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USE OF MULTIMEDIA AIDS IN PRIMARY EDUCATION: A COMPARATIVE ANALYSIS OF KOSOVO AND NORTH MACEDONIA

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Abstract/Izvleček

This quantitative, descriptive-comparative study examined primary teachers' multimedia use in Kosovo and North Macedonia. Questionnaire data were collected from 298 teachers. Overall, 79.5% used multimedia at least sometimes and 46.3% often or always. YouTube, educational videos, quizzes, and music were most common, mainly for consolidating learning and promoting interaction. Multimedia use differed significantly by country and gender, favouring North Macedonia and female teachers, but not by subject area. Teachers without formal training reported significantly more frequent use than trained teachers, although sample composition warrants caution. Findings highlight the importance of pedagogical quality, context, and relevant professional development.

Keywords:
multimedia integration, educational technology, teacher confidence, professional development, digital learning.

Uporaba multimedijskih učnih sredstev v osnovnem izobraževanju: primerjalna analiza Kosova in Severne Makedonije

Ta kvantitativna deskriptivno-primerjalna raziskava je preučevala uporabo multimedije med osnovnošolskimi učitelji na Kosovu in v Severni Makedoniji. Podatki so bili zbrani z vprašalnikom, ki ga je izpolnilo 298 učiteljev. Skupno je 79,5 % učiteljev poročalo, da multimedijo uporablja vsaj občasno, 46,3 % pa pogosto ali vedno. Najpogosteje so uporabljali YouTube, izobraževalne videoposnetke, kvize in glasbo, predvsem za utrjevanje znanja in spodbujanje interaktivnega učenja. Uporaba multimedije se je statistično značilno razlikovala glede na državo in spol, pri čemer je bila pogostejša v Severni Makedoniji in med učiteljicami, ne pa glede na predmetno področje. Učitelji brez predhodnega formalnega usposabljanja so poročali o statistično značilno pogostejši uporabi kot usposobljeni učitelji, vendar je zaradi sestave vzorca potrebna previdnost pri interpretaciji. Ugotovitve poudarjajo pomen pedagoške kakovosti, konteksta in ustreznega strokovnega izpopolnjevanja.

Ključne besede:
integracija multimedije, izobraževalna tehnologija, samozavest učiteljev, strokovno izpopolnjevanje, digitalno učenje.

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Introduction

In recent decades, multimedia has developed from a supplementary classroom resource into an increasingly important component of teaching and learning. Its use has also become embedded in national education policies and curriculum frameworks, including those of Kosovo and North Macedonia, where digital competence and the pedagogical integration of technology are explicitly promoted (MEST, 2021; MEST, 2016).

However, the educational value of multimedia depends less on the technology itself than on how it is integrated into teaching. Clark (1994) argued that instructional methods, rather than media themselves, determine learning outcomes. In contrast, Kozma (1994) emphasized that the capabilities of media can support learning when they interact with the cognitive and social processes through which knowledge is constructed.

Fullan (2012) argues that educational transformation requires the alignment of pedagogy, technology, and systemic support. From this perspective, technology can contribute to more engaging, accessible, and relevant learning, but only when it is embedded within sound pedagogical practice and supported by broader educational structures.

In the present study, multimedia is understood in a broad, practice-based educational sense. The term refers to digital, audiovisual, and interactive resources used by teachers to support classroom instruction, including presentations, educational videos, animations, YouTube materials, Smart Boards, music, games, and quizzes. These resources do not all operate through identical pedagogical or cognitive mechanisms; some represent platforms, others content formats, technological tools, or instructional activities. This distinction allows the empirical analysis to reflect teachers' everyday classroom practices while recognizing that effective multimedia use must still be guided by appropriate instructional principles.

Within this broad, practice-based understanding, the educational value of multimedia depends on how resources are selected, designed, and integrated into instruction. Well-designed animations, simulations, and combinations of verbal and visual information can support understanding and engagement, whereas poorly structured materials may create unnecessary cognitive demands (Höffler & Leutner, 2007; Mayer, 2021).

Nevertheless, integration does vary across contexts, shaped by teacher beliefs, self-efficacy, resources, and institutional support (Ertmer, 1999; Tondeur et al., 2016).

A more recent study highlights additional barriers, including outdated infrastructure, limited access to technology, and insufficient practical training for teachers (Thaqi & Atanasoska, 2025). Although both countries have introduced curricular reforms promoting digital competence through media education in Kosovo's Core Curriculum and ICT integration in North Macedonia's education system differences in institutional structures and resource distribution continue to shape how multimedia is implemented in primary education.

The Evolution of Multimedia in Educational Practice

The evolution of multimedia in education reflects a gradual shift from simple visual supplementation toward cognitively grounded instructional design. Early multimodal instruction can be traced to Comenius' Orbis Sensualium Pictus, which combined text and images to support multisensory learning (1967, p. 24). In the twentieth century, audiovisual tools such as film, radio, and television laid the groundwork for integrating media into classrooms (Cuban, 1986, pp. 17-18). The widespread adoption of computers enabled multimedia environments that integrate text, sound, graphics, animation, and interactivity, marking a major conceptual transformation in teaching and learning.

The theoretical foundations for multimedia learning are grounded in cognitive learning theories. Mayer's Cognitive Theory of Multimedia Learning (Mayer, 2001, 2014; Mayer & Moreno, 2003) proposes that learners process information through dual channels, verbal and visual, each with limited capacity. Meaningful learning occurs when students actively select, organize, and integrate information from both channels. Mayer demonstrated that students learn more effectively from coordinated words and images than from text alone, and his principles of coherence, signalling, redundancy, modality, and spatial contiguity show how instructional design directly affects retention and transfer. Paivio's Dual Coding Theory (1990) further supports this view, emphasizing that representing information through both verbal and visual systems strengthens memory and understanding. Similarly, Cognitive Load Theory (Chandler & Sweller, 1991; Sweller, 1988) stresses the importance of managing working memory by reducing extraneous load, sequencing complex information, and supporting schema construction. In primary education, these principles are especially relevant. Multimedia can support problem-solving in mathematics, enhance literacy skills such as phonics and comprehension, and deepen understanding in science by aligning instruction with learners' cognitive capacities (Paas & Sweller, 2012).

Dynamic visualizations, interactive manipulatives, and simulations allow students to engage actively with content, facilitating exploration without overloading working memory.

Early debates questioned whether technology itself improves learning outcomes. In his study Clark (1994) argued that media alone do not influence achievement; instructional methods do. Although initially controversial, subsequent research reframed this debate, showing that multimedia enhances learning when integrated with effective pedagogical strategies. Jonassen's (1996) concept of digital "mindtools" similarly emphasizes that multimedia functions as a cognitive tool, enabling learners to actively construct knowledge rather than passively receive information.

Benefits of Multimedia in Educational Contexts

Empirical research in the 21st century consistently reports positive effects of multimedia on learner motivation, comprehension, and retention in primary education, particularly in mathematics, science, and language learning. Several studies indicate that dynamic visualizations and interactive formats outperform static materials when designed in accordance with cognitive principles (Höffler & Leutner, 2007; Mayer & Moreno, 2003).

Research by Mayer and Moreno has extensively documented how modality and contiguity principles such as aligning narration with relevant visuals reduce extraneous cognitive load and support meaningful learning (Mayer et al., 1999; Moreno & Park, 2010). A growing body of research highlights the effectiveness of simulations, gamified environments, augmented reality, and problem based multimedia in enhancing conceptual understanding, critical thinking, and long term retention (Jalaluddin et al., 2020; Rincon-Flores & Santos-Guevara, 2021; Sekarwangi et al., 2021). Systematic reviews further demonstrate that multimedia learning principles (e.g., coherence, signalling, and segmenting) are being adapted for diverse instructional settings, including immersive and virtual environments (Çeken & Taşkın, 2022). Nevertheless, the literature identifies persistent barriers to effective multimedia integration. Empirical evidence highlights that teacher beliefs, digital competence, and instructional confidence significantly influence adoption and use (Ertmer, 1999; Mertala, 2019). Infrastructure limitations and unequal access to technology remain significant constraints, particularly in under resourced educational systems (Tondeur et al., 2016). Scholars also note that poorly designed multimedia even when theoretically grounded can increase cognitive overload, thereby undermining learning outcomes (Mayer & Moreno, 2003).

Cognitive Load Theory remains relevant to the design of digital and multimedia learning environments. Multimedia materials can support comprehension, attention, and problem-solving when they reduce unnecessary information, sequence complex content appropriately, and coordinate visual, verbal, and interactive elements effectively (Paas & Ayres, 2014). These principles are particularly important in primary education, where multimedia-supported instruction should be carefully structured and scaffolded to match learners' developing cognitive capacities.

Statement of the Problem

Although multimedia resources are increasingly used in primary education, limited comparative evidence is available regarding how teachers integrate them into everyday classroom practice in Kosovo and North Macedonia. Both countries have introduced educational reforms that promote digital competence and technology-supported instruction, yet differences in access, institutional support, teacher preparation, and classroom context may shape patterns of multimedia use. This study therefore examines the reported frequency, types, and pedagogical purposes of multimedia use among primary school teachers in the two countries. It also investigates differences according to country, gender, subject area, and prior training, as well as the relationships between multimedia use, teachers' confidence in its instructional effectiveness, and satisfaction with its use.

Methodology

Research Design

This study employed a quantitative, descriptive-comparative research design to examine teachers' reported use of multimedia aids in primary education in Kosovo and North Macedonia. The design enabled comparisons in the frequency of multimedia use across country, gender, subject area, and prior-training groups, while also allowing the examination of associations between multimedia use, teachers' confidence in its instructional effectiveness, and satisfaction with its use. Because the study was cross-sectional and based on self-reported data, it was intended to identify patterns and relationships rather than establish causal effects.

The study was guided by the following research questions:

1. What are the reported frequency, types, and pedagogical purposes of multimedia use among primary school teachers in Kosovo and North Macedonia?

2. Do teachers' reported levels of multimedia use differ significantly according to country and gender?
3. Does reported multimedia use differ significantly according to subject area and prior training in multimedia integration?
4. What relationships exist between teachers' reported multimedia use, their confidence in its instructional effectiveness, and their satisfaction with its use?

Sample Description

The study included 298 teachers from Kosovo (n = 120, 40.3%) and North Macedonia (n = 178, 59.7%). The sample consisted of 218 female teachers (73.2%) and 80 male teachers (26.8%).

Instruments

Data were collected using a structured questionnaire developed to examine teachers' use of multimedia aids in primary education. The questionnaire gathered information on teachers' demographic characteristics, frequency and forms of multimedia use, pedagogical purposes, curriculum integration, perceived effectiveness, satisfaction, confidence, preparation time, subject-related use, and prior training. The first part of the questionnaire collected demographic information, including country, age group, gender, and previous participation in training related to the use of multimedia aids. These variables were used to describe the sample and examine differences in multimedia use across teacher groups. Overall frequency of multimedia use was measured using one ordinal item, labelled "Multimedia Use." Teachers rated how frequently they used multimedia aids on a five-point response scale ranging from 1 = not at all to 5 = always. This item was designed to provide a direct indicator of teachers' general self-reported frequency of multimedia use. It was not intended to function as a multi-item psychometric scale and therefore does not capture all dimensions of multimedia integration, such as instructional quality, pedagogical alignment, or cognitive design. The questionnaire also included a multiple-response item assessing the types of multimedia aids used by teachers. Respondents could select more than one option from presentations, educational videos, animations, YouTube, Smart Boards, music, games, and quizzes. Each multimedia type was entered into the dataset as a separate dichotomous variable, indicating whether the option had been selected. These variables were treated as descriptive categories rather than as items forming a

common scale because they represent different technologies, formats, and instructional resources. A second multiple-response item examined the pedagogical purposes for which teachers used multimedia. The response categories included introducing new concepts, promoting interactive activities, supporting students' understanding, and solidifying previously taught knowledge. Each purpose was coded as a separate dichotomous variable, and respondents were permitted to select more than one purpose. Additional questionnaire items examined the integration of multimedia into the regular curriculum, the amount of time required to prepare multimedia-supported lessons, and the subject areas in which multimedia was used most frequently. Teachers were also asked to assess the effectiveness of multimedia, indicate their satisfaction with its use, and report their confidence in its instructional efficacy. Satisfaction and confidence were measured using separate ordinal items. These indicators were intended to capture teachers' direct perceptions rather than broader validated psychological constructs. Prior training was measured through a nominal item asking teachers whether they had previously received training in the use of multimedia aids. This variable reflected participation in formal training but did not assess the content, duration, quality, or practical relevance of the training. It should therefore not be interpreted as a direct measure of teachers' digital competence. In this study, multimedia aids were defined broadly as digital, audiovisual, and interactive resources used by teachers to support classroom instruction. This practice-based definition includes platforms, content formats, instructional activities, and technological tools. It is broader than the more specific definition used in the Cognitive Theory of Multimedia Learning, which primarily concerns learning from coordinated verbal and visual representations. Because the principal variables measuring overall multimedia use, satisfaction, and confidence consisted of single items, internal consistency coefficients such as Cronbach's alpha were not applicable. The absence of multi-item scales is acknowledged as a measurement limitation and is considered when interpreting the findings.

Data Analysis

Data were analysed using IBM SPSS Statistics, version 26. Descriptive statistics, including frequencies and percentages, were used to summarize the demographic characteristics of the participants and their responses. Multiple-response analyses were conducted to examine the types of multimedia aids used and their reported pedagogical purposes. Because overall multimedia use was measured using a single five-

point ordinal item, non-parametric procedures were used for the primary group comparisons. Mann-Whitney U tests examined differences in multimedia use according to country, gender, and prior training. A Kruskal-Wallis H test was used to examine differences across subject areas. Effect sizes for the Mann-Whitney U tests were calculated using $r = |Z|/\sqrt{N}$. Chi-square tests of independence were conducted to examine associations between country, gender, and prior training and the use of specific multimedia aids. Cramér's V was reported as the measure of effect size. Spearman's rank-order correlation was used to examine associations between overall multimedia use, confidence in its effectiveness, and satisfaction with its use. Statistical significance was set at $p < .05$.

Results

Sample description

The study included 298 primary school teachers, of whom 120 (40.3%) were from Kosovo and 178 (59.7%) were from North Macedonia. Female teachers constituted 73.2% of the total sample, while male teachers represented 26.8%. The gender distribution differed considerably between the two national samples. In Kosovo, 47.5% of respondents were male and 52.5% were female, whereas the North Macedonian sample consisted of 12.9% male and 87.1% female teachers. Overall, 152 teachers (51.0%) reported having received prior training in the use of multimedia aids, while 146 (49.0%) had not. Training participation differed notably by country. In Kosovo, 76.7% of teachers reported prior multimedia training, compared with 33.7% of teachers from North Macedonia. The age distributions of the two country groups were broadly similar. Most participants were between 30 and 55 years of age, representing 70.0% of the Kosovo sample and 76.9% of the North Macedonian sample. Detailed demographic characteristics are presented in Table 1.

Table 1
Sample characteristics by country

Variable	Category	Kosovo, n (%)	North Macedonia, n (%)	Total, n (%)
Gender	Male	57 (47.5)	23 (12.9)	80 (26.8)
	Female	63 (52.5)	155 (87.1)	218 (73.2)
Prior multimedia training	No	28 (23.3)	118 (66.3)	146 (49.0)

	Yes	92 (76.7)	60 (33.7)	152 (51.0)
Age group	18–29 years	11 (9.2)	9 (5.1)	20 (6.7)
	30–39 years	42 (35.0)	75 (42.1)	117 (39.3)
	40–55 years	42 (35.0)	62 (34.8)	104 (34.9)
	56 years or older	25 (20.8)	32 (18.0)	57 (19.1)

Note. Percentages in the country columns are calculated within each country. Complete demographic and training data were available for all 298 respondents.

Overall frequency of multimedia use

Overall multimedia use was assessed on a five-point ordinal scale ranging from 1 = not at all to 5 = always. The median response was 3, corresponding to "sometimes" (Mdn = 3, IQR = 1). Of the 298 teachers, 26 (8.7%) reported not using multimedia at all, 35 (11.7%) reported using it rarely, 99 (33.2%) sometimes, 84 (28.2%) often, and 54 (18.1%) always. Overall, 46.3% of teachers reported using multimedia often or always, while 79.5% reported using it at least sometimes.

Types and purposes of multimedia aids used

Teachers reported using a wide range of multimedia aids in their teaching practice (Table 2). The most frequently reported resources were YouTube (57.0%), educational videos (47.7%), quizzes (44.3%), and music (43.0%). Presentations (40.6%) and Smart Boards (31.9%) were also commonly used, while games (28.9%) and animations (19.8%) were reported less frequently.

Table 2
Multimedia aid used by teachers

Multimedia aid	n	% of respondents
Presentations	121	40.6
Educational videos	142	47.7
Animations	59	19.8
YouTube	170	57.0
Smart Board	95	31.9
Music	128	43.0
Games	86	28.9
Quizzes	132	44.3

Note. Percentages represent the proportion of the total sample selecting each multimedia aid. Respondents could select more than one option; therefore, percentages do not sum to 100%.

Regarding the purposes of multimedia use (Table 3), the most commonly cited purpose was to solidify students' knowledge (66.8%), followed by promoting interactive activities (52.7%) and introducing new concepts (43.3%). Enhancing students' understanding was reported by 36.2% of respondents.

Table 3
Purpose of multimedia aid use

Purpose	n	% of respondents
New concepts	129	43.3
Interactive activity	157	52.7
Student understanding	108	36.2
Solidifying knowledge	199	66.8

Note. Percentages represent the proportion of respondents selecting each option. Multiple responses were permitted.

Differences in overall multimedia use by country and gender

Mann-Whitney U tests were conducted to examine whether the reported frequency of multimedia use differed by country and gender (Table 4).

Table 4
Differences in overall multimedia use by country and gender

Variable	Group	n	Mean rank	Mann-Whitney U	Z	p	Effect size, r
Country	Kosovo	120	120.33	7,179.00	−4.97	< .001	.29
	North Macedonia	178	169.17				
Gender	Male	80	114.28	5,902.50	−4.43	< .001	.26
	Female	218	162.42				

Note. Overall multimedia use was measured on a five-point ordinal scale ranging from 1 = not at all to 5 = always. Effect size was calculated as $r=|Z|/\sqrt{N}$. Higher mean ranks indicate more frequent reported multimedia use.

Teachers from North Macedonia had a higher mean rank for multimedia use (mean rank = 169.17) than teachers from Kosovo (mean rank = 120.33). This difference was statistically significant, U = 7,179.00, Z = −4.97, $p < .001$, with a small-to-moderate effect size, r = .29. A statistically significant gender difference was also found. Female teachers had a higher mean rank for multimedia use (mean rank = 162.42) than male teachers (mean rank = 114.28), U = 5,902.50, Z = −4.43, $p < .001$. The effect size was small-to-moderate, r = .26. Overall, the findings indicate that teachers

from North Macedonia reported more frequent multimedia use than teachers from Kosovo, while female teachers reported more frequent multimedia use than male teachers.

Associations between demographic variables and types of multimedia aids

Chi-square tests of independence were conducted to examine associations between demographic variables (country and gender) and the use of specific multimedia aids (Table 5).

Table 5

Associations of Country and Gender with Types of Multimedia Aids

Multimedia aid	Country χ^2 (df=1)	V	Gender χ^2 (df=1)	V
Presentations	0.30 (ns)	0.03	1.45 (ns)	0.07
Educational videos	5.80*	0.14	13.66***	0.21
Animations	1.24 (ns)	0.06	0.87 (ns)	0.05
YouTube	15.42***	0.23	12.97***	0.21
Smart Board	11.29**	0.19	5.69*	0.14
Music	53.12***	0.42	21.02***	0.27
Games	2.16 (ns)	0.09	5.44*	0.14
Quizzes	1.50 (ns)	0.07	2.05 (ns)	0.08

Note. χ^2 = Pearson chi-square; V = Cramér's V. $p < .05$*, $p < .01$**, $p < .001$***; ns = not significant.

Country and multimedia types

Significant associations were found between country and the use of educational videos, χ^2 (1) = 5.80, $p = .016$; YouTube, χ^2 (1) = 15.42, $p < .001$; Smart Boards, χ^2 (1) = 11.29, $p = .001$; and music, χ^2 (1) = 53.12, $p < .001$. In all cases, teachers from North Macedonia reported higher usage rates than teachers from Kosovo. No significant country differences were observed for presentations, animations, games, or quizzes.

Gender and multimedia types

Gender was significantly associated with the use of several multimedia aids. Female teachers were more likely than male teachers to report using educational videos, χ^2 (1) = 13.66, $p < .001$; YouTube, χ^2 (1) = 12.97, $p < .001$; Smart Boards, χ^2 (1) = 5.69, $p = .017$; music, χ^2 (1) = 21.02, $p < .001$; and games, χ^2 (1) = 5.44, $p = .020$. No significant gender differences were found for presentations, animations, or quizzes.

Multimedia use by subject taught

Differences in overall multimedia use across subject areas were examined using a Kruskal-Wallis H test. The results indicated no statistically significant differences in multimedia use among teachers of different subjects, $H(6) = 6.11$, $p = .411$.
The analysis provided no evidence of statistically significant differences in reported multimedia-use frequency across the subject areas represented in the sample.

Training, confidence, satisfaction, and multimedia use

Differences in multimedia use based on prior training were examined using a Mann-Whitney U test. A statistically significant difference was found between teachers who had received training in the use of multimedia aids and those who had not, $U = 8265.50$, $Z = -3.94$, $p < .001$, with a small-to-moderate effect size ($r = .23$). Teachers without prior training reported higher levels of multimedia use than those who had received training. Spearman's rank-order correlations were conducted to examine relationships between multimedia use, confidence in the efficacy of multimedia, and satisfaction with multimedia use. Multimedia use was positively associated with teachers' confidence in the effectiveness of multimedia, $\varrho = .20$, $p = .001$, as well as with their satisfaction with multimedia use, $\varrho = .19$, $p = .001$.

Training and types of multimedia aids

Additional chi-square tests examined associations between prior training and the use of specific multimedia aids. No statistically significant associations were found between training and any of the multimedia types examined. The results for educational videos, $\chi^2(1) = 3.83$, $p = .050$, and music, $\chi^2(1) = 3.77$, $p = .052$, were close to the predefined significance threshold but did not meet the criterion of $p < .05$. In both cases, teachers without prior training reported higher usage rates.

Discussion

This study examined teachers' use of multimedia aids, focusing on usage patterns, demographic differences, prior training, confidence, and satisfaction. The findings indicate that multimedia use was widespread and varied according to several contextual and demographic characteristics. Reported use was also weakly associated with teachers' confidence in multimedia effectiveness and satisfaction with its use, while no statistically significant differences were found across subject areas. These results suggest that multimedia use may be related to a combination of contextual,

professional, and attitudinal factors rather than to any single characteristic (Ertmer & Ottenbreit-Leftwich, 2010; Teo & Zhou, 2014). Teachers most frequently used accessible tools such as YouTube, educational videos, quizzes, and music, supporting prior research that highlights teachers' preference for resources requiring minimal preparation and adaptable to diverse contexts (Höffler & Leutner, 2007). The primary pedagogical purposes (solidifying knowledge, promoting interactive activities, and introducing new concepts) reflect a learner-centred approach, emphasizing engagement and reinforcement over mere content delivery (Mayer, 2009; Moreno & Valdez, 2005; Prensky, 2001). Significant differences emerged by country and gender. Teachers from North Macedonia reported more frequent overall multimedia use and higher use of educational videos, YouTube, Smart Boards, and music than teachers from Kosovo. These differences may reflect variations in technological access, infrastructure, institutional support, educational policy, or other contextual factors; however, these explanations were not directly examined in the present study (Tondeur et al., 2016). In addition, the national samples differed considerably in their gender and prior-training distributions, so the observed country difference may partly reflect differences in sample composition.

Female teachers reported more frequent overall multimedia use and higher use of educational videos, YouTube, Smart Boards, music, and games than male teachers. However, the study did not investigate the mechanisms underlying these differences. They may be associated with country distribution, teaching context, prior training, access to resources, age, or other unmeasured characteristics. The findings should therefore be interpreted as descriptive associations rather than evidence that gender itself determines teachers' use of multimedia.

The analysis provided no evidence of statistically significant differences in reported multimedia-use frequency across the subject categories represented in the sample. However, the finding does not establish that multimedia is integrated in the same way or with the same pedagogical quality across all subjects. An unexpected finding was that teachers without prior formal training reported more frequent multimedia use than teachers who had received training. This result should be interpreted cautiously. One possible explanation is that untrained teachers may rely more heavily on self-directed experimentation with accessible tools such as YouTube, music, and online quizzes, particularly when formal professional development is limited or insufficiently connected to classroom practice (Hew & Brush, 2007)

However, other explanations are also possible. Teachers who participated in formal training may have done so because they or their schools had already identified gaps

in their practice, which may introduce a form of selection bias. In addition, the training received may have varied in content, duration, quality, and practical relevance, all of which can influence whether professional development leads to meaningful changes in technology integration (Lawless & Pellegrino, 2007). Previous research has also shown that formal training alone does not necessarily result in greater technology use unless it addresses teachers' beliefs, confidence, pedagogical knowledge, and classroom context (Ertmer et al., 2012b).

It is therefore possible that training influences the quality, intentionality, or pedagogical alignment of multimedia use rather than its frequency. Accordingly, the present finding should not be interpreted as evidence that training is ineffective, but rather as an indication that future research should examine the design, quality, and practical relevance of professional development in greater detail. Multimedia use was positively associated with teachers' confidence in its effectiveness and their satisfaction with its use. However, both relationships were weak, and the cross-sectional design does not allow conclusions about their direction. Teachers who feel more confident about the instructional value of multimedia may be more likely to use it frequently, but repeated use may also strengthen confidence by providing teachers with greater experience and familiarity. Similarly, satisfaction may encourage continued multimedia use, while successful or frequent use may itself contribute to greater satisfaction. These findings therefore indicate related patterns of teacher perception and practice rather than causal effects (Bandura, 1997; Ertmer & Ottenbreit-Leftwich, 2010).

These findings have several practical implications. As confirmed by Ertmer et al. (2012b) professional development should move beyond technical skills to build teachers' confidence and beliefs regarding multimedia's instructional value. Policymakers and administrators should consider whether differences in technological access, infrastructure, and institutional support may contribute to variation in multimedia use across educational contexts (Tondeur et al., 2016). Because reported frequency did not differ significantly across subject areas, schools could consider providing multimedia-related support across the curriculum, while remaining attentive to subject-specific pedagogical needs. This study has several limitations. First, the use of self-reported data may have introduced response bias, while the cross-sectional design limits causal interpretation. Second, overall multimedia use, satisfaction, and confidence were measured using single-item indicators, which do not capture the full complexity of these constructs and do not permit the assessment of internal consistency. The focus on the frequency and types of multimedia use also does not address the quality, pedagogical appropriateness, or cognitive design of multimedia-

supported instruction. In addition, the study relied on prior training as an indicator of teachers' professional preparation but did not include a direct measure of their digital or pedagogical competence in using multimedia.

Formal training does not necessarily correspond to actual skill level, as teachers may also develop competence through classroom experience, self-directed learning, or informal professional support. The two national samples also differed considerably in their gender and prior-training distributions. Consequently, the separate associations observed for country, gender, and training may partly reflect overlapping sample characteristics, and the present analyses cannot establish the independent contribution of each factor. Future research should use validated multi-item measures, include direct assessment of teacher competence, and employ observational, longitudinal, or mixed-methods designs to examine how multimedia is integrated into classroom practice and how training influences instructional quality and student outcomes over time (Höffler & Leutner, 2007; Saipunidzam et al., 2010).

Conclusion

This study examined teachers' use of multimedia aids across different demographic, contextual, and attitudinal dimensions. The findings demonstrate that multimedia use is a widespread instructional practice, with teachers employing a variety of tools, most notably accessible resources such as YouTube, educational videos, quizzes, and music, to support student engagement, interaction, and knowledge consolidation (Höffler & Leutner, 2007; Kay, 2012; Prensky, 2001). Significant differences in reported multimedia use were observed by country and gender. However, these findings represent associations rather than evidence that country or gender independently determines multimedia use, particularly because the two national samples differed in their gender and prior-training distributions. No statistically significant differences were found across subject areas, indicating that reported frequency was broadly similar among the subject categories represented in the study. This finding does not, however, establish that multimedia is used with the same purpose, quality, or pedagogical approach across all subjects. Teachers reporting more frequent multimedia use also tended to report greater confidence in its effectiveness and higher satisfaction with its use. These associations were weak and should not be interpreted causally, as the cross-sectional design does not establish whether confidence and satisfaction encourage multimedia use or develop through repeated experience with

multimedia. An important finding was that, within this sample, teachers without prior formal training reported more frequent multimedia use than those who had received training. Given the differences in the composition of the country and training groups, this result should be interpreted cautiously and should not be taken as evidence that formal training is ineffective.

This finding supports previous research indicating that professional development should address teachers' beliefs, confidence, pedagogical knowledge, and classroom context rather than focusing only on technical skill (Ertmer et al., 2012b; Hew & Brush, 2007; Lawless & Pellegrino, 2007).

This result highlights the need to reconsider how professional development programs are designed and evaluated, shifting attention from the frequency of multimedia use towards its pedagogical purpose, quality of integration, and teachers' confidence in using multimedia effectively (Hew & Brush, 2007; Tschannen-Moran & Hoy, 2001).

Overall, the study suggests that effective integration of multimedia in teaching requires a balanced approach that combines access to resources, supportive institutional contexts, and opportunities for teachers to develop confidence and satisfaction in using multimedia (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2016). Future research should explore the qualitative dimensions of multimedia use and examine how targeted, reflective training models can enhance not only the quantity but also the pedagogical impact of multimedia integration in classrooms (Ertmer et al., 2012a; Höffler & Leutner, 2007; Kay, 2012).

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Data Availability Statement

The article is based on research data stored in author's repository that are not publicly available, but are available from the author upon a reasoned request.

References

Bandura, A. (1997). Self-efficacy: The exercise of control. W H Freeman/Times Books/ Henry Holt & Co.

Çeken, B., & Taşkın, N. (2022). Multimedia learning principles in different learning environments: a systematic review. Smart Learning Environments, 9(1), 19. https://doi.org/10.1186/s40561-022-00200-2

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. Cognition and Instruction, 8(4), 293-332. https://doi.org/10.1207/s1532690xci0804_2

Clark, R. (1994). Media will never influence learning. Educational Technology Research and Development, 42, 21-29. https://doi.org/10.1007/BF02299088

Comenius, J. A. (1967). Orbis Sensualium Pictus. Charles Scribner's Sons.

Cuban, L. (1986). Teachers and machines: The classroom use of technology since 1920. Teachers College Press.

Ertmer, P. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. Educational Technology Research and Development, 47(4), 47-61. https://doi.org/10.1007/BF02299597

Ertmer, P., & Ottenbreit-Leftwich, A. (2010). Teacher Technology Change: How Knowledge, Beliefs, and Culture Intersect. Journal of Research on Technology in Education, 42, 255-284. https://doi.org/10.1080/15391523.2010.10782551

Ertmer, P., Ottenbreit-Leftwich, A., Sadik, O., Sendurur, E., & Sendurur, P. (2012a). Teacher beliefs and technology integration practices: A critical relationship. Computers & Education, 59, 423–435. https://doi.org/10.1016/j.compedu.2012.02.001

Ertmer, P., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012b). Teacher beliefs and technology integration practices: A critical relationship. Computers & Education, 59(2), 423-435. https://doi.org/10.1016/j.compedu.2012.02.001

Fullan, M. (2012). Stratosphere: Integrating technology, pedagogy, and changing knowledge (1st ed.). Pearson.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. Educational Technology Research and Development, 55(3), 223-252. https://doi.org/10.1007/s11423-006-9022-5

Höffler, T. N., & Leutner, D. (2007). Instructional animation versus static pictures: A meta-analysis. Learning and Instruction, 17(6), 722-738. https://doi.org/10.1016/j.learninstruc.200–7.09.013

Jalaluddin, I., Lilliati, I., & Darmi, R. (2020). Developing Vocabulary Knowledge among Low Achievers: Mobile Augmented Reality (MAR) Practicality. International Journal of Information and Education Technology, 10, 813-819. https://doi.org/10.18178/ijiet.2020.10.11.1463

Jonassen, D. H. (1996). Computers in the classroom: Mindtools for critical thinking. Merrill/Prentice Hall.

Kay, R. H. (2012). Exploring the Use of Video in Education: A Comprehensive Review of Literature. Computers in Human Behavior, 28, 820-831. https://doi.org/10.1016/j.chb.2012. –01.011

Kozma, R. B. (1994). Will media influence learning? Reframing the debate. Educational Technology Research and Development, 42(2), 7-19. https://doi.org/10.1007/BF02299087

Lawless, K. A., & Pellegrino, J. W. (2007). Professional Development in Integrating Technology into Teaching and Learning: Knowns, Unknowns, and Ways to Pursue Better Questions and Answers. 77(4), 575-614. https://doi.org/10.3102/0034654307309921

Mayer, R. E. (2001). Changing conceptions of learning: A century of progress in the scientific study of education. In L. Corno (Ed.), Education across a century: The centennial volume (pp. 34-75). University of Chicago Press.

Mayer, R. E. (2009). Multimedia learning (2nd ed.). Cambridge University Press. https://doi.org/1–0.1017/CBO9780511811678

Mayer, R. E. (2014). Cognitive theory of multimedia learning [doi:10.1017/CBO9781139547369.005]. Cambridge University Press.

Mayer, R. E. (2021). Multimedia learning (3rd ed.). Cambridge University Press. https://doi.org/10. – 1017/9781316941355

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. Educational Psychologist, 38(1), 43-52. https://doi.org/10.1207/S15326985EP3801_6

Mayer, R. E., Moreno, R., Boire, M., & Vagge, S. (1999). Maximizing constructivist learning from multimedia communications by minimizing cognitive load. Journal of Educational Psychology, 91, 638-643.

Mertala, P. (2019). Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. Computers in Human Behavior, 101, 334-349. https://doi.org/10.1016/j.chb.2019.08.003

MEST, N. M. (2021). Concept note on primary education.

MEST. (2016). Korniza Kurrikulare e Arsimit Parauniversitar të Republikës së Kosovës (e rishikuar).

Moreno, R., & Park, B. (2010). Cognitive load theory: Historical development and relation to other theories. In J. L. Plass, R. Moreno, & R. Brünken (Eds.), Cognitive load theory (pp. 9-28). Cambridge University Press. https://doi.org/10.1017/CBO9780511844744.003

Moreno, R., & Valdez, A. (2005). Cognitive load and learning effects of having students organize pictures and words in multimedia environments: The role of student interactivity and feedback. Educational Technology Research and Development, 53, 35-45. https://doi.org/1– 0.1007/BF02504796

Paas, F., & Ayres, P. J. E. P. R. (2014). Cognitive Load Theory: A Broader View on the Role of Memory in Learning and Education. In (Vol. 26, pp. 191-195).

Paas, F., & Sweller, J. (2012). An evolutionary upgrade of cognitive load theory: Using the human motor system and collaboration to support the learning of complex cognitive tasks. Educational Psychology Review, 24(1), 27-45. https://doi.org/10.1007/s10648-011-9179-2

Paivio, A. (1990). Mental representations: A dual coding approach. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195066661.001.0001

Prensky, M. (2001). Digital Game-Based Learning. McGraw-Hill, New York, 1. https://doi.org/1– 0.1145/950566.950567

Rincon-Flores, E. G., & Santos-Guevara, B. N. (2021). Gamification during COVID-19: Promoting active learning and motivation in higher education. Australasian Journal of Educational Technology, 37(5), 43-60. https://doi.org/10.14742/ajet.7157

Saipunidzam, M., Ibrahim, M., & Mohd Taib, S. (2010). M-Learning: A New Paradigm of Learning Mathematics in Malaysia. https://doi.org/10.48550/arXiv.1009.1170

Sekarwangi, T., Sartono, K., Mustadi, A., & Abdulah, A. (2021). The Effectiveness of Problem Based Learning-Based Interactive Multimedia for Elementary School Students. International Journal of Elementary Education, 5, 308. https://doi.org/10.23887/ijee.v5i2.31603

Sweller, J. (1988). Cognitive Load during Problem Solving: Effects on Learning. Cognitive Science, 12, 257-285.

Teo, T., & Zhou, M. (2014). Explaining the intention to use technology among university students: A structural equation modeling approach. Journal of Computing in Higher Education, 26. https://doi.org/10.1007/s12528-014-9080-3

Thaqi, V., & Atanasoska, T. (2025). Challenges and Solutions in Implementing Multimedia in the Classroom. Open Journal of Social Sciences, 13, 583-604. https://doi.org/10.4236/jss.202– 5.136039

Tondeur, J., Pareja Roblin, N., van Braak, J., Voogt, J., & Prestridge, S. (2016). Preparing beginning teachers for technology integration in education: Ready for take-off? Technology Pedagogy and Education, 26. https://doi.org/10.1080/1475939X.2016.1193556

Tschannen-Moran, M., & Hoy, A. (2001). Teacher Efficacy: Capturing an Elusive Construct. Teaching and Teacher Education, 17, 783-805. https://doi.org/10.1016/S0742-051X(01)00036

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