GLOBUS PUBLICATION

Cosmos Journal of Engineering & Technology
A Refereed Research Journal
Vol 15 / No 1 / Jan-Jun 2025 ISSN: 2231-4210

TEACHERS' ASSESSMENT OF MULTIMEDIA TOOLS USED IN SELECTED SCIENCE CLASSES IN BULACAN

*Paolo M. de Guzman

Paper Received: 28.11.2024 / **Paper Accepted**: 22.12.2024 / **Paper Published**: 24.12.2024
Corresponding Author: Paolo M. de Guzman; Email: paolo.deguzman001@deped.gov.ph; doi:10.46360/cosmos.et.620251006

Abstract

This study determined and evaluated the effectiveness of multimedia-based instructions in teaching science subjects and crafted an action plan in strengthening the use of multimedia in teaching science discipline. The ex post facto research method under the quantitative research was designed in analyzing the assessment of teacher respondents. The purposive sampling approach was also used in the selection of the respondents. There were 20 secondary schools with at least 100 science teachers that served as respondents as target locale of the SDO in Bulacan. The findings of this study revealed that the most used multimedia platforms in teaching science subjects assessed by the teacher respondents are the Presentation Tools. Moreover, there is a significant difference in educational effectiveness and design features. This indicates that perception in multimedia effectiveness differs from one another in terms of sex and years in service. However, there is no significant difference in the indicator's entertainment value and user friendliness of technology regardless of the respondents' profile. Therefore, there is a significant difference in teacher's assessment in multimedia-based instruction when grouped according to profile. As for the desirable multimedia assessment indicators, the greater the rating means the better the quality of the multimedia-based platform. It is recommended that the school administration take the initiative in integrating multimedia in each classroom. There must be a strong integration of multimedia materials in every school.

Keywords: Multimedia, Teaching Science, Presentation Tools, Educational Effectiveness, Technology.

Introduction

The concept of multimedia in teaching science subjects is not a new one. Students have long been immersed in classrooms in which teachers use PowerPoint presentation and other web tools in teaching the lessons. The multimedia being used today can be summed up as a seamless digital integration of text, graphics, animation, music, still images, and motion video to give users a high degree of control and engagement. A learning environment that combines words and images for the purpose of facilitating learning is called a multimedia learning environment.

In the preceding years, most of the science teachers caressed difficulty in handling science lacking clear visual presentations. Most of the attention has focused on understanding the impact of visual representations in textbooks and multimedia materials have on students and their learning. However, very few studies have focused on teachers' use multimedia.

This study determined and evaluated the effectiveness of multimedia-based instructions in teaching science subjects and crafted an action plan in strengthening the use of multimedia in teaching science discipline. This research paper aimed at helping the teacher for further improvement of their method or towards the implementation of strategies on how to motivate students to learn in science courses. Using multimedia in the classroom helps the teacher engage the students and helps the student be more involved and retain more information from the lesson. On the part of the student, multimedia applications engage learners and provide valuable learning opportunities and also encourages deep reflective thinking because it is encouraging the students to work in groups, express their knowledge in multiple ways, solve problems, revise their own work, and construct knowledge.

Theoretical Framework

One of the most widespread theories that deals with the correct design of multimedia materials is the Mayer's Cognitive Theory of Multimedia Learning. Multimedia learning theory is based on the idea that when using multimedia, it is important to reduce cognitive load and therefore improve the information processing capabilities of our memory. "A major challenge for instructional designers is that meaningful learning can require a heavy amount of essential cognitive processing, but the cognitive resources of the learner's information processing system are severely limited. Therefore, multimedia instruction and assessment should be designed in

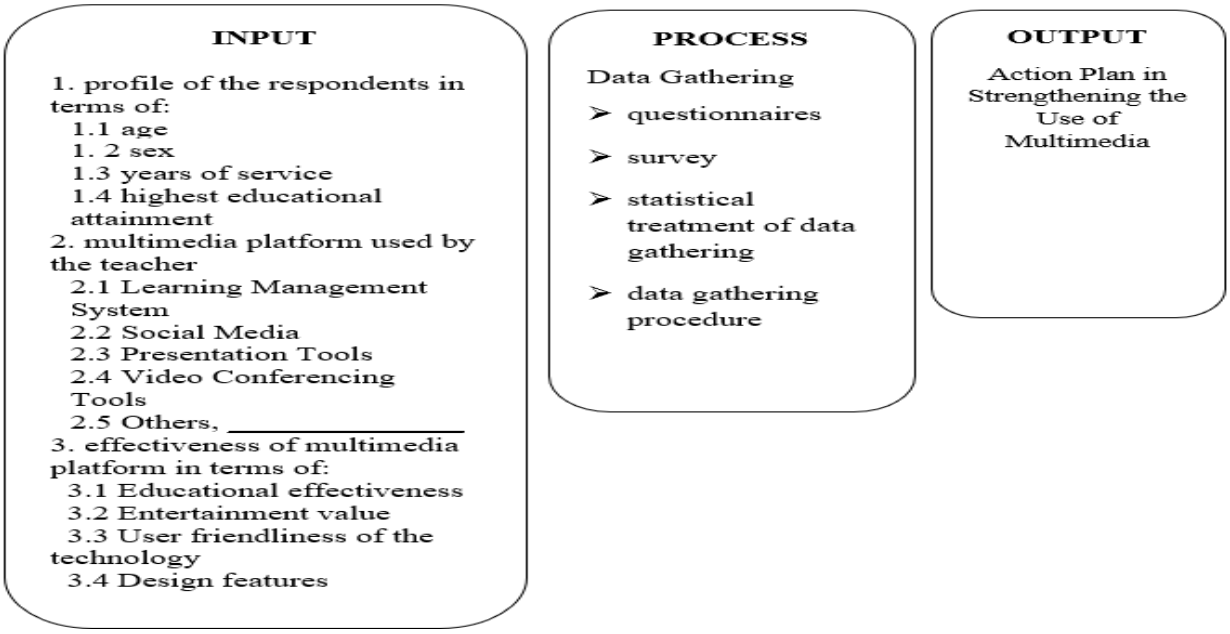
Department of Education, Norzagaray National High School, Philippines.

ways that minimize any unnecessary cognitive load".

Conceptual Framework

The framework can serve as a reliable tool to assess multi-media learning platforms or at least can assist the teachers to get general ideas about the quality of multimedia tools in teaching science. The conceptual model of the study, as shown in Figure 1, the researcher adopted the Input Process Output (IPO) model. It includes all the materials and information that are required in the process, the specific details of the process itself, and the guide on the integration of multimedia in teaching science subjects among secondary teachers.

Figure 1: Conceptual Model of the Study



Statement of the Problem

The primary concern of this study assessed the teacher's assessment of multimedia tools used in teaching science among secondary school in the Eddis VI - Schools Division Office of Bulacan. Specifically, this study sought an answer to the following questions:

1. What is the demographic profile of the respondents in terms of?
   1.1 age
   1.2 position/rank
   1.3 years of service
   1.4 highest academic achievement
2. How may the extent of use of multimedia-based teaching be described in terms of:
   2.1 Learning Management System (such as Google Classroom and Edmodo)
   2.2 Social Media (Facebook/Messenger, YouTube, Twitter, Instagram and Tiktok)
   2.3 Presentation Tools (such as PowerPoint Presentations and Google Slide)
   2.4 Video Conferencing Tool (Zoom, Google Meeting, MS Teams)
   2.5 Other platforms/tools, _____
3. How effective the multimedia platform used by the teachers in teaching science discipline in terms of:
   3.1 educational effectiveness
   3.2 entertainment value
   3.3 user friendliness of technology
   3.4 design features
4. Is there a significant difference on the respondents' assessment on the multimedia effectiveness when grouped according to profile?
5. Based on the result of the study, what action plan may be crafted on strengthening the use of multimedia in teaching science?

Scope and Delimitation

The major concern of the study was to determine the most common multimedia platform that science teachers used in discussing the lesson and assessed the effectiveness of multimedia instructions in teaching science courses in the public secondary schools in the Eddis VI District of SDO Bulacan for the academic year 2023-2024. The descriptive ex post facto method under the quantitative research was designed in analyzing the assessment of teacher

respondents in terms of; respondent's profile, multimedia used by the teacher and its effectiveness which obtained using a survey questionnaire.

The purposive sampling approach was also used in the selection of the respondents. There will be 20 secondary schools with at least 100 science teachers that served as respondents from the study from the Eddis VI District as target locale from the SDO in Bulacan. In analyzing the significant difference on the respondents' assessment on the multimedia effectiveness when grouped according to profile, ANOVA test also used.

Methodology

Research Design

This study focused on using Descriptive Ex Post Facto Research. According to Silva (2010), descriptive ex post facto study or after-the-fact research is a category of research design in which the investigation starts after the fact has occurred without interference from the researcher. It is also often applied as a substitute for true experimental research to test hypotheses about cause-and-effect relationships or in situations in which it is not practical or ethically acceptable to apply the full protocol of a true experimental design. Despite studying facts that have already occurred, ex post facto research shares with experimental research design some of its basic logic of inquiry.

In this study, quantitative approach also used in analyzing the assessment of teacher respondents in terms of; respondent's profile, multimedia used by the teacher and its effectiveness which obtained using a survey questionnaire. The survey questionnaires served as the primary source of the data gathering tool in the study, and this was administered to the respondents using digital platforms. Also, RA10173 followed strictly to comply with the ethical standards from the start to the end part of the study.

Participants/Respondents of the Study

The respondents of this study are the public high school science teachers (junior and senior) in Eddis VI District. Teacher respondents are handling science subjects at least one (1) year in service to satisfy the objective of the study.

Moreover, purposive sampling was also used as a technique of the study. The primary consideration in purposive sampling is the judgment as to who can provide the best information to achieve the objectives of your study (Kumar, 2011).

Instrument/s of the Study

The study utilized a survey questionnaire as the main research instrument that was used by the researcher to gather data on teacher's assessment in multimedia-based teaching of science subjects among secondary school teachers. The instrument consists of the following sections:

Section 1: Profile of the Respondents - This section determined the background of the respondents. This includes items such as age, sex, years of service in teaching and highest educational attainment.

Section 2: The Integration of Multimedia in Teaching science – On this part, it was determined the most common multimedia platforms used by the teacher in teaching science subjects. The following multimedia platform comprises; Learning Management System, Social Media, Presentation Tools, Video Conferencing Tools and other platforms to be mention. The Likert Scale used in this study is the 5 - point Level of Frequency.

Section 3: Multimedia Platform Evaluation – This section assessed the effectiveness of multimedia in teaching science using the four indicators namely, educational effectiveness, entertainment value, user friendliness of the technology and design features. The Likert Scale used in this study is the 5 - point Level of Agreement.

Data Collection and Analysis

1. The researcher submitted the revised manuscripts based on the proposal defense and received the ethical clearance from La Consolacion University Philippines Ethics Review Committee.
2. The study determined the Teacher's Assessment in Multimedia Based Teaching of Science Subjects Among Secondary School Teachers". The study employed three-part types of tools. Parts 1 involve demographic profile and part 2 multimedia platform used by the teachers, while Part 3 involves the multimedia evaluation tool. The data collection followed several steps.
3. In protecting the confidentiality of the data, the researcher ensured that the data collected will be safe and secure.
4. The Google form responses was downloaded immediately after all the responses are collected and stored in a password-protected folder in the researcher's laptop.
5. The researcher downloaded the file in google forms and google drive and transform it in Excel format for analysis of data. Terms and conditions govern electronic data transfer from the researcher's computer to the third-party statistician. The transfer sent to the official email of the statistician.
6. After the responses are encoded, the data will be destroyed immediately after 3 month of storage duration. The hard copy of the questionnaire will be shredded completely to avoid further use. The soft copy will be deleted on the same day from

the file folder to completely remove the data from the computer.
7. The data collected was tabulated and processed using Statistical Packages for Social Sciences (SPSS). In order to analyze and interpret the data that gathered, the following statistical measures was used:

In this quantitative type of study, data from demographic profile and common multimedia platform used by secondary science teacher-respondents in terms of Learning Management System, social media, presentation tools, video conferencing tools and others platforms was described using frequency, percentage and weighted mean. The Likert Scale also be used in common multimedia platform used by secondary science teacher-respondents is the 5 - point Level of Frequency. The assessment of multimedia platform used by the teacher in teaching science discipline was described using frequency, percentage and weighted mean of the four indicators such as educational effectiveness, entertainment value, user friendliness of technology and design features. The respondents can be described the effectiveness of multimedia platforms using the 5 - point Level of Agreement. In analyzing the significant difference on the respondents' assessment on the multimedia effectiveness when grouped according to profile, ANOVA test also used. ANOVA stands for Analysis of Variance. One-Way Analysis of Variance tells you if there are any statistical differences between the means of three or more independent groups.

Ethical Considerations

The researcher submitted the revised manuscripts based on the proposal defense and received the ethical clearance from La Consolacion University Philippines Ethics Review Committee.

Upon approval to conduct the study, the researcher informed all the participants about the purpose of the study and significance of its findings. It was clearly stated through an informed written consent and assent from that participation would be completely voluntary. Likewise, the researcher assured confidentiality and voluntarily withdrawal from the study without the necessity of providing an explanation or of any prejudice at any point during the conduct of the study.

Results and Discussion

- The most used multimedia platforms in teaching science subjects assessed by the teacher respondents are the Presentation Tools, dominating the other multimedia platform. Respondents believed that when effectively planned and used, PowerPoint (or similar tools, like Google Slides) can enhance instruction. Multimedia tools are used to project visuals that would otherwise be difficult to bring to class.
- In terms of multimedia educational effectiveness, indicator "science teaching principles and visuals, multimedia enhances the achievement of the program educational objectives" had a verbal meaning of strongly agree based on the assessment of teacher respondents. That in education, educational effectiveness helps students achieve their learning goals. Effective teaching can help to assess the needs of the students, allowing them to understand which classroom strategies may be helpful.
- Entertainment value had a general interpretation of strongly agree based on the assessment of teacher respondents. It has been clearly witnessed that the topic which is explained with multimedia approaches take a lot less time to be explained and the student can also enjoy the science environment and refresh one's mind and preserve learner's mental health as well as emotional well-being.
- The finding also revealed that regarding the friendliness of the technology, the navigation tools are readily available through menus and icons are the top indicator of the teacher respondents. This means multimedia platform's programs, apps, and other digital content must be accessible for use and can be manipulated for individual or group instruction.
- Furthermore, most teacher-respondents concluded that indicators sound and video are an alternative means of presenting scientific information and the sound and video can be played smoothly and adjusted or muted at will have a result of agree. This shows that multimedia design features are a good way for presenting scientific information because that can be easy to communicate and understand what its purpose. This can be easier to attract students to listen to what is supposed to be.
- Moreover, there is a significant difference in educational effectiveness and design features. This indicates that perception in multimedia effectiveness differs from one another in terms sex and years in service. However, there is no significant difference in the indicator's entertainment value and user friendliness of technology regardless of the profile of the respondents. Therefore, there is significant difference on teacher's assessment in multimedia-based instruction when group according to profile.

Conclusion

After recording and analyzing the outcome of the study, herewith are the conclusions drawn:

- That most of the teacher respondents conducted in this study was female, aged 31 – 40, which have a Bachelor's Degree and teaching around 6 – 10 years in their chosen career.
- The most used multimedia platforms in teaching science subjects assessed by the teacher respondents are the Presentation Tools, dominating the other multimedia platform. Respondents believed that when effectively planned and used, PowerPoint (or similar tools, like Google Slides) can enhance instruction. PowerPoint is an effective tool to present material in the classroom and encourage student learning. Respondents used multimedia tools to project visuals that would otherwise be difficult to bring to class.
- In terms of multimedia educational effectiveness, indicator "science teaching principles and visuals, multimedia enhances the achievement of the program educational objectives" had a verbal meaning of strongly agree based on the assessment of teacher respondents. That in education, educational effectiveness helps students achieve their learning goals. Effective teaching can help to assess the needs of the students, allowing them to understand which classroom strategies may be helpful.
- Entertainment value had a general interpretation of strongly agree based on the assessment of teacher respondents. It has been clearly witnessed that the topic which is explained with multimedia approaches take a lot less time to be explained and the student can also enjoy the science environment and refresh one's mind and preserve learner's mental health as well as emotional well-being.
- The finding also revealed that regarding the friendliness of the technology, the navigation tools are readily available through menus and icons are the top indicator of the teacher respondents. This means multimedia platform's programs, apps, and other digital content must be accessible for use and can be manipulated for individual or group instruction.
- Furthermore, most teacher-respondents concluded that indicators sound and video are an alternative means of presenting scientific information and the sound and video can be played smoothly and adjusted or muted at will have a result of agree. This shows that multimedia design features are a good way for presenting scientific information because that can be easy to communicate and understand what its purpose. This can be easier to attract students to listen to what is supposed to be.
- The findings of this study anchored on the Mayer's Cognitive Theory of Multimedia Learning (2003). Generally, the framework can serve as a reliable tool to assess multi-media learning platforms or at least can assist the teachers to get general ideas about the quality of multimedia tools in teaching science. As for the desirable multimedia assessment indicators, the greater the rating means the better the quality of the multimedia-based platform.
- Moreover, there is a significant difference in educational effectiveness and design features. This indicates that perception in multimedia effectiveness differs from one another in terms sex and years in service. However, there is no significant difference in the indicator's entertainment value and user friendliness of technology regardless of the profile of the respondents. Therefore, there is significant difference on teacher's assessment in multimedia-based instruction when group according to profile.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are being offered:

1. It is recommended that the school administration take the initiative in integrating multimedia in each classroom. There must be a strong integration of multimedia materials in every school. Thus, an Information Technology personnel member shall be available in the school to assist the teachers and students.
2. To ensure proficient delivery of performance, teachers shall open themselves to various types of experiences that could help them better understand the learners.
3. Further, teachers are recommended to be trained in the various aspects of the use of multimedia and other social media applications that are not frequently used via workshops, seminars, short-term courses, and the like.
4. Faculty and school staff must promote Multimedia and Information Literacy. This would create an awareness in the students that lifelong learning is vital with global change and innovations.
5. Ultimately, a school administrators and teachers must utilize and consider the output of this research in providing technical assistance to enhance the implementation of science curriculum which may contribute for further improvement of teacher's quality of teaching and student's academic achievement. This action plan is called ATOMICA: Application as Teaching Strategy of Multimedia-Based Instruction on Classroom Activities. This action plan aims

to enable teachers and students to have knowledge and practical experience in enhancing their scientific skills and improving academic performances, respectively. Generally, the framework is able to serve as a reliable tool to assess multi-media learning platforms or at least can assist the teachers to get general ideas about the quality of multimedia tools in teaching science.

6. A similar study may be conducted to verify the results of this paper. Furthermore, future researchers can expand the coverage of their study by extending the scope to the national level.

Conflict of Interest

There is no conflict of interest between the authors in this manuscript. Results have been deduced objectively; nothing influenced this result by any individual, monetary, or institutional interests. In effect, utmost endeavors were in order to conduct a bias-free operation of gathering and analyzing the data into interpretation and producing a study based on merit, away from research inconsistencies.

References

1. Abdi, A., Ridha, S., Yunus, M., Kamil, P., Safiah, I., & Gadeng, A. (2021). Assessing the Effectiveness of Geography-based Online Learning During the Covid-19 Pandemic in Higher Education. Geosfera Indonesia, 6(3), 319-333. doi:10.19184/geosi.v6i3.25811
2. Abdulrahaman MD, Faruk N, Oloyede AA, Surajudeen-Bakinde NT, Olawoyin LA, Mejabi OV, Imam-Fulani YO, Fahm AO & Azeez AL. (2020). Multimedia tools in the teaching and learning processes: A systematic review. Heliyon, 26(11), e05312. doi:10.1016
3. Aloraini, Sara. (2012). The impact of using multimedia on students' academic achievement in the College of Education at King Saud University. ISSN 2210-8319. https://doi.org/10.1016/j.jksult.2012.05.002.
4. Altan, T. & Cagiltay, K. (2022). An Eye Tracking Based Investigation of Multimedia Learning Design in Science Education Textbooks. Educational Technology & Society, 25(2), 48-61. https://eric.ed.gov/?q=multimedia+teaching+in+science&id=EJ1344884
5. Anthony Jnr, B. & Noel, S. (2021). Examining the Adoption of Emergency Remote Teaching and Virtual Learning During and After COVID-19 Pandemic. International Journal of Educational Management, 35(6), 1136-1150. https://doi.org/10.1108/IJEM-08-2020-0370
6. Bahian, H. (2019). The Use of Multimedia instruction in Teaching Science Concepts. Ascendens Asia Journal of Multidisciplinary Research Abstracts, 3(2). https://ojs.aaresearchindex.com/index.php/AAJMRA/article/view/7285
7. Budiarto MK, Joebagio H & Sudiyanto. (2020). Integration of Interactive Multimedia with Local Potential as a Learning Innovation in Digital Era. Proceedings of the 4th International Conference on Arts Language and Culture, 336-345. https://doi.org/10.2991/assehr.k.200323.040
8. Callao, M. (2020). Impact of Integration of Multimedia in Teaching Science. IJARIIE-ISSN(O)-2395-4396, 6(5).
9. Capulong M., Bergantiños K., Honrubia K., Integro MG., Trinidad D., & Ablen A. (2019). The Effects of Multimedia in Teaching English in Senior High Students at Bestlink College of the Philippines AY: 2018-2019. Ascendens Asia Singapore - Bestlink College of the Philippines Journal of Multidisciplinary Research Abstracts, 1(1).
10. Castro-Alonso, J.C., Wong, R.M., & Adesope, O.O. (2021). Effectiveness of Multimedia Pedagogical Agents Predicted by Diverse Theories: A Meta-Analysis. Educ Psychol Rev 33, 989-1015. https://doi.org/10.1007/s10648-020-09587-1
11. Chelliah, S. & Masran, N. (2020). Using Interactive Multimedia Courseware to Improve Algebra Thinking Among Year 4 Students. International Journal of Modern Education, 2, 59-75. 10.35631/IJMOE.27005.
12. Code, J., Ralph, R. & Forde, K. (2020), Pandemic Designs for the Future: Perspectives of Technology Education Teachers during COVID-19. Information and Learning Sciences, 121(5/6), 419-431. https://doi.org/10.1108/ILS-04-2020-0112
13. Cruz E., Arellano M., Sales M., Ombina J., Balatucan R. & Ablen A. (2019). The Use of Multimedia in Teaching Grade 12 at Bestlink College of the Philippines: Its Effects to Academic Performance. Ascendens Asia Singapore - Bestlink College of the Philippines Journal of Multidisciplinary Research Abstracts, 1(1).
14. Dariyono & Mukhidin. (2021). Using Multimedia Interactive in Online Learning in the Covid-19 Pandemic. Proceedings of the 6th UPI International Conference on TVET 2020, 11-14, 2352-5398. https://doi.org/10.2991/assehr.k.210203.076
15. Davis, E. & Wheeler, K. (2020). Use of 3D Printing to Manufacture Document Camera Mounts in Support of Online Education Shifts during the COVID-19 Pandemic. Journal of Chemical Education, 97(9), 2691-2695. DOI: 10.1021/acs.jchemed.0c00629
16. Egede, B. (2021). An Assessment of Final Year Pre-Service Teachers' Readiness to Use

ICT to Teach Implication for COVID-19 Education Response. Frontiers in Education Technology, 4, 66. 10.22158/fet.v4n1p66
17. E. M. Crisologo, A. C. Guinto, M.J. A. Morete, A.T. Olegario, J. D. Orbe & Tandoc, A. (2019). The Effectiveness of Multimedia on the Academic Performance of Grade 5 Teachers in San Bartolome Elementary School. Ascendens Asia Singapore - Bestlink College of the Philippines Journal of Multidisciplinary Research Abstracts, 1(1).
18. Fu, G. (2021). The Effectiveness of Using Multimedia for Teaching Phrasal Verbs in Community-College ESL Classes". Doctoral Dissertations. 570. https://repository.usfca.edu/diss/570
19. González-Calvo G, Barba-Martín RA, Bores-García D & Hortigüela-Alcalá D. (2022). The (virtual) teaching of physical education in times of pandemic. European Physical Education Review, 28(1). 205-224. doi:10.1177/1356336X211031533
20. Guan N., Song J. & Li D. (2018). On the Advantages of Computer Multimedia-aided English Teaching. Procedia Computer Science, 131, 727-732. ISSN 1877-0509. https://doi.org/10.1016/j.procs.2018.04.317
21. Guo, J. (2021). Integration of multimedia education into the teaching of college english writing. The International Journal of Electrical Engineering & Education. doi:10.1177/00207209211005258
22. Hartman H. & Johnson P. (2018). The effectiveness of multimedia for teaching drug mechanisms of action to undergraduate health students. Computers & Education, 125, 202-211. ISSN 0360-1315. https://doi.org/10.1016/j.compedu.2018.06.014.
23. Ilhan, GO & Oruç, S. (2016). Effect of the use of multimedia on students' performance: A case study of social studies class. 11(8), 877-882, 1990-3839. http://www.academicjournals.org/ERR
24. Irfannuddin M, Laeto AB, Zulissetiana EF, Santoso B, Kurniati AM & Hestiningsih T. (2021). Virtual national workshop: preparation of multimedia modules for physical education teachers in accordance with COVID-19 prevention procedures. Adv Physiol Educ., 45(3), 563-567. doi:10.1152/advan.00249.2020.
25. Jian-hua, Shi & Hong, Liang. (2012). Explore the Effective Use of Multimedia Technology in College Physics Teaching. ISSN 1876-6102. https://doi.org/10.1016/j.egypro.2012.02.329.
26. Kapri, U. (2017). Impact of Multimedia in Teaching of science. IJARIIE-ISSN, 3(4). http://ijariie.com/AdminUploadPdf/IMPACT_OF_MULTIMEDIA_IN_TEACHING_OF_SCIENCE_ijariie6298.pdf
27. Kiat, Teo & Jumintono, Joe & Setyo Kriswanto, Erwin & Sugiri, Sugiri & Handayani, Etty & Anggarini, Yunita & Rofik, Mochamad. (2020). The Effectiveness of Multimedia Learning on Academic Achievement in Reproduction Topic Science Subject. Universal Journal of Educational Research, 8. 3625-3629. 10.13189/ujer.2020.080839.
28. Maričić, Olja & Ivkov-Džigurski, Anđelija & Stojšić, Ivan & Cvjetićanin, Stanko & Ivanović Bibić, Ljubica. (2020). Multimedia Teaching Effectiveness in Natural Science Teaching. Geographica Pannonica. 24. 147-156. 10.5937/gp24-23357.
29. Mayer, R. (2017). Chapter Three - Applying the Science of Learning to Multimedia Instruction. Psychology of Learning and Motivation (pp 77-108). https://doi.org/10.1016/B978-0-12-387691-1.00003-X.
30. Mohamad Subaidi bin Abdul Samat & Azlina Abdul Aziz. (2020). The Effectiveness of Multimedia Learning in Enhancing Reading Comprehension Among Indigenous Pupils. Arab World English Journal (AWEJ), 11(2), 290-302. https://dx.doi.org/10.24093/awej/vol11no2.20
31. Molina Díaz, Ana & Navarro, Óscar & Ortega, Manuel & Lacruz Alcocer, Miguel. (2018). Evaluating Multimedia Learning Materials in Primary Education using Eye Tracking. Computer Standards & Interfaces. 59. 10.1016/j.csi.2018.02.004
32. Munzil M., Rochmawati, S., Suwono, H., Habiddin, H. & Rodić, D. (2021). Development of e-learning teaching materials based on guided inquiry models equipped with augmented reality on hydrocarbon topics as teaching materials for COVID-19 pandemic. AIP Conference Proceedings 2330, 020025; https://doi.org/10.1063/5.0043238
33. Munzil, M., Perwira, M., Suwono, H., Habiddin, H. & Rodić, D. (2020). Development of e-learning based inquiry guided and VARK learning style on the topic of chemical bond as teaching material in COVID-19 pandemic era. AIP Conference Proceedings 2330, 020028. https://doi.org/10.1063/5.0043244
34. Nyirahabimana, P., Minani, E., Nduwingoma, M. & Kemeza, I. (2022). A Scientometric Review of Multimedia in Teaching and Learning of Physics. International Journal on Math, Science and Technology Education, 10(1), p89-106 2022. https://eric.ed.gov/?q=multimedia+teaching+in+science&id=EJ1345930
35. Onorato, P. (2014). Laboratory and Multimedia in Science Teaching: Experiments about Magnetic Force. Procedia – Social and

Behavioral Sciences, 116.https://doi.org/10.1016/j.sbspro.2014.01.383.
36. Peterson, L., Scharber, C., Thuesen, A. & Baskin, K. (2020). A Rapid Response to COVID-19: One District's Pivot from Technology Integration to Distance Learning. Information and Learning Sciences, 121(5/6), 461-469. https://doi.org/10.1108/ILS-04-2020-0131
37. Putri Urifah, Munzil, Novida Pratiwi, & Erni Yulianti. (2021). Interactive Teaching Materials Using Learning Cycle 5E Equipped with Augmented Reality on Human Respiratory System. AIP Conference Proceedings 2330, 060018. https://doi.org/10.1063/5.0043274
38. Rada D., Aladeza B, De Guzman C., Mullasgo R., Palen J. & Tandoc A. (2020). Effectiveness of Multimedia in Teaching Performance of Grade 3 Teachers at Caloocan North Elementary School. Ascendens Asia Singapore - Bestlink College of the Philippines Journal of Multidisciplinary Research Abstracts, 1(2).
39. Rong, Liu. (2021). Design of Ideological and Political Multimedia Network Teaching Resources Integration System Based on Wireless Network. Scientific Programming, Article ID 4293771, 15 pages. https://doi.org/10.1155/2021/4293771
40. Sediyani, T., Yufiarti, & Hadi, E. (2017). Integration of Audio Visual Multimedia for Special Education Pre-Service Teachers' Self Reflections in Developing Teaching Competencies. Journal of Education and Practice, 8, 106-112.
41. Tarricone, E. (2021). Multimedia resources and movies in the new perspectives on teaching geography through CLIL and ICT[J]. AIMS Geosciences, 7(4), 605-612. doi: 10.3934/geosci.2021036
42. Toong TH, Liyen L & Ping LY. (2021). The impact of virtual learning on Multimedia University student performance: a cross-sectional study. F1000Research, 10, 11-23. https://doi.org/10.12688/f1000research.72881.1
43. Wei, P. C., He, F., & Huang, S. (2018). Effects of Instructional Multimedia Integrated Situational Approach on Students' Learning Achievement. Eurasia Journal of Mathematics, Science and Technology Education, 14(7), 3321-3327. https://doi.org/10.29333/ejmste/91244
44. Wilcha, RJ. (2020). Effectiveness of Virtual Medical Teaching During the COVID-19 Crisis: Systematic Review. JMIR Med Educ, 6(2). doi: 10.2196/20963. PMID: 33106227; PMCID: PMC7682786.
45. Wu, D., Shen, H., & Lv, Z. (2021). An Artificial Intelligence and Multimedia Teaching Platform based Integration Path of IPE and IEE in Colleges and Universities. J. Intell. Fuzzy Syst., 40, 3767-3776.
46. Ye, L., Su, H., Zhao, J. & Hang, Y. (2021). The Impact of Multimedia Effect on Art Learning: Eye Movement Evidence from Traditional Chinese Pattern Learning. International Journal of Art & Design Education, 40. 10.1111/jade.12347
47. Yuan, Liying. (2022). The Construction and Exploration of University English Translation Teaching Mode Based on the Integration of Multimedia Network Technology. Mathematical Problems in Engineering, Article ID 7609195, 8 pages. https://doi.org/10.1155/2022/7609195
48. Zacal, Steve. (2014). Effect of Multimedia Teaching to the Achievement of Junior High School Students in Trigonometry. JPAIR Institutional Research, 3. 10.7719/irj.v3i1.289.