



## Learning Revolution: The Positive Impact of Computer Simulations on Science Achievement in Madrasah Ibtidaiyah

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### ABSTRACT

**Purpose of the study:** This study aimed to investigate the impact of using computer simulation media on the learning achievement of elementary school students in natural sciences, particularly focusing on fourth-grade students at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga.

**Methodology:** The study employed a quasi-experimental design using computer simulation media for experimental group teaching and conventional methods for the control group. The sample was taken using a purposive sampling technique, in which two classes were selected from the class IV population, namely one class as the experimental group and one class as the control group. Each class consists of 30 students. Data collection involved pre-tests, post-tests, and questionnaires to measure student interest and motivation. Analysis was conducted using descriptive and inferential statistical methods.

**Main Findings:** The study found a significant increase in learning achievement among students who used computer simulation media compared to those who did not. Post-test results revealed higher scores for the experimental group. Questionnaire responses indicated increased student interest and motivation in the experimental group.

**Novelty/Originality of this study:** This study contributes to the existing literature by specifically examining the effectiveness of computer simulation media in enhancing learning outcomes in natural sciences among elementary school students in a Madrasah setting. It fills a gap in research by providing empirical evidence of the positive impact of such media on student performance and motivation, thus advocating for the integration of technology in primary education.

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## 1. INTRODUCTION

In essence, the teaching and learning process is a communication process. Teaching and learning activities in the classroom are a separate world of communication where teachers and students exchange ideas to develop ideas and thoughts [1], [2]. In communication, deviations often arise and occur so that communication is not effective and efficient [3], [4]. One effort to overcome this situation is the integrated use of media in the teaching and learning process, because the function of media in these activities is not only to provide information stimuli,

attitudes, etc., but also to increase harmony in receiving information [5], [6]. In certain cases the media also functions to regulate progress steps and to provide feedback.

Learning media is an inseparable unit that helps support the teaching and learning process [7], [8]. The school's physical facilities not only have a direct influence on children's absorption capacity, facilitate children's learning, but also act as stimulants for learning, and avoid boredom with varied media [9]. The use of media must be in accordance with the lesson and material to be taught by the teacher [10], [11]. Because not all subjects are suitable to be taught using media. The current development of media used varies greatly, not only books or other media [12], [13].

Along with the development of existing technology, teachers also use computer media for teaching. In urban schools this media is probably nothing new [14], [15]. There is not just one model taught, but various models. One of them is computer simulation media, the use of this media is to introduce students to current technological developments. Using computer simulation media provides students with the opportunity to learn dynamically, interactively and funly [16-18]. This media provides real experience to students without having to directly practice teaching.

By using computer simulation media, it is hoped that it can help students improve their learning achievement in class. Especially for Natural Science subjects where there are many natural events that students need to know about without involving them directly [19-21]. Student achievement at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga is currently in the good category. Every time there is a competition, whether held at school or between schools, many students will definitely take part.

The use of computer simulation learning media for students at Madrasah Ibtidaiyah Ma'arif Global Salatiga will attract more students' attention. Teachers use computer simulation learning media in the classroom so that students prefer the learning that will be delivered. This media will attract students' attention in class [22], [23]. Students who usually do not pay much attention to teachers during the teaching and learning process will pay attention to the lessons that the teacher has packaged to present to students.

Learning achievements at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga, especially for class IV, have shown the level of students' abilities. Class IV is included in the high class category, students must be more familiar with technology so as not to miss out on advances in information technology. In learning, especially natural science (science) learning, teachers must be creative in presenting the material that will be conveyed to students. This is so that students become interested in the lessons so that they do not easily get bored with the lessons delivered by the teacher. Apart from attracting students' attention, students' interest in learning will also increase. Students' curiosity will make them want to learn, so that their curiosity will be answered. In science lessons, students usually get bored easily. So several media are needed that can support students so that their learning achievements can be further improved [24-26]. In the complete Indonesian dictionary, it is mastery of knowledge or skills that are developed through subjects which are addressed by test scores or numbers given by the teacher.

Natural science is an orderly (systematic) science that can be tested and proven to be true. With the belief that nature can be understood. Natural science is a very important way to establish a relationship between humans and nature and their environment [27-29]. Achievement in learning material about parts of plants in this lesson. The media used is also suitable for use according to the material that will be presented by the teacher. Don't let the use of media actually reduce the level of student learning achievement. The media chosen should be in harmony with and support the learning objectives that have been set [30], [31]. Whether or not the material and learning objectives are appropriate will have an impact on student learning achievement results [32], [33]. The use of appropriate media for natural science lessons, especially for the material that will be provided, must be appropriate.

Based on previous research, it was found that computer simulation media increases the level of conceptualization of natural science ideas through unlimited experience and provides tools for scientific investigation, problem solving, and the development of skills in hypothesis construction and graphical interpretation [34]. Thus, the use of media in learning natural knowledge can improve student learning achievement. It is expected that students will be able to understand complex concepts, conduct virtual experiments, and develop the analytical skills necessary for success in the subject.

This research prioritizes the use of computer simulation media as a science learning tool at Madrasah Ibtidaiyah level, especially class IV at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga. This approach is considered innovative, a novelty because there has not been much research that specifically evaluates the impact of computer simulation media on science learning achievement at the basic education level in Indonesia. The focus on educational technology in the madrasa context also provides a new perspective on the application of technology in generally more traditional educational environments.

The implications of the results of this research can provide valuable insight for educators and policy makers in the field of basic education regarding the importance of technology integration in learning. The findings show that increasing learning achievement through the use of computer simulation media can encourage other schools to adopt similar technology. Apart from that, this can be a basis for developing a more interactive and

dynamic curriculum, as well as enriching science teaching methods so that it can increase students' interest and understanding of the subject matter.

The urgency of this research lies in the urgent need to improve the quality of basic education in Indonesia through the use of technology. With increasingly rapid technological developments, education must be able to adapt so that students are not left behind [23], [35]. This research is important to ensure that students in madrasas, who may have more limited access to technology than urban schools, still receive modern and relevant learning. It also highlights the need to train teachers in the use of computer simulation media so that they can be more effective in teaching and motivating students.

The media chosen must also be able to explain what the teacher will convey to students. Effective teaching requires good planning. The media that will be used in the teaching process also requires good planning. The media used and selected should attract students' interest and attention. Apart from being appropriate, it is also beneficial for students so that it can be achieved optimally. With these existing problems, the researcher aims to determine the relationship between the use of computer simulation learning media and the science learning achievement of class IV students at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga.

## 2. RESEARCH METHOD

This research uses a quantitative approach with a quasi-experimental research design. This design was chosen to test the effect of using computer simulation learning media on student learning achievement in Natural Sciences subjects. A quasi-experiment is a research design used to evaluate the effect of a treatment or intervention when the researcher cannot fully control all relevant variables or cannot fully randomize the research subjects [36], [37]. In a quasi-experiment, an experimental group and a control group are used, but the assignment of subjects to the groups is not completely random.

The population in this study were all class IV students at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga in the 2023/2024 academic year. The sample was taken using a purposive sampling technique, in which two classes were selected from the class IV population, namely one class as the experimental group and one class as the control group. Each class consists of 30 students.

The independent variable in this research is the use of computer simulation learning media and the dependent variable in this research is student learning achievement in natural science subjects. The instruments in this research are student learning achievement tests (multiple choice test questions that have been validated to measure students' understanding of the science material being taught) and questionnaires to measure students' interest and motivation to learn before and after using computer simulation learning media. The following is a grid of this research instrument:

Table 1. Research instrument grid

Learning achievement test	Indicator	Questionnaire	Indicator
Plant Parts	Students can explain the functions of roots, stems, leaves, flowers and fruit.	Interest to learn	The level of student interest in science lessons.
Photosynthesis	Students can identify plant parts in pictures or descriptions.	Motivation Study	The level of student enjoyment when taking science lessons.
Water cycle	Students can explain the process of photosynthesis.		Students' desire to learn more deeply about science.
Ecosystem	Students can mention the role of chlorophyll in photosynthesis.		Student interest in the learning media used.
	Students can identify the products of photosynthesis.		Student responses to science learning activities.
	Students can explain the processes of evaporation, condensation, and precipitation.		The student's desire to get good grades in science.
	Students can describe the water cycle in diagram form.		Students' efforts to understand science material.
	Students can identify biotic and abiotic components in an ecosystem.		Students' persistence in completing science assignments.
	Students can explain food chains and food webs.		Students' readiness to take science lessons.
			Students' self-confidence when studying science.

This research procedure begins with preparing a lesson plan using computer simulation media, as well as creating and validating research instruments in the form of learning achievement tests, questionnaires and observation sheets. Next, the experimental group received science learning using computer simulation media for six weeks, while the control group studied using conventional methods. Data is collected through pre-tests and post-tests to measure learning achievement, questionnaires to assess interest and motivation, and observations to see student interactions. Data were analyzed using the t-test to evaluate significant differences between groups, and descriptive analysis to process questionnaire and observation data, in order to identify the effect of computer simulation media on student learning achievement.

Data analysis techniques using descriptive analysis are used to interpret data from questionnaires and observations in order to see changes in students' interest and learning motivation. Followed by a normality test to ensure that the data obtained is normally distributed. This test uses the Kolmogorov-Smirnov method. Then a homogeneity test is carried out to ensure that the variance between the experimental and control groups is homogeneous. This test uses the Levene method. Then the hypothesis test, namely the two independent sample t-test, is used to determine whether there is a significant difference between the learning achievements of students who use computer simulation media and those who do not use it.

### 3. RESULTS AND DISCUSSION

This research involved two IV classes at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga, each consisting of 30 students. The experimental class uses computer simulation media in science learning, while the control class uses conventional methods. The data collected includes the results of pre-test and post-test learning achievement, as well as questionnaires about interest and motivation to learn.

#### 3.1. Pre-test and Post-test results

Before treatment, a pre-test was carried out to determine the initial abilities of students in both groups. The pre-test results show that there is no significant difference between the experimental group and the control group, with the average pre-test scores as follows:

Table 2. Description student pre-test results

Class	N	Mean
Experiment	30	66.4
Control	30	65.8

After knowing the students' initial abilities, they continued by giving treatment to the experimental group, namely using computer simulation media on learning material about plant parts. The following are the results of the post test, the results of measuring student learning achievement after five weeks of using computer simulation media.

Table 3. Description student post-test results

Class	N	Mean
Experiment	30	85.4
Control	30	75.3

The post-test results showed a significant improvement in the experimental group compared to the control group.

Questionnaires are used to measure students' interest and motivation to learn before and after using computer simulation media. The results of the descriptive analysis show an increase in interest and motivation to learn in the experimental group compared to the control group. The measured indicators show an increase as follows:

- The level of interest in science lessons increased from 3.2 to 4.5
- The level of enjoyment when taking science lessons increased from 3.1 to 4.6
- Desire to learn more about science increased from 3.0 to 4.4
- Interest in learning media increased from 3.3 to 4.7
- Response to learning activities increased from 3.0 to 4.5

#### 3.2. Hypothesis testing

The normality test using the Kolmogorov-Smirnov method showed that the pre-test and post-test data from both groups were normally distributed ( $p > 0.05$ ). The homogeneity test using the Levene method shows that the variance between the experimental group and the control group is homogeneous ( $p > 0.05$ ).

The t-test for two independent samples was carried out to determine whether there was a significant difference between the learning achievements of students who used computer simulation media and those who did not. Testing in this research was carried out with the help of SPSS. Table 4 below is the t-test result of this research data which has been simplified in appearance:

Table 4. T test results

Sig. (2-tailed)	Mean Difference	Std. Error Difference	t-test for Equality of Means	
			95% Confidence Interval of the Difference	
			Lower	Upper
.004	-7.57143	2.55345	-12.66676	-2.47610

The two-tailed significant value (Sig. (2-tailed)) is 0.004. This value is smaller than alpha ( $\alpha$ ) which is usually set at 0.05. This shows that there is a statistically significant difference between the learning achievements of students who use computer simulation media and those who do not use it. In other words, the null hypothesis, which states that there is no difference in learning achievement between the two groups, can be rejected. The average difference value (Mean Difference) is -7.57143. This means that the average learning achievement of students who use computer simulation media is 7.57143 points higher compared to students who do not use this media. The negative sign indicates that the experimental group (which used computer simulation media) had a higher average value than the control group.

The 95% confidence interval of the mean difference in learning achievement is between -12.66676 and -2.47610. Since this interval does not include zero, it strengthens the conclusion that there is a statistically significant difference between the two groups. This confidence interval indicates that we can be 95% confident that the difference in mean learning achievement is actually between -12.66676 and -2.47610 points. From the results of the t-test, it can be concluded that the use of computer simulation media in learning Natural Sciences has a significant positive influence on the learning achievement of class IV students at Madrasah Ibtidaiyah Ma'arif Global Blotongan Salatiga. Students who use computer simulation media show a higher increase in learning achievement compared to students who study using conventional methods.

Based on the results of previous research by Çelik [38] it was found that computer simulation media was integrated into the sequence of learning activities in the classroom and laboratory, and carried out at the students' own pace. Computer simulations raise the level of conceptualization of natural knowledge ideas through seamless experience and provide tools for scientific inquiry. Thus, the use of this media in learning natural knowledge can improve student learning achievement because they can learn independently according to the student's own understanding. According to Yang et al. [39] it was found that the main advantage of this computer simulation is that it provides learners with direct feedback and reinforcement from the computer. When students interact with a simulation, students can immediately see the results of the actions or decisions the student takes in the virtual environment. This feedback can take the form of information about mistakes students make, suggestions for improvement, or explanations about concepts being studied.

This research provides a new contribution in the context of the use of computer simulation media in learning Natural Sciences at Madrasah Ibtidaiyah. The main breakthrough lies in the research focus which specifically explores the influence of computer simulation media on the learning achievement of fourth grade students [40], [41]. This research fills the literature gap by providing empirical evidence about the effectiveness of computer simulation media in increasing students' understanding of science material. Apart from that, this research also strengthens evidence that the use of technology in basic education, especially in the madrasa environment, can have a significant positive impact on the learning process.

The novelty of this research lies in an intensive investigation of the influence of computer simulation media on academic achievement of class IV students in the madrasa environment, especially Madrasah Ibtidaiyah Maarif Global Brotongan Salatiga. In contrast to previous studies that broadly discuss technological integration into education, this study provides evidence that shows the effectiveness of computer simulations in increasing students' understanding of scientific content. This study shows a significant increase in learning performance and student interests and motivation, highlighting the unique benefits of the interactive learning environment and rich in feedback created through computer simulations. In addition, this technology has the potential to change traditional learning methods in basic education, especially in the context of madrasas, so as to fill in critical gaps in existing literature and provide practical implications for curriculum development and teaching strategies.

The results of this research have significant practical implications for basic education, especially in madrasas. The use of computer simulation media in science learning can be an effective strategy for improving student learning achievement and also increasing their interest and motivation to learn. These implications underscore the importance of technology integration in madrasa curricula, which can help create a more dynamic and relevant learning environment for students. Apart from that, the results of this research can provide encouragement for other schools to adopt and develop the use of technology in learning.

Although this research provides a valuable contribution, there are several limitations that need to be noted. First, this research was conducted in only one madrasah in a particular location, so generalization of the findings needs to be done with caution to different contexts and populations. Second, the use of a quasi-experimental design causes limitations in controlling external variables that might influence research results. Furthermore, data collection methods that rely primarily on tests and questionnaires may not be able to fully capture students' learning experiences.

For future research, it is recommended to conduct similar research with a larger sample and from various madrasahs in various locations. This will allow broader generalization of the findings. In addition, longitudinal research involving long-term monitoring of the effects of using computer simulation media in learning can provide additional insight into the sustainability of its impact on student achievement. Furthermore, research can explore more deeply the contextual factors and interventions that can influence the effectiveness of using computer simulation media, such as teacher training, access to technology, and institutional support.

#### 4. CONCLUSION

This research highlights the importance of using computer simulation media in learning natural sciences at Madrasah Ibtidaiyah. Through a quasi-experimental approach, this research shows that the use of computer simulation media has a significant positive impact on the learning achievement of class IV students. The post-test results showed a significant increase in the learning achievement of students who used computer simulation media compared to students who used conventional methods. In addition, questionnaire analysis showed an increase in students' interest and motivation to learn in the experimental group. In the context of further research, it is recommended to conduct a broader study with a larger sample and from various madrasahs. Longitudinal research can also be conducted to monitor the long-term impact of using computer simulation media in learning. In addition, further research can explore more deeply the contextual factors that influence the effectiveness of using computer simulation media, as well as intervention strategies that can be implemented to improve learning outcomes. Thus, this research provides a strong foundation for further development in the field of madrasah education.

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