Evaluating the Effectiveness of Multimedia Instructional Resources Utilization in Teaching Science and Technology in Grade 6 in Kenya

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.9020248

Received: 31 January 2025; Accepted: 07 February 2025; Published: 15 March 2025

ABSTRACT

Science education plays a critical role in promoting technological and industrial development and attaining of Kenya's Vision 2030 development goals. Achieving this can be facilitated by using multimedia instructional resources in science. This paper explored the extent of utilization of multimedia instructional resources in Grade 6 science class and its effect on science curriculum implementation. The study was conducted in Trans-Nzoia, Bungoma and Busia Counties in Kenya. It was grounded on Stafflebeam's CIPP model targeting head-teachers and their respective grade 6 science and technology teachers. Mixed methods research design was used. Cluster and simple random sampling technique was used in coming up with the three counties. Stratified sampling was used to categorize the school into two groups, public and private. In each of the two strata, simple random sampling was used while choosing schools from which participants came from. Simple random sampling was also used in selecting participating teachers in schools with two or more science teachers teaching Grade 6. Questionnaire for grade 6 science and technology teachers and interview guide for head-teachers were used to collect data. The collected data was analyzed descriptively and using Pearson's correlation. Multimedia utilization recorded a moderate mean (M = 2.8252, SD = 1.1920) implying that multimedia is not used by teachers teaching science in Grade 6 as expected. The study also found a significant moderate positive correlation between multi-media use and Science and Technology curriculum implementation $r_{(244)} = .72^{**}$, p=.001. This implies that utilization of multimedia in the classroom positively affects science curriculum implementation. The study recommends Kenya Institute of Curriculum Development (KICD) to develop and distribute multimedia resources to schools. Teachers on the other hand to use available multimedia. This study contributes to a deeper understanding of multimedia instructional resources utilization in teaching science and technology in Kenyan context.

Key Word: Multi-media Instructional Resources, Competency Based Curriculum

INTRODUCTION

The importance of foundational primary science education cannot be overstated in the quest to achieve Kenya's second educational goal, which seeks to promote technological and industrial development and in attaining of the country's vision 2030 development goals (Mutisya, 2015). As the country aims to transform into a technologically advanced and industrialized nation, establishing a strong foundation in science education at primary level is essential for cultivating critical thinking, problem-solving skills, and fostering innovation among the learners.

Despite the significance of science education, there still seems a crisis in effective science and technology curriculum implementation even with curriculum change to Competence Based Curriculum. This is evidenced by the results of the inaugural Kenya Primary School Education Assessment (KIPSEA) national exam in 2023 (Table 1.1), where science and technology emerged with the least mean score nationally. This highlights the need to address the challenges faced in teaching and learning science early enough to enhance learners' attainment of the set competencies in science.

Table 1.1: 2023 KPSEA Percentage Mean per Learning Area

ENG	KIS	MAT	SCI	AGR	HSC	PHE	SST	ART	MUS	CRE
49.96	49.42	42.43	41.15	43.09	42.50	47.21	47.95	48.57	42.18	52.66

Source KNEC

One of the key strategies to improve science and technology curriculum implementation is the effective utilization of multimedia instructional resources (Onah & Nzewi, 2021). Multimedia resources like graphics, images, audio, audio-visuals and animations, have the potential to make learning more interactive, engaging and accessible. They can help demystify complex scientific concepts, cater to diverse learning styles, and foster a deeper understanding of the subject matter.

Studies done on Competency Based Curriculum (CBC) implementation indicate that there are concerns about inadequate instructional resources needed to facilitate learning with the view of attaining the core competencies (Opondo, 2023; Sifuna & Obonyo, 2019; Sossion, 2017; Ondimu, 2018). Multimedia as one of the instructional resources are integral part in the teaching and learning process and educationists have often argued that it should be seen as a component in all subjects. In science, Ogunbote and Adesoye, (2006) states that multimedia should be part and parcel of the teaching process because it adds a new dimension to learning experiences. They opined that with multimedia instructional resources, complex science concepts can easily be presented and understood. In addition, they affirmed that learners have a more permanent memory when they learn via different senses. They also noted that the intensity of learning experience in science can be evoked by involving the social, emotional and intellectual senses provided by multimedia use.

Use of multi-media instruction benefits in science cannot be overemphasized. Teaching science using multimedia enable learners to be satisfied and motivated (Yarbrough, 2001 as cited by Ludwig et al., 2004). Multimedia usage in teaching science also appeals to different learning styles. As noted by Ludwig et al. (2004) for instant, visual learners and auditory learners will both benefit from watching a video clip or a presentation from listening to a song respectively.

Despite the benefits of multimedia instructional resource utilization in science, it seems that multimedia instructional resources are still underutilized. Kwegyriba et al. (2022) in their study about the use of audio-visual materials in teaching and learning process in Effia junior high schools, in which they used qualitative approach found that 100% of the teacher respondents affirmed that they do not use Audio-Visual materials in teaching their students in the class, even though 77.8% of them preferred using them. Similarly, Abdulmalik et al. (2023) findings on audio instructional resource were in agreement. They found that 100% of their respondents don't utilize audio multimedia instructional resources in Kogi State, Nigeria.

Some studies however shows that some multimedia instructional resources are utilized in teaching science subjects. Regarding animation, Hassan & Nasibi (2023) in their study on attitudes of teachers toward the use of computer 3D animation in teaching biology established that approximately more than half (53.8%) of their respondents, agreed that they use computer 3D animation in teaching biology, while 46.2% of their respondents showed that they do not teach biology employing animation. They attributed the percentage of teachers not using animations to their lack of confidence and basic skills needed to solve technical problems in animation.

Pasalidou & Fachantidis (2021) in their study that involved 206 Greek primary school teachers to examine their perceptions towards educational application of simulation in teaching reported similar findings on animation. They reported that teachers' intentions to utilize simulation were welcoming and they considered the simulation useful and easy to use in teaching their students. Although 67% of their respondents reported not having been familiar with animations before, 98% of them showed positive attitudes towards them. They stated that animations improve efficiency of their teaching.

In Kenya, the change from the 8-4-4 Content Based system of education to 2-6-6-3 Competency Based Curriculum calls for a paradigm shift in the integration and application of multimedia instructional resources.

This shift emphasizes the need for interactive, engaging and practical multimedia instructional resources that fosters realization of competencies in learners. This led to the ministry of education to come up with Basic Education Curriculum Framework (BECF), which advocates for facilitated learning with a view of attaining the seven core competencies outlined in the competency-based curriculum, (KICD, 2017). The core competencies include digital literacy, communication and collaboration, self-efficacy, creativity and imagination, learning to learn, critical thinking and problem solving. These competencies in science can effectively and efficiently be acquired through an interactive and facilitated individualized learning process with utilization of multimedia resources (Mosonik, 2021).

Competency Based Curriculum in Kenya is expected to be a learner-centered curriculum emphasizing the application of knowledge and skills that can efficiently and effectively be acquired through utilization of multimedia resources in the classroom. However, Mosonik (2021) in his study which sought to determine the influence of using multimedia resources in teaching and learning measurement in Mathematics in Kericho County established that 85% of teachers reported that multimedia resources were not proportionate to the number of pupils. He also found out that 80% of the teachers agreed that using multimedia resources in a large classroom was a challenge. An issue of multimedia instructional resources availability also arose. In his findings, he noted that 73% of the teachers affirmed that they lack multimedia resources in their schools for teaching. Masonik also noted that all (100%) of the teachers he interviewed confessed that they lacked enough time to utilize the available multimedia resources in teaching.

It is important to note that multimedia is a very essential instructional resource in science (Onah & Nzewi, 2021). With such findings in Kericho County, it would be challenging to achieve set competencies in CBC, contributing to dismal performance in science and technology, in the long run, impacting on the attainment of national educational goals. This is because learning science in CBC requires specific regular variations in pupils' targeted intellectual abilities to attain required core competencies. Instead of Mosonik's generalizing his Kericho findings to other Counties within the Country, he recommended further research on the use of multimedia resource in other counties to compare the results.

It was therefore important for this study to be carried out in more than one County; Bungoma, Busia and Trans-nzoia Counties to determine the extent of utilization of graphics, images, audio, audio-visual and animations multi-media instructional resources in teaching science and technology in Grade 6, a transitional class where learners transit from primary to Junior Secondary School. Science and technology were considered for this study considering that the second educational goal in Kenya seek to promote technological and industrial needs for national development. This goal can only be realized fully if science curriculum is implemented well, contrary to the least mean in the first KPSEA of 2023. Doing well in science and technology at foundational level is the only way learners can build a strong technological and industrial development foundation in tandem with changing global trends. This study aimed to evaluate the extent of utilization of graphics, images, audio, audio-visual and animations utilization by teachers teaching science and technology in Grade 6.

Statement of the Problem

Through Science, education in Kenya needs to provide learners with necessary competencies for technological and industrial development in tandem with Kenya's educational goals and Vision 2030. To achieve this, the MoE through KICD, among other measures developed national curriculum policy to mobilize instructional resources to ensure that the ratio of instructional resources and learners in the classroom is narrowed. The government committed itself to provide more opportunities for learners to access instructional resources (KICD, 2018). Despite the government's commitment, there are still concerns about science curriculum implementation, evident from 2023 CBC first Kenya Primary School Education Assessment (KPSEA), where science and technology performed the least nationally (Mean = 41.15). It was against this backdrop that the researcher saw the need to look at the extent of multimedia instructional resource utilization in teaching science and technology in grade 6 and its influence on science and technology curriculum implementation.

Theoretical Framework

This study was guided by Stufflebeam's Context Input Process Product (CIPP) evaluation model. As noted by

Stufflebeam (2003), this model emerged from the recognition that traditional evaluation approaches often lack flexibility and adaptability for dynamic educational contexts. In this study, multimedia instructional resources were considered as the 'Inputs' within the CIPP framework. Their utilization by teachers in the classroom represents the 'Process' that influences learners' competency acquisition (KPSEA), ultimately impacting curriculum implementation as the final 'Product' of the evaluation.

METHODOLOGY

The research design that was used in this study is mixed method research design. The study was conducted in three Counties, Trans-Nzoia, Bungoma and Busia Counties. The study targeted 246 primary schools head-teachers with their respective 246 grade 6 science and technology teachers from a population of 2,421 head-teachers with their respective 2,421 science and technology teachers in 2,421 primary schools. Cluster sampling technique was used to get the Counties. Stratified sampling was used to put schools into their two distinct categories, public and private. In each school category, simple random sampling was used to choose on 246 participating schools, 167 public and 79 private from which respondents came from. The sample size was calculated where a desired minimum percentage of 10% in each schools category, in each County, from where respondents came from was used. The sample size was congruent to sample requirements proposed by Mugenda and Mugenda (2003) that a sample of between 10 and 30 percent is acceptable in descriptive research and is reliable and representative enough for generalization. For schools with more than one science and technology teacher, simple random sampling was used to choose on one. Each head teacher from the selected school was interviewed.

Data was collected through questionnaires for science teachers because it enables the researchers to have all the data in more or less the same format (Cecic & Musson, 2004) and interview guide for head-teachers because the tool gives a lot of extra information from respondents (Opdenakker, 2006). The obtained data was analyzed descriptively to determine the extent of multimedia use. Pearson's correlation was also employed to establish the relationship between multimedia with Science and Technology curriculum implementation. Pearson correlation was necessary as it describes the strength and direction of the linear relationship between two quantitative variables in this study (Turney, 2023).

A research permit was sought from National Council of Science Technology and Innovation (NACOSTI) after approval to carry out research was issued by Kibabii University.

RESULTS

The aim of this study was to determine the extent of multimedia instructional resource utilization in Grade 6 in Western region of Kenya. Data was collected and analyzed descriptively as presented in Tables 1.2 and 1.3, and inferential using Pearson correlation as shown in Table 1.4.

Frequency of Multimedia Utilization

Table 1.2 presents analyzed findings regarding frequency of utilization of each multimedia instructional resource examined.

Table 1.2: Frequency of Multi-media Utilization

Extent of Multi-media use	To a very large extent		To a large extent		To some extent		To a very small extent		Not at all	
	FQ	%	FQ	%	FQ	%	FQ	%	FQ	%
Graphics	59	24	15	6.1	72	29.3	80	32.5	20	8.13

Images	85	34.6	25	10.2	56	22.8	74	30.1	6	2.44
Audio	18	7.32	77	31.3	57	23.2	89	36.2	5	2.03
Audio-visual	12	4.88	73	29.7	45	18.3	42	17.1	74	30.1
Animation	0	0	12	4.88	87	35.4	24	9.76	123	50

Source: Field Data 2024

On graphics utilization, 80 (32.52%) teachers, the highest number of respondents reported utilizing graphics to a very little extent with only 15 (6.10%) admitting using graphics to a large extent. This is what one of the teachers had to say regarding her experience with multimedia use:

> *Without much needed support from the school in acquiring some of the graphics needed, it takes me a lot of time drawing illustrations and diagrams on the chalkboard or on chats to help capture learners' attention and cater for different learning styles* (STT53).

Science and technology teachers were also asked about their frequency in utilization of images while teaching science and technology in Grade 6. From the findings in Table 1.2, 85 (34.55%) teachers admitted using images to a very large extent with only 6 (2.44%) saying they do not use images in class at all. One of the teachers when responding on his experience in using multi-media in the classroom had this to share:

> *I mostly use images as the most versatile, memory retention, efficient tool with high visual impact because they can easily be found in various formats like print materials at affordable costs* STT78).

On Audio-visual, 74 (30.08%) teachers confirmed not using audio-visual instructional media at all with only 12 (4.88%) agreeing to use them to a very large extent. This is what one of the head teachers noted about Audio-visual:

> *I believe we would be far with CBC implementation was it not for some of teachers shunning away from using them claiming they waste teaching time in the name of watching video clips that excite young leaners deviating them from learning* (H/T18).

This is what another respondent narrated about audio-visual multimedia:

> *One of the challenges I face in utilization of some multimedia like audio-visual is limited access to gadgets that would help me convey audio-visual messages to my learners* (STT 204).

Findings in Table 1.2 on frequency of animations use reveal that 123 (50%) teachers don't use animations in the classroom at all with no teacher admitting to use animation to a very large extent. One of the teachers when asked about his opinion regarding the ministry of educations support, this is what he expressed:

> *The government through the ministry of education should do more in providing necessary infrastructures, hardware and software then emphasis to teachers about their benefits to enable them utilize some of multimedia instructional resources needed for efficient and effective curriculum implementation* (H/T87).

Multimedia Instructional Resource Utilization in Public and Private Primary Schools

It was also necessary to come up with means and standard deviations for science teachers teaching science and technology in the two school categories on their utilization of multimedia instructional resources. The findings are illustrated in Table 1.3.

Table 1.3*:* Multi-media Usage in Public and Private Schools

School Category	Extent of Graphics Utilization	Extent of Images Utilization	Extent of Audio-Visual Utilization	Extent of Animations Utilization	Aggregate
Public	**Mean**: 2.3952	**Mean**: 2.8144	**Mean**: 2.5689	**Mean**: 2.0060	**Mean**: 1.4970
	N: 167	**N**: 167	**N**: 167	**N**: 167	**N**: 167
	Std. Deviation: 0.87094	**Std. Deviation**: 1.06207	**Std. Deviation**: 0.82491	**Std. Deviation**: 1.08936	**Std. Deviation**: 0.87725
Private	**Mean**: 4.4430	**Mean**: 4.7722	**Mean**: 4.0886	**Mean**: 3.9241	**Mean**: 2.9114
	N: 79	**N**: 79	**N**: 79	**N**: 79	**N**: 79
	Std. Deviation: 0.87335	**Std. Deviation**: 0.52986	**Std. Deviation**: 0.51115	**Std. Deviation**: 0.61545	**Std. Deviation**: 0.53565
Average	**Mean**: 3.0528	**Mean**: 3.4431	**Mean**: 3.0569	**Mean**: 2.6220	**Mean**: 1.9512
	N: 246	**N**: 246	**N**: 246	**N**: 246	**N**: 246
	Std. Deviation: 1.29412	**Std. Deviation**: 1.30103	**Std. Deviation**: 1.02460	**Std. Deviation**: 1.31528	**Std. Deviation**: 1.02502

Source: Field Data 2024

Legend: 4.20-5.00 (Very High), 3.40-4.19 (High), 2.60-3.39 (Moderate), 1.80-2.59 (Low), 1.00-1.79 (Very Low)

Results in Table 1.3 show that teachers teaching public schools have a low mean for Graphics (M = 2.3952, SD 0.8709), audio (M = 2.5689, SD = 0.82491) and Audio-Visual (M = 2.0060, 1.0894) use. The mean is moderate for Images (M = 2.8144, SD = 1.06207) and very low for animation (M = 1.4970, SD = .87725) use.

On the other hand, teachers teaching private schools show a significantly higher aggregate mean (M =4.0279, SD = 0.6131). Graphics (M =4.4430, SD = 0.8734), Images (M = 4.7722, SD = 0.5299), and Audio posted a very high mean (M = 4.0886, SD = 0.5112) whereas audio-visual showed a high mean (M = 3.9241, SD = 0.6155). Animations on the other hand indicates a moderate mean (M = 2.9114, SD = 0.5357).

When asked about the experience teachers have in using multimedia instructional resources in the classroom, one of the teachers had this to say about audio-visual and animations:

> *I have fared on well with multi-media use, except for audio-visual and animations which require use of gadgets like smart phone or computer because our school lacks computers and other related gadgets* (STT25).

Relationship between Utilization of Multi-media Instructional Resources, and Science and Technology Curriculum Implementation.

Finally, Pearson's correlation was used to examine the relationship between multi-media Instructional resources

and science and technology curriculum implementation. The findings for correlation coefficient are presented in Table 1.4.

Table 1.4: Utilization of Multi-media Instructional Resources and Science and technology Curriculum Implementation.

Multimedia Instructional Resource Utilization	Pearson Correlation (r)	P-Value
Extent of using Graphics	.694**	.001
Extent of using Images	.784**	.001
Extent of using Audio	.679**	.001
Extent of using Audio-Visual	.758**	.001
Extent of using Animations	.662**	.001
Average	**.7154****	**.001**

Source: Field Data 2024

From the findings in Table 1.4, the results show a significantly moderate positive correlation between multi-media instructional resources and Science and technology curriculum implementation $r(244) = 0.72^{**}$, $p=.001$. The coefficient of determination (r^2) was also calculated and found to be $r^2 = .5184$.

DISCUSSION

Based on provided findings in Table 1.2 on graphics, the implication is that graphics, which includes illustrations, drawings, charts, and diagrams among other visual features are not utilized by most of teachers teaching science and technology. The reason is attributed to the cost involved in getting them, either in terms of finance for commercial ones or time for those made by teachers themselves as it was claimed by some teachers interviewed. Abdulmalik et al. (2023) in their study had divergent findings on graphics. In their study on the use of audio-visual aided instruction in teaching and learning of chemistry. They established that 20 (100%) teachers they sampled for their study with 200 (97%) students agreed that graphics/posters are utilized while teaching chemistry. The difference between the findings in these studies is contextual, one being the different in education budgetary allocation and a difference in education policies on multimedia.

Science and technology teachers were also asked about their frequency of utilization of images while teaching science and technology. From the findings in Table 1.2, the implication is that images which comprise of visual representation of objects, scenes or people captured using image capturing devices like cameras on mobile phones are frequently used in the classroom. The reason why images are most preferred is because they are cheap, easy to find given that they do not require much time preparing and can be taken using mobile phones to convey complex ideas quickly saving time as it was put by one of the teachers when responding on his experience using multi-media in the classroom. Similar findings were reported by Abdulmalik et al. (2023). In their study on use of audio-visual aided instruction in teaching and learning of chemistry in Kogi State-Nigeria, where they used survey research design, they established that 100% of chemistry teachers in their study agreed that they use pictures/photos as visual teaching aids while teaching chemistry given they can easily be found.

On Audio multimedia instructional resources, findings in Table 1.2 show the highest number of respondents acknowledged utilizing audio multimedia instructional resources in their teaching process to a very small extent. This implies that while some teachers reported utilizing audio in classroom, majority of them do not use sound based components, which include auditory elements intended to enhance the learning process. On the contrary, Ronalyn (2022) found divergent results. In his study on audio approach in teaching chemistry, he established audio utilization in teaching chemistry with a very high mean.

Findings in Table 1.2 on audio-visual indicate that the highest number of teachers confirmed that they do not use audio-visual instructional media at all. This implies that majority of the teachers teaching Grade 6 science and technology in Western region of Kenya do not use audio-visual while teaching science. Most of the teachers in this study said they do not use audio-visual instructional resources because they are not available. Other teachers believe that audio-visual distracts primary school learners when used in class, making them to concentrate on visual element missing out on the audio component as noted by one of the head teachers. These findings on audio-visual are similar to Kwegyriba et al. (2022). In their study about the use of audio-visual materials in teaching and learning process in Effia junior high schools, where they used qualitative approach, they reported that 100% of the teachers they interviewed said they do not use Audio-Visual materials in teaching their students.

Findings in Table 1.2 on frequency of animations use reveal that half the number of teachers do not use animations in the classroom at all, meaning half the teachers do not use moving images formed through various means like computer software in the classroom. This findings contradicted those of Hassan & Nasibi (2023). In their study on attitudes of teachers toward the use of computer 3D animation in teaching biology, they established that approximately more than half (53.8%) of their respondents, agreed that they use computer 3D animation in teaching biology. Similarly, Pasalidou and Fachantidis (2021) in their study on Greek primary school teachers to examine their perceptions towards educational application of animations in teaching, reported that teachers' considered animations useful and easy to use in teaching their students. For the teachers they interviewed, 98% of them showed positive attitude towards animations. They stated that animations improve efficiency, success, and productivity of their teaching.

This study established that a number of reasons contribute to majority of teachers in Western region of Kenya not using animation. Some teachers raised the issue of limited infrastructures like computers, projectors and reliable internet and electricity. Others attributed their lack of use to the cost. They noted that it is costly to get animation software with educational content locally. It was also noted that some teachers seem ignorant of animation benefits as a multimedia instructional resource, or hesitant in impressing new teaching methods. Most of the head teachers interviewed expressed these concerns when asked during interview schedule to whether the ministry of education is doing enough in ensuring that teachers get adequate, appropriate and efficient multimedia resources.

Looking at multi-media instructional resources usage between public and private schools, results in Table 1.3 show that animations are the least used multimedia instructional resource. The reason for animation not being used as expected is because it requires gadgets like computers and electricity connection that are lacking in most primary schools. These findings were reiterated by most of the responded who noted challenges using instructional media that requires ICT and electricity.

In Table 1.4, results show a direct positive relationship between utilization of multi-media and implementation of science and technology curriculum. The implication is that availing and utilizing multimedia instructional resources appropriately improves Science and Technology curriculum implementation. The coefficient of determination (r^2) implies that 51.84% of variance in science and technology curriculum implementation can be explained by multi-media instructional resource utilization. Given that $p < .05$, the null hypothesis was rejected signifying a statistically significant relationship between utilization of multimedia instructional resources and science and technology curriculum implementation. Availability and proper use of multimedia instructional resources improves implementation of science curriculum. Wickens (2008) and Nkweke (2010) had similar opinion. They noted that effective and efficient use of multi-media instructional resources appeals to the sense of sight and hearing at the same time, making students to feels a sense of reality in what is taught to them impacting positively on curriculum delivery. Onyegegbu (2006) and Hoska (2009) were also of the same view, they noted that a lot of frustrating situations that could lead to poor curriculum implementation can be saved from learners if teachers use relevant and efficient multi-media instructional resources during teaching and learning.

CONCLUSION

Based on the results above, it was concluded that animations are the least multimedia used with half the number

of science and technology teachers in Western region of Kenya admitting that they never use them at all. From the aggregate mean for multi-media instructional resources utilization, it was concluded that teachers are not fully integrating graphics, images, audio, audio-visuals, and animations into their teaching practices as expected. Considering the positive correlation, it was concluded that the overall average utilization of multimedia resources by teachers teaching science has positive impact on science and technology curriculum implementation.

The broader implication of these findings is, when multimedia instructional materials are availed and used effectively and appropriately in teaching science, science curriculum will be implemented as envisaged. This in turn will have a ripple effect on attainment of educational and 2030 development goals.

RECOMMENDATIONS

The study recommends KICD to develop and distribute multimedia instructional resources and broadcast science lessons via local radio stations that are widely accessible even in remote areas. Teachers on the other hand are encouraged to use available multimedia instructional resource in resource-constrained and emergency settings.

While the moderate mean indicates average use of multimedia resources, these findings also highlight a critical gap that if addressed, could significantly enhance teaching effectiveness and student learning outcomes in science and technology. This finding therefore opens avenues for further research into the challenges teachers face in utilizing multimedia instructional resources. Understanding these challenges can inform targeted interventions.

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