and 2nd ranking in TIMSS 2015 (Andres & Piotr, 2016) [2]. Besides, Malaysia received a science PISA score of 438 in 2018 (OECD, 2019) [21]. As a result, this indicates that the integration of ICT in education could be used in science education to help with these issues.

ICT integration in education refers to a technology-driven approach to teaching and learning that is closely linked to the use of educational technology in classrooms (Ghavifekr & Rosdy, 2015) [11]. It is believed that integrating ICT into the classroom improves student learning and makes the most of their capacity for active learning as it aids educators in creating engaging, innovative, and successful lesson plans (Jamieson-Procter *et al*., 2013) [13]. This has greatly increased students' and teachers' effectiveness in learning and teaching lessons. Next, the study of Ghavifekr & Rosdy (2015) [11] indicates that using technology to enhance teaching and learning is more efficient than using a traditional classroom. This is because utilising ICT tools and equipment will create a more engaging and productive learning environment for both teachers and students. Moreover, according to a Tezci (2011) [26] study, the majority of pre-service teachers said they only use elementary ICT tools for educational purposes and a majority of teachers believe ICT integration is effective. Klimov (2012) [14] gives an obvious comparison that ICT emphasises Student-centered learning and allows students to achieve critical learning in real-world contexts while the traditional teaching approach emphasizes Teacher-centered learning and facts as well as recitation. Thus, it is significant that the integration of ICT such as Scratch in education could increase the effectiveness of the teaching and learning process. As a result, students can use the software's interactive and multimedia features to help them understand concepts and ideas in the curriculum, it is anticipated that this will increase student motivation and thus the multimedia capabilities of programmes like Scratch can be used to help students understand concepts and ideas covered in the curriculum (Instefjord & Munthe, 2017) [12]. From several studies that have been reviewed by Siiman *et al*. (2014) [25] about teaching aids or interventions in computing pedagogy can increase student motivation. Appropriate teaching and technological approaches can actively engage learners in programming (Bers *et al*. 2014) especially integrating with Science subjects.

3. Methodolgy

3.1 Research Design

This study is an action research project. The Moon Phases Achievement Test (MPAT) and Motivation Questionnaire (MQ) are the instruments used in this quantitative study. This action research will employ the Kemmis and Kurt Lewin's model (1946) [15]. Class action research is defined by Kurt Lewin's model (1946) [15] as a life that necessitates a cycle of planners in order to make a reflection (Rahayu *et al*., 2018). Kurt Lewin's approach of Action Research is a research method in which the researcher intervenes in and during the research. This serves two purposes: firstly, according to Kurt Lewin, it will bring about positive change and secondly, knowledge and theory will be generated. Kurt Lewin's design is the classroom action research methodology that was applied in this study. It is divided into two cycles, with four phases in each cycle: Planning, Acting, Observing and Reflecting.

3.2 Study Participant

Students in Year 3 have been chosen by the researcher to participate in the study. The researcher carefully selected the study participants based on their academic performance in scientific courses. For this study, the researcher has selected 25 kids from class 5A as the treatment group and 25 students from class 5B as the control group. Thus, a total of fifty students were selected to take part in the research.

3.3 Instruments

The Moon Phases is the subject of the Scratch interventions employed in this study. Using the Scratch application, the questions and animation about the moon phases will appear. MPAT and MQ are the instruments employed in this study. The MPAT consists of a pre-test and a post-test, with fifteen objective questions on each. The Primary School Achievement Test is the source of all of the questions (UPSR). Pre- and post-questionnaires are included in MQ. This verified and reliable questionnaire was utilized in Wong's (2017) [8] research. There are two areas in the pre-and post-questionnaires: a general section and a science section. There are 15 questions in the general portion and 10 in the scientific area.

3.4 Procedure

This treatment was conducted in a Penang school over a period of five days. Before instruction, a 35-minute pre-test and pre-motivation level questionnaire will be given to both the treatment group and the control group. Moon Phases will then be taught using the Scratch application by a teacher in the treatment group, whereas a different instructor in the control group will employ a conventional approach. Following instruction, a 35-minute post-test and post-motivation level questionnaire will be given to both the treatment group and the control group. The effectiveness of using the Scratch programme to enhance students' performance on the Moon Phases topic was then evaluated by comparing the pre- and post-test results.

4. Findings and Discussion

4.1 Achievement

Fig 1 of the data shows that the treatment group's improvement in achievement is greater than that of the control group. This demonstrates how using the Scratch programme can raise students' performance in the Moon Phases topic. This result is consistent with Afrin *et al.* (2017) [1], who found that using the Scratch programme in teaching and learning raises student achievement. Additionally, previous studies have shown that using Scratch programming in Science raised student achievement (Ming *et al.*, 2023; Chongo *et al.*) [18, 19] and may be utilised to aid students in understanding curriculum topics and ideas (Munthe & Instefjord, 2017) [12].

In general, ICT proved to be more successful in teaching and learning chemistry science than the laboratory training paradigm (Badeleh & Sheela, 2020) [3]. This is due to the fact that ICT makes it easier for pupils to learn conceptual material because it is visible to them (Fig 2). The quiz in Fig 3 confirms the pupils' comprehension. Virtual environments provide an analogue of the reinforcement programme, since they offer drill and practise tasks as a means of obtaining extra stimuli or reinforcements (Chung & Wu, 2017). Instructors can create animations with the Scratch programme. Therefore, by utilising the Scratch application, kids can overcome misconceptions in science and understand a particular topic more effectively.

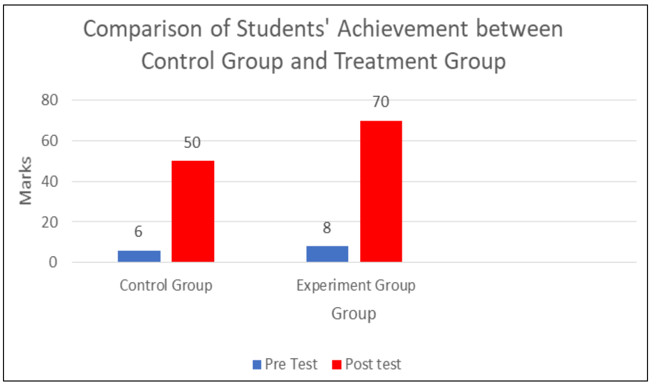

Fig 1: Comparison of mean of pre-test and post-test of treatment and control group

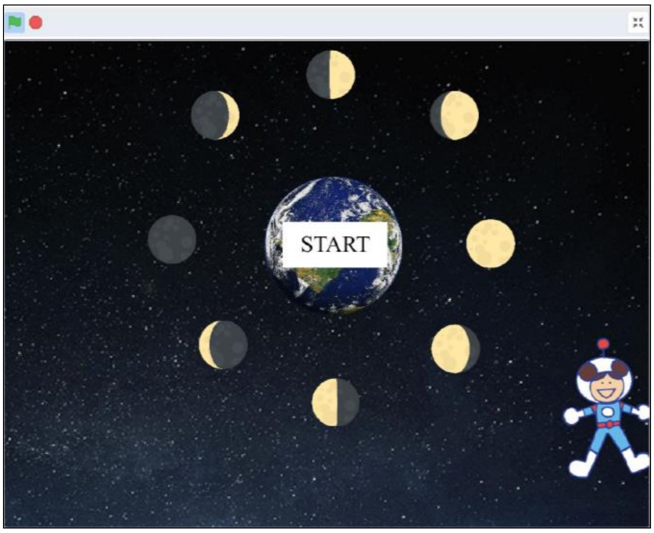

Fig 2: Animation of moon phase changes

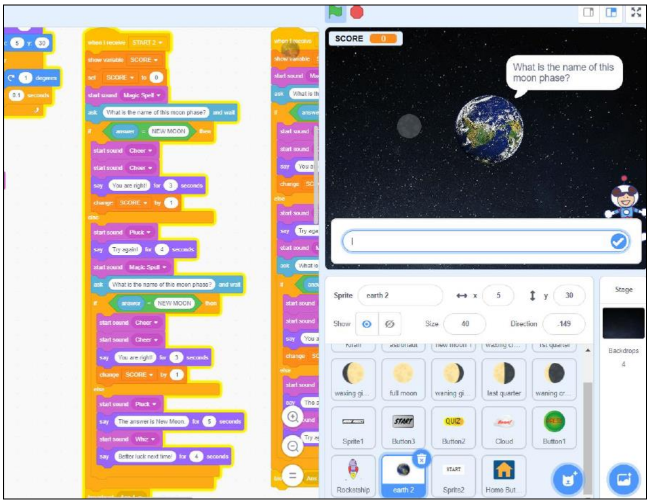

Fig 3: Quiz on the topic of Moon Phases

The reinforcement programme has an equivalent in virtual settings where there are virtual activities with drill and practise processes that serve as extra stimuli or reinforcements (Chung & Wu, 2017).

4.2 Motivation

The treatment group's mean score has increased more than the other group's mean score, as shown by Table 1 and Fig 4. This demonstrates how teaching kids about Moon Phases with Scratch can boost their motivation. ICT can be used to distribute challenging and authentic content that will engage students in the learning process. This includes multimedia computer software, television, and video.

Table 1: Mean score of questionnaires of treatment and control group

Questionnaire	Groups	Mean Score
Pre	Treatment	2.51
	Control	2.54
Post	Treatment	3.78
	Control	3.18

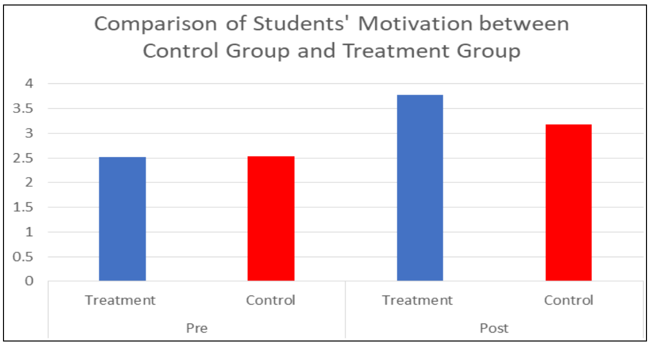

Fig 4: Comparison of students' motivation

The results of this study demonstrate that using the Scratch programme on the Moon Phases topic can increase students' motivation. Since students can use the software's interactive and multimedia elements to help them understand concepts and ideas in the curriculum, it is anticipated that this will increase student motivation (Instefjord & Munthe, 2017) [12]. ICT is a popular tool for education; it can spark new interests, improve students' motivation, and even have psychological consequences (Yassaei, 2012) [27]. (Puspitadewi, Ratminingsih & Santosa, 2017) [23]. According to Weidinger, Schwinger, and Spinath (2019), motivation in students can manifest itself in thought, emotion, or behaviour. According to their research, a student's motivation to perform well in maths may manifest as joyful feelings in the event that he receives high exam scores.

5. Conclusion

The study's findings show that teaching students with Scratch can help them perform better when it comes to the Moon Phases issue. The Scratch application has many advantages for students. Using Scratch helps students grasp teaching and learning in a better and more effective way. Additionally, the findings suggest that children' interest in science might be increased by utilising the Scratch programme. Children are encouraged to learn more science through the pictures and animations in the Scratch application. As such, instructors are advised to use Scratch programming in the classroom.

After carrying out the action research, the researcher found that integration Scratch programming in science can help to improve the pedagogical practice, skills and practice of professionalism of an educator. In the future, researchers will try to expose the concept of this Scratch game to the students so that the interest and motivation of the students can be nurtured thus improving their achievement. However, this method needs to be appropriate to the age level and needs of the students in order for the interventions developed by teachers to be relevant to the pedagogy of the 21st century.

6. References

1. Afrin N, Lu MY, Cody Ryan Z, Caleb RD. Applying Scratch Programming to Facilitate Teaching in k-12 Classrooms, 2017.
2. Andres S, Piotr B. Factors and conditions promoting academic resilience: ATIMSS-based analysis of five Asian education systems. Asia Pacific Educ. Rev. 2016; 17:511-520.
3. Badeleh A, Sheela G. The Effects of Information and Communication Technology Based Approach and Laboratory Training Model of Teaching on Achievement and Retention in Chemistry. Contemporary Educational Technology. 2020; 2(3):213-237. Doi: https://doi.org/10.30935/cedtech/6055
4. BasuMallick C. What is Scratch Coding? Meaning, Working, and Applications. Spiceworks, 2022. https://www.spiceworks.com/tech/devops/articles/scratch-coding/
5. Bers, Marina Umaschi. Coding and computational thinking in early childhood: The impact of ScratchJr in Europe. European Journal of STEM Education. 2018; 3(3).
6. Chen C, Sonnert G, Sadler PM, Sasselov D, Fredericks C. The impact of student misconceptions on student persistence in a MOOC. Journal of Research in Science Teaching. 2019; 57(6):879-910. Doi: https://doi.org/10.1002/tea.21616
7. Chongo S, Osman K, Nayan NA. Impact of the Plugged-In and Unplugged Chemistry Computational Thinking Modules on Achievement in Chemistry. EURASIA Journal of Mathematics, Science and Technology Education. 2021; 17(4).
8. Cindy, Wong. Development and Effectiveness of Kayue Module on the Achievement and Motivation of the Penan Community. PhD Thesis. UKM, 2017.
9. Engelmann CA, Huntoon JE. Improving student learning by addressing misconceptions. Eos, Transactions American Geophysical Union. 2011; 92(50):465-466. Doi: https://doi.org/10.1029/2011eo500001
10. Freed R. Astronomy Research Seminar-The Impact on Students from their Perspective. Preliminary results from one spring seminar. Robotic Telescopes, Student Research and Education Proceedings. 2018; 1(1):291-301. Doi: https://doi.org/10.32374/rtsre.2017.028
11. Ghavifekr S, Rosdy WAW. Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science (IJRES). 2015; 1(2):175-191.
12. Instefjord EJ, Munthe E. Educating Digitally Competent Teachers: A Study of Integration of Professional Digital Competence in Teacher Education. Teaching and Teacher Education. 2017; 67:37-45. Doi: https://doi.org/10.1016/j.tate.2017.05.016
13. Jamieson-Proctor R, Albion P, Finger G, Cavanagh R, Fitzgerald R, Bond T, *et al*. Development of the TTF TPACK Survey Instrument. Australian Educational Computing. 2013; 27(3):26-35.
14. Klimov BF. ICT Versus Traditional Approaches to Teaching. Procedia-Social and Behavioral Sciences. 2012; 47:196-200. Doi: https://doi.org/10.1016/j.sbspro.2012.06.638
15. Kurt Lewin. Field Theory in Social Science. New York: Harper & Brothers Publishers New York, 1946.
16. Ananda L, Syuhendri S. Misconceptions of prospective physics teacher students on the period of lunar phases. Nucleation and Atmospheric Aerosols, 2023. Doi: https://doi.org/10.1063/5.0122687
17. Meisenberg G, Woodley MA. Are cognitive differences between countries diminishing? Evidence from TIMSS and PISA. Intelligence. 2013; 41(6):808-816. Doi: https://doi.org/10.1016/j.intell.2013.03.009

18. Ming SKH, Chongo S, Lapawi N. Using Scratch to Increase Students' Achievement and Motivation Toward Solar System. In 9th International Conference on Business Studies and Education (ICBE). 2023; 44.
19. Ning TQ, Chongo S. The Role of Hands-on Approach in Overcoming Students' Misconceptions about Matter: A Case Study.
20. Nur Sahrizan S, Abdul Talib C, Aliyu F, Ali M. The TIMSS grade 8 student's science achievement: A comparative study between Malaysia, Singapore, and Japan. Learning Science and Mathematics Journal, SEAMO-RECSAM, e-ISSN, 2637-0832, 2020.
21. OECD. PISA 2018 Results. Where All Students Can Succeed. OECD Publishing, 2019. Doi: https://doi.org/10.1787/b5fd1b8f-en
22. Olson J. Students' Misconceptions as to the Cause of the Apparent Phases of the Moon, 2007.
23. Puspitadewi NPR, Ratminingsih NM, Santosa MH. The Effect of Ict-Based Interactive Game on Fourth-Grade Students' English Achievement. Jurnal Pendidikan Bahasa Inggris Undiksha. 2017; 4(2):231-240. Doi: https://doi.org/10.23887/jpbi.v5i2.12489
24. Sahrizan N, Corrienna A, Talib, Aliyu F, Ali M, Malaysia U. The TIMSS Grade 8 Student's Science Achievement: A Comparative Study between Malaysia, Singapore, and Japan, 2000. https://myjms.mohe.gov.my/index.php/lsm/issue/download/1020/2020_10_NSS_149158
25. Siiman LA, Sell R, Tonisson E, Pedaste M, Tõnisson E, Jaakkola T, *et al*. A review of interventions to recruit and retain ict students. I.J. Modern Education and Computer Science. 2014; 3:45-54.
26. Tezci E. Factors that influence preservice teachers' ICT usage in education. European Journal of Teacher Education. 2011; 34:483-499
27. Yassaei S. Using Original Video and Sound Effects to Teach English. English Teaching Forum. 2012; 1:12-16. http://americanenglish.state.gov/files/ae/resource_files/50_1_4_yassaei.pdf
28. Yetter I, Livengood K, Smith W. State Science Standards and Students' Knowledge of What States Value: Lunar Phases. Electronic Journal of Science Education. 2017; 21(1). https://files.eric.ed.gov/fulltext/EJ1187985.pdf