Proceedings of the 4th International Conference on Educational Innovation and Philosophical Inquiries
DOI: 10.54254/2753-7048/16/20231140

Multimedia Learning and Academic Performance

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Abstract: As technology becomes an important part of people's daily lives, multimedia learning in the classroom is becoming more and more common today. However, there is a lot of controversy about the impact of multimedia learning, so its impact and people's perceptions have become a topic of interest to researchers recently. This study aims to examine the impact of multimedia learning on academic performance from different perspectives through the method of controlled experiments. The analysis of existing research mainly focuses on the changes in student performance over a period of time. To further study the influence of multimedia learning on students, this study will review controlled experiments to further compare the relationship between the control group (not using multimedia) or the experimental group (using multimedia learning) and students' academic performance in different subjects. However, there are still Some deficiencies and confounding variables that need to be considered in future studies to improve the results. This study lays the foundation for the future use of multimedia methods in education and can help educators identify directions for instructional improvement.

Keywords: multimedia learning, academic performance, educational psychology

1. Introduction

When the digital gap is gradually narrowing in the 21st century, the status of technology in society is gradually rising, its rapid development and high convenience make technology an indispensable part of human society. As technology integrates into every part of life, people in society are paying more and more attention to using technology to bring more advantages to society, rather than only examining what is technology. The most prominent change that technology brought to society is multimedia along with the popularization of high-tech equipment. This change not only facilitates life, but also contributes to faster progress in entertainment, learning, and other aspects. Among them, multimedia learning is widely used today as an assistant way for students to fully understand what they have learned.

According to Mayer, multimedia learning is people using pictures and words intended to foster learning. People can understand new information easily and generates long-term memory after in-depth analysis through visual-pictorial and auditory-verbal dual information channels [1]. Therefore, low efficiency and low interest brought by traditional teaching methods can be effectively avoided when students learn new knowledge through multimedia channels such as PPT, video, illustrations, and recordings. However, multimedia learning with high technology is not perfect nowadays, there is still a lot of controversy about the impact of multimedia learning. Extensive research has shown

DOI: 10.54254/2753-7048/16/20231140

that multimedia learning and academic performance are positively related, so recent evidence has indicated that multimedia learning should be widely used inside the classroom. Most of the existing articles use experimental data to prove that multimedia learning has a positive impact on student performance to emphasize the importance of multimedia learning. However, multimedia is a double-edged sword, too much information presented in different ways is likely to make students experience the effects of information overload, which means too much information hinders students' limited attention. Moreover, the high cost of equipment construction and maintenance may also become a shortcoming of multimedia learning [2].

After integrating the existing research to analyze the relationship between multimedia learning and students' academic performance, it is found that there has been very little discussion about the negative impact of multimedia learning. While popularizing multimedia teaching, people need a more comprehensive understanding of the advantages and disadvantages of multimedia learning, because education is the foundation of social progress, and it is very important for the development of each country or even the world. Therefore, this article summarizes and discusses the relationship between multimedia learning and academic performance by analyzing existing studies with different structures.

2. Method

The independent variable for this topic is multimedia learning which could be operationalized by making student study new knowledge for one subject by using a multimedia method or not. The dependent variable is the student's academic performance during the experiment time. Academic performance is a more direct way to test whether multimedia learning is helpful or not because it could show the obvious and numerical change in grades. For the experiment group, the dependent variable could be operationalized by comparing the differences between test scores before using multimedia learning and after. For the control group, the same comparison of the pretest and post-test score processes would be made. Then researchers collect the data on the academic performance of each student to make an analysis and draw conclusions.

To answer the proposed research question with multimedia learning and student academic performance as variables, the quantitative research techniques about experimental design with experimental and control groups would be most appropriate to clarify the relationship between multimedia learning and academic performance. Because by looking at the established framework of existing research, controlled experiments can provide clear and detailed data with different groups that would be helpful to further compare the results. In that way, researchers can more clearly know the gap in whether to use multimedia learning or not, and analyze the impact of confounding variables on the data in each group as intuitively as possible. Besides, according to Genç Osman Ilhan and Şahin Oruç's research literature review, experimental design is regarded as the best model for comparing two groups, time limits, reliability and testing the hypothesis of cause and effect [3].

The experiment from previous studies selected students from the same grade and class in the same school as participants, which ensures that only a single variable appears and helps maintain the accuracy of the experimental results. And using participants with the same age group, cultural background, and learning experience can reduce the impact of other confounding variables like teaching methods, teaching materials, and learning arrangements on the experimental results. A class of participants will be randomly assigned to a control group (no multimedia learning) or an experimental group (using multimedia-assisted learning). It is worth noting that in the settings of experiments, the difference in learning methods of students will only be reflected in the same subject, and the method of multimedia learning will also be presented singly, such as using PPT or video to assist learning. Both pre-experiment and post-experiment scores of students will be recorded and will eventually be used for comparison as evidence to support the experimental results for determining whether multimedia learning has a positive impact on student's academic performance.

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Furthermore, researchers should be aware of the influences on experiment results from different possible reasons. Although the students possibly have similar backgrounds and the same education process, different students may have different acceptance of multimedia learning. The fixed experiment time needs to be continued examined whether it can provide a reliable and real experiment result. Because only one subject is used as the basis, students' interest in the subject being tested also affects academic performance and final results. In addition, researchers also need to consider the efficiency of students' extracurricular learning, and whether the use of multimedia learning will become a distraction that will affect other aspects of students' life or learning performance.

3. Literature Review

Because in the present society, most schools have used multimedia as part of daily teaching, so many studies will also pay attention to the opinions of teachers and students on multimedia learning. In the following article review section, there will be the impact of multimedia learning and opinion on multimedia learning in two parts to be summarized separately.

3.1. Impact of Multimedia Learning

At the core of multimedia, teaching is to provide students with stimulating experiences to better understand concepts by delivering information using different applications. The use of multimedia technology largely ensures efficient, interesting, motivating, interactive, and high-quality delivery of classroom teaching, while meeting the needs of different learners [4]. However, due to the limited ability of people to process information, for people to enjoy high-quality education without affecting efficiency different forms of multimedia (including PowerPoint, simulation, computer games, and virtual reality) have been developed. Reviewed articles cover as many different school subjects as possible to clearly show that multimedia learning could bring advantages to students' academic performance. Because high-tech technology always has advantages and disadvantages, the research also focuses on the impact of different multimedia methods.

To examine the relationship between several multimedia learning methods and academic performance, Genç Osman Ilhan and Şahin Oruç use the controlled experiment method with 67 social studies 4th-grade students in Kayseri, Turkey [3]. The participants were randomly assigned to two groups, multimedia learning through computers was used for the experiment group, and course book study was used for the control group. However, the researchers did not limit the multimedia learning method to only one category, the experiment shows that PowerPoint, audio records, and a documentary were used for the experiment group. This study stresses the importance of both visual and auditory stimuli of multimedia learning for academic performance. Also, the experiment suggests that there is no significant difference in academic performance for the pretest in experimental and control groups, but when the grades of the experiment group itself were analyzed, a statistically significant difference is observed between the pre and post-tests. Therefore, the result could be concluded as multimedia learning positively affects students' academic performance [3]. To be noticed, only 10 hours of implementation and usage of 67 participants might be biased, making the results hard to conclude the accurate universal patterns for the whole society.

Akinoso uses the computer, calculator, speaker, etc. as a multimedia learning method to conduct a controlled experiment with 60 senior students in two different secondary schools [5]. The study compares the data about Mathematics Achievement Test (MAT) from control and experiment groups and found out students in the experimental group have higher average MAT scores than students in the control groups, showing that multimedia learning is useful for increasing students' academic performance in the field of mathematics. Moreover, the author also tried to use differences in interest in computers and technology between boys and girls to get the impact of gender differences on

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students' academic performance. However, the data shows no significant difference between the mean achievement scores of male and female students taught mathematics using multimedia materials [5]. Although this experiment has a small participant group, it has provided future researchers with a new direction to investigate the impact of gender differences or other possible variables on multimedia learning and academic performance.

Next, several studies raised other supposes about the possible influencing factors and included them in the designed experiments. Joshi et al. used the different participant structures and experiment time from previously reviewed articles to conclude the results [6]. In this study, researchers investigated more than 25,000 undergraduate students in a South Korean university and divided the experiment into two parts: first examine the relationship between multimedia learning method (video and animations) and academic performance during an 8 semester observations time; then for the second experiment, seating location of students be considered as an influential factor for academic performance. The difference between these two experiments is the second one was conducted with a small class using about 43 participants. Joshi et al. conclude that seating location and multimedia learning will have a positive impact on students' academic performance [6]. The study results show better academic performance with students sitting around the last row and near the multimedia screen, also students pay more attention to multimedia resources than regular class materials like textbooks and lecture notes. Furthermore, researchers Joshi et al. also mentioned the idea that through checking the cellphone using time and students' facial expressions to analyze students' attention time paid in class, they tried to determine students' distractions reasons help future educational institutes or educators improve classroom settings and make useful application to increase the study efficiency of students. Lauc et al. also use different multimedia learning methods including video, visual stimulus, or association games and traditional learning material like printed text and pictures to make the controlled experiment [7]. Participants in 170 students from 4 different elementary schools in Croatia. However, besides the immediate knowledge test after students studied the class material, they also are asked to assess on a 5-point Likert scale how interesting, fun, and instructional each activity was. Results show better motivation and higher grades in the experiment group with multimedia learning involved. Lauc et al. state that better academic performance is also correlated with higher study motivation, it helps the field about the relationship between multimedia learning and study motivation to build a solid base to make future research [7].

Incedayi discussed the importance of using animation as a multimedia learning method to help students improve their academic performance [8]. 20 experiment group participants used animation to learn plate tectonic in geography class, and 20 control group participants used dialog and discussion as a traditional learning method. After taking the lesson quiz, the multimedia learning method was found very helpful for students to learn geography knowledge and understand volcanic activities, and natural hazards very well. Multimedia learning methods could convey more information than traditional learning methods at the same time increase students' academic performance. Another special study was done by Momcilovic, mobile applications being used as a special multimedia learning method for experiment groups. The purpose of this study is to test the contribution of the mobile application to the quality and durability of knowledge of botanical fieldwork [9]. 120 fourth-grade students as participants be divided into control and experiment groups. Researchers use a pretest to ensure the equalization of all participants, and a post-test after they have done the field study, then a retest three months after the post-test. However, the control group in this study also has the multimedia tool, a computer, in the computer classroom and at home to help them identify the plants. Momcilovic's study has significant grade differences in the post-test between the experiment group and control group, also experiment group students show higher quality and durability of knowledge in the re-test [9]. That demonstrates multimedia learning does have a positive influence on students'

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academic achievement, and using convenient multimedia tools for fieldwork would help improve students' study quality and durability.

These experiments help the education field to conclude that multimedia learning can indeed help students improve their academic performance in various subjects by adopting similar experimental structures and procedures. Compared with traditional teaching methods, the advantages of multimedia learning are very prominent, it can help students improve their learning efficiency and learning interest. At the same time, because everyone has different acceptance of multimedia tools, people's attitudes towards multimedia learning are also important for researchers.

3.2. Attitude Towards Multimedia Learning

Some of the previous studies mentioned the importance of people's opinions or interest in multimedia learning, which could also become part of the influence on students' academic performance. The study made by Shakil et al. and Khan et al. ask school teachers' and students' opinions on multimedia learning on a large scale by using questionnaires or surveys, the results show that most teachers and students in the school think that the use of multimedia has a significant impact on students' academic performance [10,11]. Khan et al. found that students believe that the help of multimedia makes them actively participate in classroom activities, concentrate on lectures more, and the help of multimedia learning improves learning performance and reduces cognitive load [11]. Shakil et al. also conclude the results from surveys and questionnaires that most principals, teachers, and students are in favor of using multimedia in schools to improve school performance [10]. However, due to social or government welfare policies, they also think that the school does not provide students with multimedia learning facilities and teachers with relevant teaching experience.

While all experimental research has focused on testing the effectiveness and liking of multimedia learning, there has been a gap in the research on national and regional differences.

4. Suggestion

All the studies mentioned above revealed that multimedia learning can have a positive impact on student achievement. And studying the possible diverse effects of multimedia on learning of different subjects also helps to provide a solid theoretical basis for future experiments. The experiment results obtained through the controlled experiment can guarantee the reliability and accuracy of the research. At the same time, in the process of retrieving related articles, the present study found that there were relatively few articles about the negative aspects of multimedia learning, and in the experimental design, articles with primary and secondary school students as participants accounted for the majority, so there is still some research gap in these aspects. The methods of effectively controlling and reducing confounding variables are not mentioned in the experimental process of many articles, so the results of the experiment may be affected. However, existing articles can indeed prove that multimedia learning has multiple advantages, students' learning interests and academic performance can also show that multimedia learning is successful for the steady development of education in today's society. In the case of too many confounding variables, each school should analyze and decide whether to use multimedia learning according to the actual situation.

5. Conclusions

By summarizing the conclusions and data of previous studies, this paper finds that multimedia learning has a positive impact on student's academic performance in all aspects and subjects. The advantages and disadvantages of multimedia learning are always a big controversy in society because education has a lot to do with the development of society and even the progress of the whole world. However, through literature review, it is found that there are indeed many advantages of multimedia

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learning. First, multimedia learning is to strengthen students' dual perception of new knowledge through high-tech means. Most studies have conducted experiments using different multimedia learning methods and found that students' grades are significantly improved compared with using traditional learning methods. Secondly, student's enthusiasm for learning will gradually increase due to the use of multimedia learning like video, games, recording and other methods. Because multimedia combined entertainment and education in a successful way.

These studies help the public to have a basic understanding of multimedia learning and reduce the perception that technology can only have a negative impact on students. The researchers also demonstrated that multimedia learning is well accepted by presenting students' and teachers' opinions. However, as described in this literature review, there are still many confounding variables that need to be considered in the relationship between multimedia learning and students' academic performance. Students' extracurricular study habits, students' preferences for subjects, and even the seating location in the classroom may have a significant impact on the conclusions. Because there are few articles about the negative aspects of multimedia learning, the only information people can get is through several websites without professional analysis, so it is impossible to make a comprehensive comparison between the disadvantages and advantages of multimedia learning. Further research and analysis for these research gaps are needed, that will be helpful to generate more accurate and common conclusions for society.

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