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The Use of Video as a Learning Media in Science Learning (A Systematic Review)

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ABSTRACT

Video is the one of the learning media that can facilitate the learning process. This study aims to systematically review and analyze the results of research on the use of video in learning based on 42 articles searched from six online databases of Sciencedirect, Tandfondline, Sage, Google Scholar, Springer, and Emerald between 2019 – 2021. The method used is systematic literature review (SLR). The articles analyzed cover various levels of education, disciplines and the use of video in learning. The results of the analysis found that the use of video in learning tended to focus on increasing the effectiveness of learning (59.52%), exploring the influence of video in learning (23.81%), media development (9.52%) and the rest on general use and instrument development. Most studies adopt survey methodology (questionnaires or interviews) (40.48%), however there are mostly studies involving quantitative data sources (42.86%). The use of video in science learning can improve students' understanding and learning achievement.

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1. INTRODUCTION

The era of information and communication technology (ICT) has influenced various fields, one of which is the field of education(Gómez & Galán, 2020). Digital transformation affects how and what to teach (Guggemos & Seufert, 2021). In supporting learning in the ICT era, the addition of teacher competencies to the technological aspect is the impact of emerging technology, especially the knowledge needed by teachers to be able to integrate technology into teaching effectively (Sickel, 2019a)

Most teachers have mastered pedagogy and content skills which are then combined and referred to as "pedagogical content knowledge" (Schmid, Brianza, & Petko, 2020). In supporting learning in the ICT era, the addition of technological aspects (namely, technology, pedagogical technology, technological content, and knowledge of technological pedagogical content) is an indication of the impact of emerging technology in the field of education (Sickel, 2019b)

In science, concepts related to processes that occur at the molecular level both have challenges to teach and learn. Advances in information and graphic technology have allowed the use of good visualization tools for scientific phenomena and abstract information (Dorfman, Terrill, Patterson, Yarden, & Blonder, 2019). Some studies say that visualization in science learning can improve students' conceptual understanding, understand the submicroscopic aspects of a chemical phenomenon and improve student achievement (Berg, Orraryd, Pettersson, & Hultén, 2019; Shiu, Chow, & Watson, 2019;

Ugwuanyi, Okeke, Nnamani, Obochi, & Obasi, 2020; Wu, Lai, Hwang, & Tsai, 2021). Based on Edgar Dale's cone of experience, students remember 10% of what they read and 20% of what they hear. This percentage increases by 10% towards more interactive teaching methods, and students perform tasks while explaining (Masters, 2020).

Several studies have shown that video is compelling in explaining complex concepts, visualizing abstract ideas in science and mathematics subjects, and facilitating learning. Videos can also be used as learning tools to improve conceptual understanding (Espinoza, Orvis, & Brophy, 2020; Hansen et al., 2019; Martzoukou, 2020; Pekdağ, 2020; Shahat, Ohle-Peters, & Ambusaidi, 2021; Shiu et al., 2019). In this study, we systematically reviewed various learning videos used in science learning. The methodological approach used in this paper was a systematic literature review (SLR).

2. METHODS

The systematic literature review is a review of questions that are clearly formulated using systematic methods to identify, select and critically assess relevant research to collect and analyze data from the research included in the review (Chapman, 2021)

Data analysis is carried out thematically and arranged according to the analysis of the theme and written narratively. Article search results ware guided by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and flowcharts compiled based on Prisma 2009 guidelines (Figure 1). Conclusions are made by summarizing the results of research analysis and interpretation with the aim of research as a benchmark.

Literature searches in six online databases, namely Science Direct, Tandfonline, Sage, Google Scholar, Springer, and Emerald. The database was chosen to cover a wide range of disciplines. We searched for research published between 2019 and 2021 using the same keywords, using Boolean logic by using appropriate conjunctions (and, or), and the logic used in this systematic review is Animation Video for Learning Media AND Blended Learning, AND Digital Learning AND Animation Video Learning Chemistry.

Tabel 1. Paper selection results

	2018	2019	2020	2021	Total
Number of articles examined	1	15	20	13	48
Number of articles selected for this study	0	14	18	10	42
Percentages of number articles selected	0.00%	93.33%	90%	76.92%	87.50%

Table 1 shows the distribution of 42 articles selected from 2019 to 2021. Based on the needs of the selected topic, the research questions in this study are what are the research objectives that most often appear in articles on the use of video in science learning from 2019 - 2021? What research methods are most often used in articles on the use of videos in science learning from 2019 – 2021?

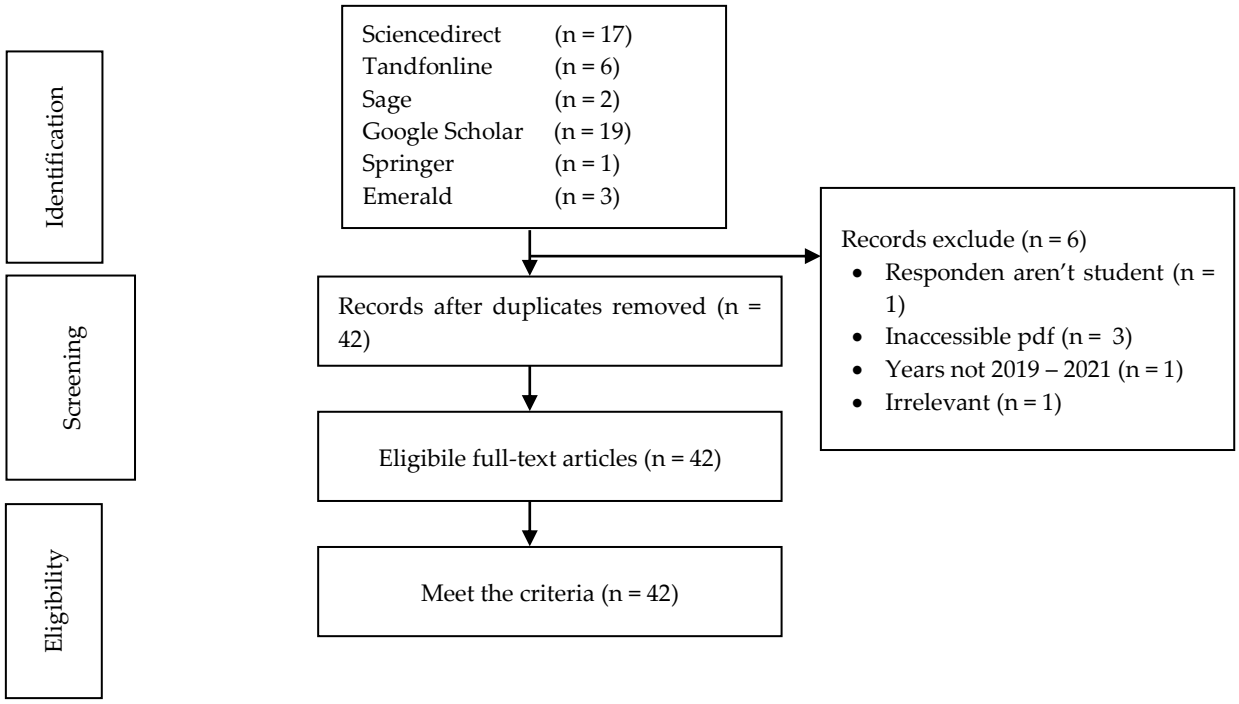

Figure 1 Diagrammatic representation of the literature selection process

Tabel 2. Details of Article Publisher

Publisher	Sum. Of Article	%
American Behavioral Scientist	1	2.38
Chemistry Education Research and Practice	5	11.90
Computers & Education	7	16.67
Computers in Human Behavior	3	7.14
Cypriot Journal of Educational Sciences	1	2.38
Education and Information Technologies	1	2.38
Education for Chemical Engineers	1	2.38
European Journal of Educational Research	1	2.38
Heliyon	1	2.38
Interactive Learning Environments	1	2.38
International Journal of Elementary Education	1	2.38
International Journal of Instruction	1	2.38
Journal Information	1	2.38
Journal of Applied Research in Higher Education	2	4.76
Journal of Biological Education	1	2.38
Journal of Research in Innovative Teaching & Learning	1	2.38
Journal of Research on Technology in Education	1	2.38
Journal of Science Education and Technology	2	4.76
Journal of Science Teacher Education	1	2.38
Journal of Teacher Education	1	2.38
Jurnal Kimia dan Pendidikan Kimia	1	2.38

Jurnal Pembelajaran Matematika Inovatif	1	2.38
Jurnal Pendidikan Teknik Sipil	1	2.38
Jurnal Penelitian Pembelajaran Fisika	1	2.38
Jurnal Riset Pendidikan Kimia	1	2.38
Kwangsan: Jurnal Teknologi Pendidikan	2	4.76
Materials Today: Proceedings	1	2.38
Total	**42**	**100.00**

Table 2 shows the list of review journals and the number of articles in each journal. An analysis of the approach carried out on 42 articles was read in full to determine the context and benefits of the video used. The relevant information of each selected article is systematically extracted according to the research questions specified with Excel and Nvivo 12 spreadsheets used to store and analyze all data. The approach to collecting data from articles and analyzing them can be described as occurring in two stages, involving thematic analysis to correct themes and category boundaries. The two stages are as follows.

In the first stage, the columns of the Excel spreadsheet are initially divided into four parts, where the first part records the general information of the article under review. The columns listed for the first part consist of the author's name (AU), the year the article was published (Y), and the article title (TP). The second part of the table notes the research background consisting of the problem (PR), research objectives (PU), and research scope, limitations, and recommendations (SC). The third part of the table notes the design and methodology of the study consisting of data collection and research method (RM) and research findings (F). The fourth part of the table records the results of the discussion (D).

The second stage, after filling in the entire column for 42 articles, is adding additional columns that present thematic analysis. For example, various fields of science, such as physics, chemistry, mathematics, biology, and engineering, are categorized in the field of science (DA) of science.

Themes and subthemes are developed using the principles of thematic analysis (Braun & Clarke, 2006). Many themes are relatively directly taken from stage 1 data, for example, the research methodology used as well as the level of education and the field of discipline. For other analyses, such as the use of video in learning, it is necessary to repeat the analysis of the primary data (article).

Table 3. Details of the analysis spreadsheet

Columns in the analysis spreadsheet	
Article information in general	Authors' details (AU), year of publication (YP), title of the paper (TP), problem (PR), publisher (PU), research scope, limitations and recommendations (SC), research methodology (RM), research findings (F). the results of discussion (D).
Specific article information	Level of education (LE), Discipline areas being taught (DA) types of data (TD)

3. FINDINGS AND DISCUSSION

The results obtained from the research have to be supported by sufficient data. The research results and the discovery must be the answers or the research hypothesis stated previously in the introduction part.

The sample of 42 studies related to the use of video in learning. The use of video in learning is widely used at the university or college education level (40.48%), high school level (16.67%), junior high school, elementary school, and all levels, as shown in table 4.

Table 4. Number of Articles by Education Level

Education Level	Number of articles	%
Primary school	3	7.14
Junior High School	6	14.29

High School	7	16.67
Secondary school	2	4.76
University	17	40.48
All Tiers	2	4.76
Common	1	2.38
Not mentioned	4	9.52
Total	**42**	100.00

The disciplinary fields of the entire sample as shown in table 5. Various fields of science are represented among the samples, half of the samples are science-oriented subjects (50%), and the rest are in various fields of science.

Table 5. Number of Articles by Field of Science

Science	Number of articles	%
Science (Mathematics, Physics, Biology, Chemistry, and Engineering)	21	50.00
ICT (information systems/ICT)	1	2.38
Professional Education and Training (teacher education/training, professional development)	8	19.05
Multidisciplinary (science, literature, history, geography, sociology/psychology, humanities, music, IT,, business, MTK, Kim)	4	9.52
Not mentioned	5	11.90
Business & Economics	1	2.38
Psychology, Sociology, and Humanities	2	4.76
Total	**42**	100.00

In science subjects, a visual display is needed to complement the explanation and facilitate students' understanding of complex material (Shahat et al., 2021). Other disciplines with a lower percentage include business and economics, information systems and psychology, sociology, and humanities.

The research methods used in the sample articles are categorized with systematic reviews as carried out by Lai & Bower (2019). Of the 42 articles selected, the survey was the most commonly used research method (40.48%), followed by mixed method (26.19%), quasi-experimental (14.29%), a systematic review (11.9%), interviews or group discussions (4.76%) and Case studies (2.38%). As shown in Table 6.

Table 6. Number of Articles Based on Research Methodology

Research Methodology	Number of articles	%
Surveys (questionnaires, interviews)	17	40.48
Mixed Methods (e.g., survey + interview, survey + observation or survey + interview + observation)	11	26.19
Quasi-Experiment	6	14.29
Systematic Review	5	11.90
Interviews/Discussion Groups	2	4.76
Case Studies	1	2.38
Total	**42**	100.00

Almost half (42.86%) of the data sources in this article use quantitative data (including the use of Likert scales), as seen in table 7, mixed quantitative and qualitative data (28.57%), and the remaining 26.19% on qualitative data.

Table 7. Number of Articles by Data Type

Data Type	Number of articles	%
Quantitative (including Likert scale)	18	42.86
Mixed Method (quantitative & qualitative)	12	28.57
Qualitative	11	26.19
Not mentioned	1	2.38
Total	**42**	100.00

Most (59.52%) of the use of videos in learning that are used as data sources in this article to increase the effectiveness of learning, such as material explanation, integrase the use of ICT with the material, for self-study, increase understanding, and strategies in learning.

Table 8. Use of Video in Review Articles

Video Roles	Number of articles	%
Media Development	4	9.52
Learning Effectiveness (Explanation, ICT Integration, Self-Study, assisting the understanding of the material)	25	59.52
a. Material Explanation	5	11.90
b. ICT Integration with Materials	12	28.57
c. Self-Study	1	2.38
d. Understanding the Material	5	11.90
e. Strategies in Learning	2	4.76
Common	2	4.76
Instrument Development	1	2.38
Exploration of Influence in Learning	10	23.81
Total	**42**	100.00

Table 9. Characteristics of the article

No.	Name	Year	Research Objectives
1	Abdinejad, M., Talaie, B., Qorbani, H. S., & Dalili, S.	2020	To assist students in understanding the molecular structure and mechanism of chemical reactions at the molecular level by developing 3D animation.
2	Alsalhi, N. R., Eltahir, M. E., & Al-Qatawneh, S. S	2019	Videos used in blended learning of science subjects and 9th grade attitudes
3	Asad, M. M., Hussain, N., Wadho, M., Khand, Z. H., & Churi, P. P.	2020	The effectiveness of the integration of ICT and e-learning in the KBM process of science and social studies subjects
4	Athavan Alias Anand, S.	2021	Used in the flipped classroom learning in chemistry education to support student-centered learning
5	Chávez Herting, D., Cladellas Pros, R., & Castelló Tarrida, A	2020	Test variables that affect the use of Powerpoint by lecturers at universities
6	Cole, M. H., Fuller, D. K., & Sanger, M. J.	2021	The video is used to compare students' explanations of the oxidation-reduction reaction between silver nitrate and copper metal.

7	Dorfman, B.-S., Terrill, B., Patterson, K., Yarden, A., & Blonder, R.	2019	Videos used in teacher training materials to develop TPACK learning
8	Espinoza, C., Orvis, K. S., & Brophy, S. P.	2020	Students learn about the electron transport chain (ETC) process in photosynthesis by watching the video, followed by playing a serious board game - Electron Chute- that models ETC.
9	Farizi, Z A., Sulisworo, D., Hasan, M.H., Rusdin, M. E.	2019	To develop learning animation media on TPACK-based torque materials.
10	Gómez-Galán, J	2020	Train students to be more critical of the powerful influences of ICT to create a more critical, equitable and supportive society
11	Guggemos, J., & Seufert, S.	2021	To predict the use of technology as a means and as the content of instructions
12	Hanif, M.	2020	Observe the development and effectiveness of graphic video media for elementary school students in science learning.
13	Hansen, S. J. R., Hu, B., Riedlova, D., Kelly, R. M., Akaygun, S., & Villalta-Cerdas, A	2019	Animated videos are used to provide a correct understanding of the concept of chemical phenomena
14	Hapsari, A. S., Hanif, M., Gunarhadi, & Roemintoyo.	2019	Untuk mengetahui efektivitas pengembangan video animasi motion graphic media pada mata pelajaran IPA di Sekolah Dasar.
15	Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., & Reiss, K. M.	2020	To determine the effectiveness of developing motion graphic media animation videos in science subjects in elementary schools.
16	Jung, J., Ding, A.-C. E., Lu, Y.-H., Ottenbreit-Leftwich, A., & Glazewski, K.	2020	Exploring the knowledge of prospective teachers in the use of digital technology in teaching activities and the reasons for its use
17	Konstantina Martzoukou	2020	Cartoon videos are used for the development of digital literacy, resilience and citizenship in children in an online environment, addressing active participation
18	Lai, J. W. M., & Bower, M.	2019	Exploration of the use of technology evalution in the field of education
19	Lapitan, L. D., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M.	2021	Providing information related to DLPCA strategies in the blended learning component allows teachers and students to face the challenges of online teaching in Chemistry classes
20	Lohr, A., Stadler, M., Pernice, F. S., Chernikova, O., Sailer, M., Fischer, F., Sailer, M.	2021	Overcoming the lack of systematic research on digitally supported learning activities and institutional factors and personal factors in high school
21	Marlina, Hadi, S., Rahim, A.	2021	Animated video learning media resulting in solubility and solubility using the Sparkol videoscribe software which is produced containing material, animation, learning videos, text, and music so as to produce learning media that is

			interesting, motivating, and developing for students to improve student understanding
22	Maulana, A., Sekartaji, G., Arthur, R., & Dewi, L.	2019	Designing and developing presentation video media applied to Hydrology courses
23	Mawardi, G., Iriani, T., & Daryati, D.	2019	Producing multimedia-based learning media products in learning competency courses
24	Mei, X. Y., Aas, E., & Medgard, M.	2019	Explores the use of digital learning tools by teachers to teach in higher education.
25	Mohamed A. Shahat, Annika Ohle-Peters & Abdullah Ambusaidi	2021	Knowing the level of attitude and motivational orientation of teachers as aspects of their professional competence—towards teaching with text-picture material (TPM) and their relationship to teacher background variables
26	Pekdağ, B.	2020	Explores the effect of video-based learning on safety rules in chemistry laboratories on student learning achievement.
27	Rahmi, M., Budiman, M., & Widyaningrum, A.	2019	Creating a learning medium that can help students and teachers in learning.
28	Rizqi Ridhona, & Yasthophi, A.	2020	To design learning videos with the help of wondershare filmora software on acid-base materials
29	Rodríguez-Becerra, J., Cáceres, L. J., Diaz, T., Druker, S., Bahamonde Padilla, V., Pernaa, J., & Aksela, M. K.	2020	To develop Pedagogical Technology Knowledge of Technology (TPASK) prospective chemistry teachers through a new computational chemistry module.
30	Rokhim, D., Widarti, H., & Fajaroh, F.	2020	To develop and find out the feasibility of flipbook teaching materials on redox and electrochemical materials based on the STEM-pjbl approach assisted by learning videos
31	Schmid, M., Brianza, E., & Petko, D	2020	To develop and validate a short self-report questionnaire (TPACK.xs)
32	Schmid, M., Brianza, E., & Petko, D	2021	To investigate whether the differences in the use of digital technology in the RPP are related to TPACK
33	Schöbel, S., Saqr, M., Janson, A.	2021	Identify the state of the field and determine what is relevant when using game concepts in digital learning
34	Shiu, A., Chow, J., & Watson, J.	2019	Explaining students' perceptions regarding the design of learning materials and experiments in the laboratory for business study program students and not business study programs
35	Shoufan, A.	2019	Find out the reasons behind the positive and negative ratings of online video viewers
36	Sickel, J. L..	2019	Bridging the areas of instructional design and teacher education, bringing media influence and integrating the TPACK framework
37	Tarchi, C., Zaccoletti, S., & Mason, L.	2020	This study investigated the influence of media (text, video, or subtitled video) on student learning outcomes.

38	Ugwuanyi, C. S., Okeke, C. I. O., Nnamani, P. A., Obochi, E. C. & Obasi, C. C.	2020	Determine the relative effect of animated and non-animated (PPT) powerpoint presentations on student physics learning achievement.
39	Voithofer, R., & Nelson, M. J.	2020	Helps to better understand the practice of these teacher educators in relation to the literature on preparing teachers to use technology to support student learning
40	Wang, J., Antonenko, P., & Dawson, K.	2019	Manipulate video design with difficulty type (easy-to-understand topics versus elusive topics)
41	Wijaya, T. T., Purnama, A., Tanuwijaya, H.	2020	Developing learning media based on the TPACK concept using Hawgent Dynamic Mathematics Software
42	Wu, S.-H., Lai, C.-L., Hwang, G.-J., & Tsai, C.-C.	2021	Can provide useful information for chemistry teachers to implement effective learning activities in the school environment.
	Total	42	

4. CONCLUSION

Based on systematic literature review the use of video in learning from six online databases ranging from 2019 to 2021. The articles analyzed cover a wide range of educational levels, disciplines. Through a thematic analysis of the literature this researcher found that the use of video in learning tends to focus on the effectiveness of learning (59.52%), exploration of the influence of video in learning (23.81%), media development (9.52%) and the rest on general use and instrument development. Most studies adopted survey methodologies (questionnaires or interviews) (40.48%), however there were most studies involving quantitative data sources (42.86%).

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