

Integrating SQ3R Reading Techniques with Augmented Reality Media in The Learning of Solar System

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Abstract- This research which applies the quasy-experimental method with a pretest-posttest control group design aims to determine the extent of effectiveness of implementing learning that integrates the SQ3R reading technique assisted by augmented reality media in improving learning outcomes on the topic of the solar system for seventh grade junior high school students. The target population for this research is all seventh grade students of four junior high schools who have not yet studied the topic of the solar system. Samples were taken using the unproportioned-intact group random sampling technique consisting of 109 students in the experimental group and 106 students in the control group. The research instrument is a learning outcomes test consisting of 15 multiple choice questions and 5 essays. Based on data analysis, it was concluded that there were significant differences in learning outcomes between students who were involved in learning that integrated the SQ3R reading technique assisted by AR media and those who applied the expository method ($t = 5.165$, $p < 0.05$) and its level of effectiveness was classified as high ($ES = 5.54$). SQ3R reading techniques and other audio-visual media based on information technology (IT) should be integrated in physics learning for other teaching materials.

Keywords: SQ3R technique, integrating, solar system, augmented reality, junior high school, information technology media

I. INTRODUCTION

Nowadays, education system worldwide has focused on reading understanding as a consequence of the International Student Assessment Program (PISA) [1], [2] which stated that only about 8% of learners in OECD nations are top reader. It is reported [3], (2022) that students' competency in reading elements, they are; retrieving information, forming a broad understanding, developing an interpretation, reflecting on and evaluating the content of a text, and reflecting the form of a text are stil low. According to Jurowski et al.[4], including digital technology such as an Augmented Reality Technology inside the classroom is a precious instrument for achieving required learning objectives. In addition, it enable to promote students' reading competency that is highly needed to enriches the entry and long-term and exciting learning [5].

In the context of learning objectives of solar system topics in junior high school, as described in Inodonesia Minister of Education and Culture Regulation Number 24 of 2016, it is explained that the essential competency objective of learning solar system topics is to improve students' ability to explain the solar system and examine the characteristics of the members of the solar system [7].

The topic of the solar system e.g planets and its

motion, and the occurrence of lunar and solar eclipses, in general, cannot be observed directly with the eye and are abstract. Learning the abstract objects requires using media. Sukirman [7]) explained that anything that can channel information from information sources to information recipients is media. The use of media can attract students' attention and create imitations of real objects, and make abstract concepts into real concepts. One of the media that can be used in learning the topic of the Solar System is augmented reality (AR) media [8].

Until now, in Indonesia, the solar system material taught to students in many schools still uses textbooks using the expository method (lectures, explanations interspersed with demonstrations, examples of solutions). Information related to the topic of the Solar System at elementary and middle school levels---most of which is presented textually (verbally), supported by pictures, and several examples of practice questions---will be understood by students optimally on the basis of reading ability and skills the good one.

Theoretically and from the results of previous research, it is confirmed that students' ability to understand reading text material presented verbally (declarative knowledge) is greatly influenced by their ability to read [9], [10]. This means that (good) reading ability influences students' learning outcomes at school, on any teaching material. One of the reasons why students are less successful in learning science is because they have difficulty reading textbooks seems worthy of

anticipation by many parties involved in the world of education. Therefore, it is quite rational that the ability to read textbooks needs to be trained and improved from the elementary education level [11].

The development of reading skills in many schools, it seems, is considered less important by some teachers. Developing the ability to understand textbooks tends to be considered the only main task of a language subject teacher. On the other hand, there is an opinion that developing reading and writing skills if integrated into learning will take a lot of time, especially since the teaching material itself is considered dense. As a result, in schools it is rare to find science teachers who integrate or train in a deliberate and planned way a reading technique (for learning). One of the reading techniques that is considered powerful is SQ3R (Survey, Question, Read, Recite, Review) [12],[13].

In the *Survey* step, the activity of glancing at the headings and subheadings contained in a reading text is carried out. After that, ask several questions (*Questions*) related to the title/subtitle or which are still relevant. The questions that have been formulated will become a tool for self-control and self-monitoring. *Reading* activities are carried out to understand the reading text (reading for understanding). Underline. giving color to words, sentences, or concepts that are considered important, or making notes in the margins is highly recommended. Before answering the questions (*Recite*) that have been

asked, readers can make two-dimensional notes (graphs, charts, schematic maps) or mental hook notes (mnemonics) to improve memory (retention). These activities enable students to construct actively some knowledges. *Review* is an activity carried out to self-assess the answers given, or to identify parts/paragraphs in the text that need to be read again. In addition, augmented reality (AR) media is an application that combines the real world with the virtual world in two-dimensional (2D) or three-dimensional (3D) form which is projected in a real environment at the same time [14][15]. Augmented reality (AR) prioritizes reality because this technology is closer to the real environment which can allow users to interact in more real time with the system, so that the characteristics of the planets in the solar system can be visualized more realistically. Augmented reality media operations can be used on Android-based devices. Devices that use the Android operating system are smartphones. Using a smartphone or tablet in augmented reality media is easier for students to use because it is already known and used by them.

From tracing study of numerous journals, it is convinced that research that integrating SQ3R reading technique assisted by AR media has not been much conducted especially in the learning of solar system materials in seventh grade of junior high school. The results of previous research mostly focused on testing the effectiveness of the SQ3R reading technique and the use of AR media in learning certain teaching materials separately. Due to the rapid technological revolution has influenced education system, it is necessary to develop and use technology media supported by Technological-Pedagogical Content Knowledge (TPACK) approach. Therefore, this study integrated SQ3R reading technique assisted by AR media is regarded quite rational. The main focus of this study is to gauge the extent of effectiveness of integrating SQ3R reading technique assisted by AR media in enhancing the students' achievement of solar system.

II. METHOD

This collaborative research applied the quasi-experimental method with the pretest-posttest non-equivalent control group design [16]. The target population is the total seventh grade students of junior senior high schools (SMP/MTs) in Westkalimantan-Indonesia enrolled in the same (first) semester academic year 2023/2024. Sample of this study is 215 students consists of 109 students (as experimental group) and 106 students (as control group). The four schools and their classes as sample of this study were drawn by using unproportioned-intact group random sampling technique. The distribution of samples in experimental-control classes in this study is shown in Table I.

Before conducting the research, I have trained the four

volunteer teachers (as co-researchers) in the nonformal meetings. At the meeting, we discussed to explore the possible causes of students errors or difficulties in the learning of solar system topic they faced in the schools as base-line. I trained them about and provided the guidelines the integrating of the syntaxes SQ3R techniques and augmented reality (AR) media in the learning of solar system topic. I executed the teachers training by modelling explicitly the models for two-times instructional interventions (treatments) regarding SQ3R integrated with AR for experimental group and Expository Instruction (conventional) model for control group.

TABLE 1-THE DISTRIBUTION OF NUMBER OF SAMPLES PER CLASS

Schools		Experiment Classes	Control Classes
MTs	Darul	VII-A (25 students)	VII-B (27 students)
SMPN	11	VII-A (34 students)	VII-E (34 students)
	Pontianak		

SMPN 3	VII-B	VII-C
Teluk Keramat	(25 students)	(25 students)
MTs Assalam	VII-A	VII-B
Pontianak	(25 students)	(20 students)
Total	109	106

In the line of the integrating of the syntaxes SQ3R techniques with augmented reality (AR) media implemented in this study, I operationalized the instructional phases as follows:

- *Survey phase:*

The activity carried out is to examine the entire (structure) text at a glance. The teacher and students checked the length of the text to be read, recognize the title and subtitle, identify terms (key words) and summary (if any).

- *Questions phase:*

The teacher guided (by giving examples) and encouraged students to ask several questions related to the title/subtitle of the reading. Writing them on the board would be better. The questions that have been formulated will become a tool for self-control and self-monitoring so that reading activities become more focused, namely providing answers to questions that have been asked previously.

- *Read phase:*

Teacher actived and focused reading activity required in this third stage. Marking parts or contents that are considered important in a text with a pencil, colored ballpoint, or highlighter is highly recommended. Reading to learn does not only mean reading text, but you must also pay close attention to tables, graphs, pictures, charts or other illustrations contained in it.

After reading the text, students are asked to watch the AR video. After watching AR, students are trained to make charts, graphs, illustrations, concept mapping, mnemonics notes).

- *Recite phase:*

After the activities of reading, watching AR, and making summaries/charts/graphs, *mnemonics notes*, the students asked to answer the questions that have been proposed and/or questions contained in the reading text (if any). Recite is the activity of memorizing answers to questions proposed.

- *Review phase:*

Teacher recommended to students for reading the parts contain answers to questions that have not been found and reviewing the correctness of the answers to all questions. This stage is considered effective for entering new knowledge/information into students' long-term

memory (memory). Tecaher gave feedbacks to the wrong or incomplete that enable to encourage students to read a part of the text more carefully and in depth.

The score of the multiple choice test that consists of consists of 5 items of four-options (with the reliability coefficient of Kruder Richardson KR-21 was 0.78) is 75.00. The score essay test consist of 5 items (with the coefficient of Alpha Cronbach was 0.61) is 25. So, the total score of the achievement test is 100.00. After administering the pre-tests, no feedback was given to students. The pretest scores were reserved for use after the posttest. Students were asked not to discuss their responses or solutions after the test.

The timeline of a three times treatments with 2 x 45 minutes each of solar system topics implemented to the two groups is shown in Table II. The students who were absent during the treatments or pre-posttest administration were excluded from the data analysis.

TABLE II- THE TIMELINE OF TREATMENTS

Treatments	Experiment Classes (integrating SQ3R with AR)	Control Classes (Expository model)
Pretest	Solar system topic	Solar system topic
Treatment-1	Identify the Solar system and its motion	Identify the Solar system and its motion
Treatment-2	Rotation and Revolution Period of planets	Rotation and Revolution Period of planets

Treatment-3	Lunar and solar eclipses	Lunar and solar eclipses
Posttest	MPT and PAT	MPT and PAT

The significant difference of the mean scores of the experimental dan control will be examined by using *t*- test. The extent of effectiveness of the model is assessed by using Cohen's *d* formula of Effect Size (ES) rate.

III. RESULTS AND DISCUSSION

A. *Statistics of Achievement Test Before and After The Treatments*

Descriptive statistical values of learning outcomes before and after treatment in the experimental and control groups can be seen in Table III.

In the line of Table III, this research found that the learning outcomes on the topic of the Solar System for seventh grade junior high school students before and after learning that integrated the SQ3R reading technique assisted by AR media experienced varying increases depending on the research sample school, with an average increase of between 23.37 to 34.12. Variations in mproving learning outcomes after this treatment can be understood as many factors influence student learning outcomes. So, the increase in learning outcomes is not linear.

It was concluded that the learning outcomes of students involved in learning that integrated SQ3R reading techniques assisted by AR media and those that applied the expository method were significantly different. Its effectiveness is relatively high.

TABEL 3- DESCRIPTIVE STATISTICAL VALUES OF LEARNING OUTCOMES

Schools	Statistical Descriptives	Exp. Class		Cont.Class	
		Pre	Post	Pre	Post
MTs Assalam Pontianak	Mean	49.44	75.48	36.60	59.25
	SD	10.07	12.16	11.51	13.91
	Minimum	22	50	24	34
	Maximum	80	100	80	90
SMPN 3 Teluk Keramat	Mean	28.72	54.92	27.04	49.68
	SD	10.75	11.77	11.73	17.67
	Minimum	16	12	0	10
	Maximum	50	80	51	76
SMPN 11 Pontianak	Mean	56.06	76.56	42.44	75.44
	SD	15.86	11.66	16.31	9.54
	Minimum	30	53	6	52
	Maximum	82	100	80	100
MTs Darul Ulum Matang Danau	Mean	41.76	66.04	37.59	53.15
	SD	13.93	11.74	11.36	10.53
	Minimum	21	43	16	32
	Maximum	63	90	57	73

From tracing of foreign and domestic journals, it is convinced that there has not been much research that integrates the SQ3R reading technique assisted by AR media. In fact, it has never been done, especially when studying Solar System material in seventh grade of junior high school. The results of previous research mostly focused on testing the effectiveness of the SQ3R reading technique and the use of AR media in learning certain teaching materials separately Egyankosh [17] emphasizes that learning is a function of interaction between personal factors and the environment and "can be mathematically represented as; $L = f(EF \times PF)$, where $L =$ Learning; $f =$ Function; $EF =$ Environmental Factors; $PF =$ Personal Facts. Benjamin [18] stated that students or people bring numerous individual differences with them into memory experiments, and many of these variables affect learning. In the classroom, motivation matters, although experimental attempts to induce motivation with money yield only modest benefits. Learners are, however, quite able to allocate more effort to learning prioritized over unimportant materials.

The results of research conducted by the Indonesia Ministry of Education and Culture Team [19] classified the determinant factors that influence student learning outcomes in schools into 11 (eleven) factors, namely: (1) Study group size; (2) The principal's instructional leadership; (3) Socio-economic status; (4) Metacognition; (5) Mentoring; (6) Peer Tutoring; (7) Ownership and Use of ICT; (8) Feedback; (9) Collaborative Learning; (9) Individualized Instruction; (10) School climate; (11) Parental Engagement, and (12) Student physical and mental factors. Mudzakir and Sutrisno (as cited in the Ministry of Education and Culture Team [19]), stated that important factors that influence learning achievement are: physiologica factors (which are physical in nature) because they are related to physical

conditions that are sick, unhealthy or disabled. Apart from that, psychological factors (spiritual factors) also greatly influence student achievement. These psychological factors include; intelligence, talents and interests, motivation, and mental health.

B. *The Effectiveness of Integrating SQ3R with AR Media*

The average score difference test was carried out in two stages. The first stage is a difference-test of two averages of pre- and post-tests per school and overall (using two independent samples t-test). If there is a significant difference, the analysis continues by calculating the Effect Size (ES) value.

Before treatment, there was no difference in the average initial test of the experimental and control classes in each school. Thus, if after treatment there is a (significant) difference between the two classes, it is assumed to be due to differences in the treatment given. Analysis of the difference test between the experimental and control classes per school, after being given treatment, was analyzed using the t-test for two independent samples and the ES used the Cohen formula. The results are presented in Table IV.

TABLE IV- RECAPITULATION OF DIFFERENT TEST RESULTS FOR EXPERIMENTAL AND CONTROL CLASSES AND THE EFFECT SIZE (ES)

Schools	Exper. Class	Control Class	t	sig	ES	Category
MTs Assalam Pontianak	75.48	59.25	6.742	0.000*	1.24	high
SMPN 3 Teluk Keramat	54.92	49.68	2.794	0.007*	0.35	low
SMPN 11 Pontianak	76.56	75.44	0.432	0.667	-	-
MTs Darul Ulum Matang Danau	66.04	53.15	4.172	0.000*	1.15	high
Total	68.94	59.39	5.165	0.000*	5.54	high
	1.593	1.840				

(* $p < 0.05$)

From Table IV, the findings of this research can be concluded that there is a significant difference in learning outcomes on the topic of the Solar System between students involved in learning that integrates the SQ3R technique assisted by augmented reality (AR) media and those involved in expository learning. The level of effectiveness is relatively high (ES = 5.54).

From tracing study of international and domestic journals, it is convinced that there had not been much research that integrated the SQ3R reading technique assisted by AR media. Even, probably, has never been done, especially in learning Solar System material in first class of junior high school. The results of previous research mostly focused on testing the effectiveness of the SQ3R reading technique and the use of AR media in learning certain teaching materials separately. The findings of this study are in line with the results of previous research. Wijaya et al. [20], for example, concluded that science learning activities that implemented SQ3R were more active and the retention of learning outcomes was better (significantly different) compared to learning activities usually carried out by teachers at SMP Negeri 10 Jember class VII. Classroom action research conducted by Sudirman et al. [21] in class VII SMPN 2 Kendari, involving 40 students, concluded

that there was a very good increase in learning outcomes (from 52.5% to 90.0% in the third cycle. Student learning activities using SQ3R can reach 80.0%.

According to Costa [22], reading and learning in general is a thinking process. According to him. Factors that influence learning outcomes are context or environment. Context or environment is an external variable from the person who is carrying out the thinking process. Second factor, namely; goals-internal variables that are different for each person (*idiosynoratio*). The environment or context greatly influences the involvement and use of the three components of thinking (mental operations, knowledge and disposition) to produce meaning or thinking products. Environmental

factors are divided into three dimensions, that is; time, arena, and subject, topics, data, and subject matter that is being thought about. When the environment changes, then it also changes how a person thinks.

The use of the SQ3R reading technique has been widely used in science learning. SQ3R is the most popular reading technique and is considered effective for improving students' reading abilities (for learning). The reading process involves metacognitive thinking processes. Croner [23] argued that in the context of reading skills, metacognition refers to thinking about what one is reading and it depends upon four variables: texts, tasks, strategies, and learner characteristics. Carin & Sund [24] emphasized that reading and science process skills emphasize the same intellectual processes. Both involve thought processes. When teachers train students to develop scientific processes, whether you realize it or not, he has also helped students develop their reading process.

Considering that reading is a learning activity that is inherent in every student and subject. So, the learning process at school should have an impact on improving reading skills. Learning to read and reading to learn must be developed together during school. Reading is a learning activity to understand scientific content. To become a scientifically literate citizen. Students need to be trained to read, write and repeat. Reading texts involves the same critical thinking as engaging in "hands-on science" activities. Science and reading have a lot in common when it comes to process skills [24]. According to Chrzanowski et al. [25], although language has an important meaning for scientific literacy, everyone is not free from misunderstandings, misperception, or misconceptions that result from the use of language (when reading text).

In this study, after students take the *Reading stage* of the SQ3R technique, before answering the question (*Recite*), the teacher gave examples of mnemonics notes --- namely the acronym technique and the peg technique, to strengthen student retention (memory), for instance: (in Indonesia; *malas aku mas* (anggota tata surya: *matahari*.

planet, satelit, komet, meteor, Asteroid. The farthest distance of the earth (a planet) from the sun is called *apelium* (*jauh*) and the closest is called *perihelium* (*dekat*). Jurowski et al. [26] argued that mnemonics are memory aids or tricks, mental anchor tool, designed to help students learn and remember specific information. In addition to helping students store information and procedures in long-term memory.

Mnemonics also help students remember these things. Learning using this mnemonic learning strategy not only requires active teachers but also involves student activity. The teacher's role in directing students to develop thinking patterns using the mnemonic method is very necessary to make it easier for students to develop their thinking patterns and memory. According to Mocko et al. [27], the use of mnemonics aims to translate information into a form that is easily accepted by the brain and is ready to be transferred into long-term memory. A person's ability to retain memory depends on the technique and ability itself.

Some previous researches had shown that AR can more efficiently support learning outcomes in schools. It is explained that if the teaching material content is represented as a 3D learner, objects can be manipulated and information handled interactively [28], The rapid evolution of technology has changed the face of education, especially when technology is coupled with an appropriate pedagogical foundation. Currently the combination has developed new possibilities to improve the quality and teaching and learning experience in schools [29].

In the context of science learning, it is concluded that the use of AR can overcome the problem of low motivation, interest, and student learning outcomes. Wang [30] stated that augmented reality (AR) can be a successful approach to overcome problems related to teaching magnetic fields. The analysis results show that AR-based motion sensing software can improve students' learning attitudes and learning outcomes. Moro et al. [31] stated that in learning about health sciences, medical anatomy and neurosurgery are also very helpful for using augmented reality as a learning tool. In environments where the required structure needs to be inspected from all angles. Anatomy learning is best done using tools that are able to explain this.

Wang [30] concluded that digital game-based learning designed innovatively for elementary school students in biology learning that combines augmented reality (AR) is as follows: (1) students are very confident and see learning operations satisfactorily; (2) students can achieve their understanding goals; and (3) this research is an innovative teaching program specifically to improve academic achievement and learning efficiency; (4) The application of augmented reality in science, which is the integration of investigation-based teaching activities in science courses, is more effective in involving students more deeply in investigative project activities compared to traditional simulations.

IV. CONCLUSION

In the line of the research problems, it was concluded that there were significant differences in learning outcomes between students who were involved in learning that integrated the SQ3R reading technique assisted by AR media and those who applied the expository method ($t = 5.165$, $p < 0.05$) and its level of effectiveness was classified as high ($ES = 5.54$). SQ3R reading techniques and other audio-visual media based on information technology (IT) should be integrated in physics learning for other teaching materials.

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