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Research Article

Examining the Relationships Between Media Literacy, Technology Integration Skills, and STEM Applications Self-Efficacy Perception via A Structural Equation Model: A Study of Visual Arts Teacher Candidates

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Abstract:

The purpose of this study was to examine the relationship between Visual Arts teacher candidates' media literacy, technology integration skills, and STEM application self-efficacies. The research, designed using the relational scanning model, was conducted with the participation of 204 Visual Arts teacher candidates. To collect the data, "Media Literacy," "Teacher Technology Skills," and "Teacher STEM Self-Efficacy Perceptions" scales were used in the study. The analysis of the research data was carried out using STEM analysis in the AMOS program. According to the research findings, visual arts teacher candidates' media literacy was found to be high, but their technology integration skills and STEM application self-efficacy were found to be moderate. According to STEM analyses, media literacy and technology integration skills significantly predict STEM self-efficacy in Visual Arts teacher candidates, both separately and together.

Keywords: Visual arts, teacher candidates, media literacy, technology integration skills, self-efficacy of STEM applications

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INTRODUCTION

The change and development in the visual arts with technological developments and the opportunities offered by computers have also affected the concepts of art education and what and how to teach in educational programs. Visual arts teacher candidates must have competencies in traditional and contemporary art concepts to be well-equipped art educators in all aspects (Tepecik & Tuna, 2001). Art educators argue that its education should adapt to the changing structure of today's art (Mayo, 2007; Özdemir, 2022).

While technological developments lead to significant changes in the creation and presentation of art works, some studies need to be carried out in their evaluation. It is thought that there is a need for courses in institutions that train visual arts teachers, in which both applied studies contribute to the understanding of contemporary art and courses encourage students to read, write, think, and discuss. It is thought that the variety of courses on contemporary art education technologies should be increased to gain the ability to understand and interpret new understandings of art (Demirtaş & Özçelik, 2021; Oliveira, Oxley & Petry, 2006; Patton & Buffington, 2016).

When issues related to the use of technology in art and the review and arrangement of curricula are discussed, it should be noted that the use of technology is not new. What is meant by technology is not only the use of technology such as computers but also the use of modern tools and adequate equipment in the educational environment. Technology has supported artistic and creative expression in terms of tools, materials, and development for centuries (Robyler & Doering, 2010; Taylor & Carpenter, 2007). Especially in recent times, media literacy, art education-technology integration, STEM applications, online education, etc. have begun to come to the fore in art education, similar to other fields.

The concept of media literacy has been defined in different ways, each emphasizing a different aspect. According to the general definition of Aufderheide (1993), media literacy is expressed as "a citizen's ability to access, analyze, and produce information for certain results". Chu and Lee (2014) considered media literacy a life skill, especially for young people, to critically understand, analyze, and influence the media. Bulger and Davison (2018) evaluated media literacy as skills that support critical participation with the information presented by the media and provide ways to deal with fake news.

Media literacy, which emerges as an educational approach of the 21st century, is seen as an important factor in developing the knowledge and skills necessary for lifelong learning in a constantly changing world (Alexander & Galina, 2020; Moto et al., 18; Thoman & Jols, 2008). Media literacy requires both individuals' knowledge, media literacy skills, and critical understanding, analysis, interpretation, judgment, and active participation abilities (Buckingham, 2003; Domine, 2011; Sachdeva & Tripathi, 2019).

Although media use has benefits in constructing knowledge, research (Steeves, 2014; Wineburg et al., 2016) shows that young people have difficulty evaluating media content.

Students report that they are taught basic digital literacy competencies in school, such as searching online and verifying information, but research has shown that students have limited knowledge about the business aspects of online sites and platforms (Abrosimova, 2020; Eshet, 2004; Steeves, 2014). Similarly, students cannot effectively reason about information found on the internet (McGrew, Ortega, Breakstone & Wineburg, 2016 and have difficulty analyzing various media messages (Wineburg et al., 2016).

After emphasizing that media literacy education is a basic need, UNESCO published the Grunwald Declaration on Media Education in 1982. The declaration emphasizes that the conscious use of communication tools and products and media education are important at every stage of human life (UNESCO, 1982).

Stating that media literacy should be expanded to include digital media in the Grunwald Declaration, UNESCO has prepared guidelines focusing on digital media literacy. The resource titled "Media and Information Literacy: Policy & Strategy Guidelines", published in 2013, provides information about the knowledge and skills needed by societies in the use of new communication tools, including the Internet, and in the production of content. More than 70 countries are addressing the seriousness of this issue by enacting various activities related to media and information literacy. This study conducted by UNESCO is important because it is the first to combine the concepts of information literacy and media literacy, considering the right to access knowledge and information and to exercise freedom of expression through new communication technologies (UNESCO, 2013). The idea of current media literacy refers to a structure (Kapucu et al., 2021; Koltay, 2011) that includes integrated media environments of print, audio-visual, computer, mobile phone, and other smart technologies. Media literacy is generally defined as a skill set that encourages critical interaction via media messages (Livingstone, 2004; Hobbs and Jensen, 2009; Lähdesmäki & Maunula, 2022).

Efforts to integrate information and digital technologies into education have revealed the need to improve teachers' proficiency in technology use (Gülcü et al., 2013; Keser and Çetinkaya, 2013). Within the scope of the National Educational Technology Standards-NETS (National Educational Technology Standard), teachers should be able to focus on how technology facilitates learning and creativity in students and contribute to the development of technology-enriched learning environments. It also emphasizes that they should have basic competencies such as being able to work in harmony with the digital age and conduct research (NETS-T, 2008).

Technology integration in education means that students benefit from new technologies at a maximum level in line with the goals specified in the curriculum and use these technologies extensively in their learning process. Technology integration is part of every lesson, unit, or activity. It is defined as using or combining technology with teaching and learning strategies to meet the standards and learning outcomes of the program (Davies & West, 2014; Ramorola, 2013; Susanto et al., 2020). In Turkey, there are no criteria for media

literacy competencies among the general competencies of the teaching profession (ÖYGM, 2020). However, few studies have addressed teacher candidates' technology readiness and technology integration self-efficacies, technology integration self-efficacy perceptions, and digital competence levels. In this respect, this study is expected to contribute to the literature regarding the variables discussed in the research. It is thought that the ability to integrate technology into education is directly related to media literacy and the effective use of digital materials in learning-teaching processes. However, the lack of sufficient data on teachers' use of digital materials in their courses may negatively affect policies regarding technology integration. In this context, determining whether visual arts teacher candidates use digital materials in their courses and the contributions of the digital materials used in STEM education will undoubtedly produce important results in art education.

STEM approach is an education that brings together many disciplines, aiming to transform theoretical knowledge into practice and product, and educates students who think, question, research, and invent together with the requirements of the age and developing technology (Tytler, 2020; White, 2014). The most important task for the emergence of these students falls on the teachers. It is thought that teachers with high STEM proficiency will use different methods and practices in their professional lives and will have student-centered courses integrated with technology. The teachers' use of student-centered methods and their ability to bring together different disciplines, as in STEM activities, make them the best guide in teaching course objectives. Their inadequacy in designing STEM activities also reflects their teaching of subjects in different disciplines (Knowles, 2017; Lo, 2021; Shernoff et al., 2017).

In their research, aimed at determining the self-efficacy and concerns of Hong Kong teachers about STEM education, Gene, Jong, and Chai (2019) found that only 5.53% of the participants saw themselves as well prepared for STEM education. Participants had intense knowledge, management, and outcome concerns regarding the implementation of STEM education in their schools. Therefore, researchers state that there is an urgent need for clearly expressed professional development and pedagogical and technological skills for teachers to increase their self-efficacy in implementing STEM education (Bicer et al., 2020; Shahidullah, & Hossain, 2022; Woolfolk, Winne, Perry, & Shapka, 2009).

When studies on STEM education are examined, it is seen that importance should be given to the training of teachers and teacher candidates before the application of STEM education to students. It is stated that teachers and teacher candidates have the necessary knowledge about STEM education, but they do not have the competencies to implement it. Thus, in this study, teacher candidates' STEM education self-efficacies was examined according to relational research methods. As one of these studies, Dadacan's (2021) study examined teacher candidates' self-efficacy, awareness, and tendency to use STEM applications in terms of gender, department, and university variables. In their research, they used Yaman et al. (2018) STEM applications teacher self-efficacy scale and found that teacher candidates' self-efficacy for STEM education was at a medium level and did not differ

regarding any of the variables mentioned. Although teacher candidates' self-efficacy levels for STEM education are of critical importance in determining their decisions on integrating STEM activities in learning environments (Kurup et al., 2019; Thibaut et al., 2018), media literacy and technology integration skills are thought to be important as strong predictors of future STEM performances (Thompson & Kanasa, 2016). Therefore, studies are needed to be conducted on the impact of technology-related variables on both determining the self-efficacy levels of teacher candidates for STEM education and transforming them into performance.

The people who are primarily responsible for the implementation of STEM education in teaching-learning processes are teachers and teacher candidates (Wang, 2012; Wang, Moore, Roehring, & Park, 2011). In contrast, the professional and technological knowledge of teacher candidates affects the quality of education and student success (Jackson, Rockoff, & Staiger, 2014). In this context, it is thought that integrating technology into teaching and media literacy is important in STEM competencies of teacher candidates. It is seen in the literature that studies have been carried out mostly in the science and mathematics field regarding the integration of STEM competence, technology integration skills, and media literacy (Çayak, 2019; Lin, Chai, Di, Wang, 2022; Yılmaz, 2019). However, in recent years, there has been limited information on how competent visual arts teacher candidates are in using the technologies needed in classes effectively and efficiently and in STEM and media literacy. In addition, understanding the relationships among media literacy, technology integration skills, and STEM application self-efficacy perception can play an important role in the education of visual arts teacher candidates. Training programs to improve pre-service teachers' media literacy and technology integration skills can help them use STEM applications more effectively in their classrooms. Research on this subject may help to better understand the relationships between visual art teacher candidates' media literacy, technology integration skills, and STEM application self-efficacies perception. This study examines the relationship between visual art teacher candidates' media literacy and technology integration skills and their self-efficacy in STEM applications. In relation to this purpose, this study sought answers to the following research question and tested two hypotheses.

Sub Problems:

What is the level of visual art teacher candidates' self-efficacies in media literacy, technology integration skills, and STEM applications?

Hypotheses:

H1: Media literacy positively affects self-efficacy in STEM applications.

H2: Technology integration skills positively affect self-efficacy in STEM applications.

METHOD

Research Model

The relational survey model, a quantitative research method, was used in the research.

Participants

The research population consists of students studying in Visual Arts Teaching departments at universities in Turkey. Due to the limitations of reaching the entire population regarding time, cost, and accessibility limitations, the sample consisted of students studying in four universities in the departments of Visual Arts Teaching. In this context, the convenience sampling method, a nonrandom sampling method, will be used. Queirós, Faria, and Almeida (2017) defined convenience sampling as a method that prevents loss of time, money, and labor. The convenience sampling method is frequently used in educational research and offers cost and accessibility advantages (Mujis, 2004). The convenient sampling method is an approach that reduces time, money, and labor losses. The researcher works on the most accessible and economical units to reach the required sample size (Acharya et al., 2013). The reason for choosing the convenience sampling method in this research is to select an easily accessible and applicable sample due to limitations such as time, money, and labor. However, this method has some limitations in fully representing the universe. This can be stated as a limitation of the study. In this context, forming the study group of the research using the appropriate sampling method reduced the practical difficulties in the research process and ensured the efficient use of limited resources. For this purpose, the research was conducted with 204 visual art teacher candidates. One hundred and thirty four of the teacher candidates were women and 70 were men. Again, 53 of the participating visual arts teacher candidates were in the first grade, 51 in the second grade, 52 in the third grade, and 48 were senior students.

Data Collection Tools

The Media Literacy Scale, Technology Integration Skills Scale, and Teacher STEM Applications Self-Efficacy Scale were used as data collection tools in the study.

Media Literacy Scale

The Media Literacy Level Determination Scale developed by zel (2018) was used in this study. There are 16 items in the scale that determine the level of media literacy. The reliability coefficient calculated by the developers was 0.82. Confirmatory factor analysis and the reliability coefficient of the scale were calculated for this study. The scale was scored as 1=never, 2=rarely, 3=sometimes, 4=often, 5=always. Confirmatory factor analysis was used to verify the construct validity of the Media Literacy Scale. The findings of the analysis indicated that the model fit values [χ^2=250.58, χ^2/df=3.06, p<.001, CFI=0.95, RMSEA=0.10, IFI=0.95, TLI =0.95, SRMR=0.07] were acceptable (Yurt, 2023). The lowest standardized factor loading value of the items in the scale was 0.65, whereas the highest was 0.79. The

Cronbach's alpha reliability coefficient was calculated to be 0.94 for the Media Literacy Scale.

Technology Integration Skills Scale

In this study, a five-point Likert-type scale developed by Wang, Ertmer, and Newby (2004) was used to measure visual arts teacher candidates' technology integration competencies. The scale consists of 19 items and two subscales. All items in the scale form consist of positive items. Teacher candidates to whom the scale was applied responded to a 5-category rating expressed as "never", "rarely", "sometimes", "often" and "always". The data collection tool was designed to be filled in using the paper-pencil method, and all findings were obtained in this context. Comparison and relational analyses can be made with the total scores obtained from the scale or the total scores related to the sub-dimensions can be made with the demographic or dependent variables to be used in the research. Within the scope of this research, hierarchical confirmatory factor analysis was performed to test the construct validity of the scale. The analysis results indicated that the model fit [χ^2=499.76, χ^2/df=4.10, p<.001, CFI=0.94, RMSEA=0.10, IFI=0.94, TLI =0.92, SRMR=0.05] values were acceptable (Yurt, 2023). The standardized factor loading values of the items in the scale were 0.70 at the lowest and 0.93 at the highest. The Cronbach's alpha reliability coefficient was calculated as 0.95 for the Technology Integration Skills Scale.

Teacher STEM Applications Self-Efficacy Scale

Özdemir et al. (2018) developed the STEM Applications Teacher Self-Efficacy Scale to measure the self-efficacy levels of teacher candidates. The scale consists of 18 items of 5-point Likert type. These were rated "Never (1), Rarely (2), Sometimes (3), Often (4) and Always (5)." Confirmatory factor analysis was used to verify the construct validity of the Teacher Self-Efficacy Scale for STEM Practices. The findings of the analysis indicated that the model fit values [χ^2=301.25, χ^2/df=2.74, p<.001, CFI=0.96, RMSEA=0.09, IFI=0.96, TLI =0.94, SRMR=0.04] were acceptable (Yurt, 2023). The lowest standardized factor loading value of the items in the scale was 0.72, whereas the highest was 0.90. The Cronbach's alpha reliability coefficient was calculated to be 0.92 for the Teacher Self-Efficacy Scale for STEM Practices.

Data Analysis

Structural Equation Modeling was applied to test the relationship between visual art teacher candidates' media literacy and technology integration skills and their self-efficacy in STEM applications. The data obtained were evaluated using SPSS 27.00 and AMOS 24 package programs. Arithmetic mean, standard deviation, correlation, and SEM analyses were performed to evaluate the data.

In structural equation model analysis, to verify the model fit χ^2/df (< 5), the Root Mean Square Error of Approximation (RMSEA) (< 0.10), the Standardized Root Mean Square Residual (SRMR) (< 0.08), the Comparative Fit Index (CFI) (> 0.90), and the Tucker-Lewis Index (TLI) (> 0.90) indices were used, (Yurt, 2023).

Ethical considerations

In this study, all rules stated to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed. None of the actions stated under the title "Actions Against Scientific Research and Publication Ethics", which is the second part of the directive, were not taken.

Ethical review board name: Kütahya Dumlupına University Chairmanship of the Social and Humanities.

Scientific Research Ethics Committee Date of ethics review decision: 02.02.2024.

Ethics assessment document issue number: 34.

RESULTS

First, the study included descriptive statistical findings regarding media literacy, technology integration skills, and stem self-efficacy of visual art teacher candidates (See Table 1). The correlation analysis results between these variables were given (See Table 2). In the final stage of the study, structural equation model analyses between variables were given (See Figure 1 and Table 3).

Descriptive Statistics Results

Table 1.

Descriptive Statistics on Media Literacy, Technology Integration Skills, and STEM Self-Efficacy of Visual Arts Teacher Candidates

	N	Minimum	Maximum	Range	Mean	Std. Deviation
Media Literacy	204	1,19	5,00	3,81	3,43	0,84
Technology Integration Subscale 1	204	1,00	5,00	4,00	3,24	0,96
Technology Integration Subscale 2	204	1,00	5,00	4,00	3,16	0,91
Technology Integration Scale Total	204	1,00	5,00	4,00	3,20	0,91
STEM Self-Efficacy	204	1,06	5,00	3,94	3,22	0,89

Table 1 shows the arithmetic mean and standard deviation values calculated for the media literacy, technology integration skills, and stem self-efficacy scores of the visual art teacher candidates. According to the average values, the media literacy of the visual art teacher candidates was found to be at a high level. However, their technology integration skills and STEM application self-efficacy were at a medium level.

Correlation Analysis Results

Table 2 shows that the average scores of the participants in media literacy, teacher STEM application self-efficacy, and technology integration are calculated as 3.43 (SD = 0.84), 3.22 (SD = 0.89), and 3.16 (SD = 0.91). The results obtained indicate that the participants' media literacy perceptions were at a high level, while their self-efficacy for STEM applications and technology integration skills were at medium.

Table 2.

Descriptive Values and Pearson Correlation Coefficients

Variables	M	SD	1	2	3	4
1. Media Literacy	3,43	0,84	1			
2. Teacher Self-Efficacy Scale for STEM Practices	3,22	0,89	0,58**	1		
3. Using computer Technologies (TI)	3,24	0,96	0,60**	0,73**	1	
4. using a computer (TI)	3,16	0,91	0,59**	0,78**	0,87**	1
5. Technology Integration Skills Scale Total	3,16	0,91	0,62**	0,77**	0,89**	0,88**

**p<0.01, N=204, TI= Technology Integration

there are medium- and high-level positive relationships between self-efficacy scores for STEM applications and media literacy (r=0.58, p<0.01) and technology integration skills (r=0.77, p<0.01) (Table 1). There is a moderate positive relationship between media literacy scores and technology integration skills (r=0.62, p<0.01).

Structural Equation Model Analysis Results

To test the hypotheses of this research, the structural equation model shown in Figure 1 was developed and tested. In the model, media literacy and technology integration skills are included as independent variables, and self-efficacy for STEM applications is included as a dependent variable. The fit values obtained by testing the model [χ2=2801.69, χ2/df=2.25, p<.001, CFI=0.92, RMSEA=0.08, TLI =0.93, SRMR=0.07] indicate that the model is compatible with the data (Yurt, 2023). The path coefficients, significance levels, and confidence intervals included in the model are summarized in Table 2.

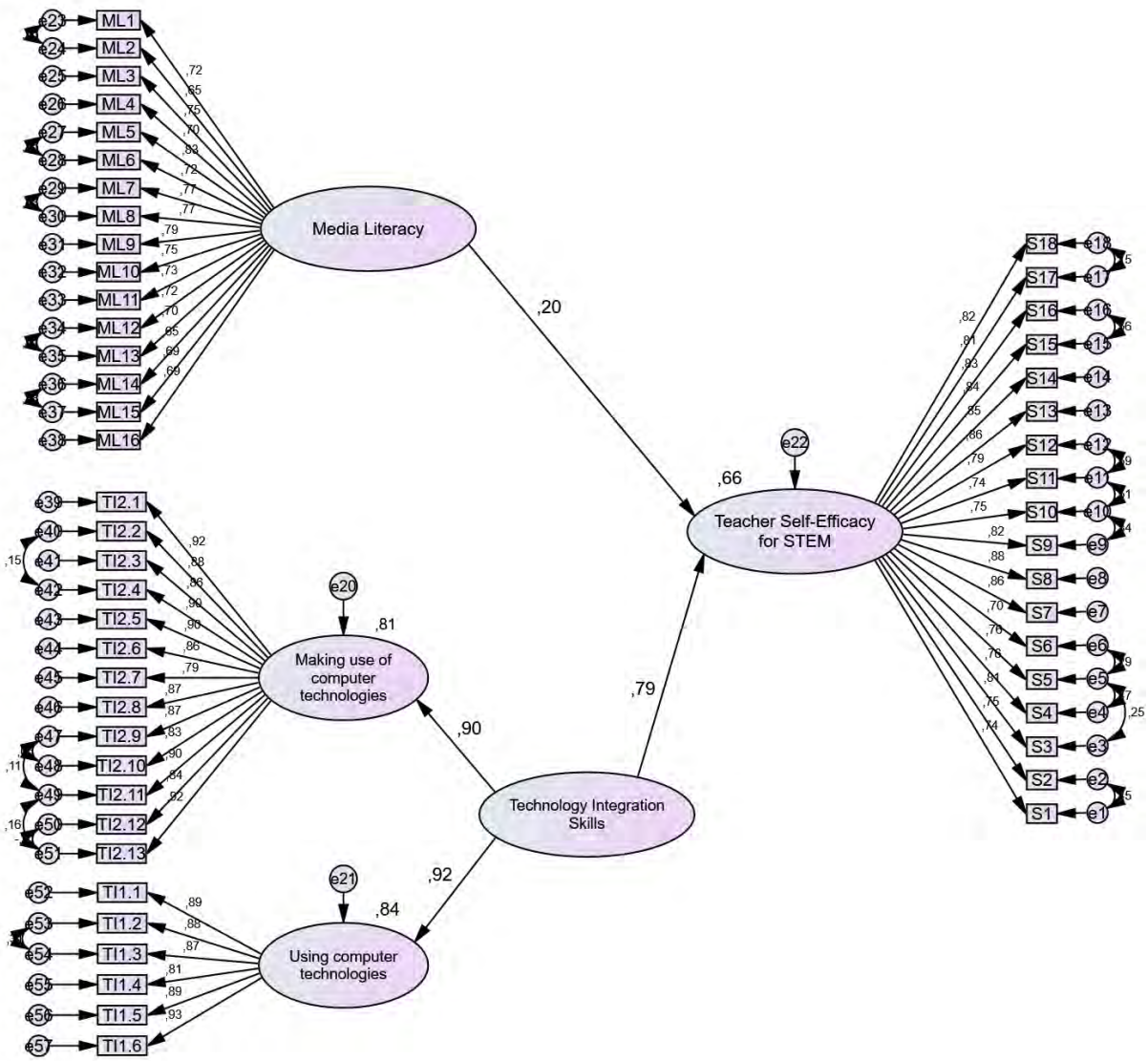

Figure 1. Structural equation model

Table 3 shows that the predictive power of media literacy for self-efficacy for STEM applications is 0.20 [95% CI (0.04; 0.39)]. According to this result, H1 was accepted. As media literacy increases self-efficacy for STEM applications, it also increases in visual art teacher candidates. The predictive power of technology integration skills for self-efficacy in STEM applications is 0.79 [95% CI (0.65; 0.89)]. According to this result, the H2 hypothesis was accepted. As technology integration skills increase in visual art teacher candidates, self-efficacy for STEM applications also increases. Media literacy and technology integration skills together explained 66% of the change in self-efficacy for STEM applications. Considering the standardized beta coefficients, it was observed that technology integration skills were more effective on self-efficacy for STEM applications than media literacy.

Table 3.

Regression Weights

			B	B	S.E.	C.R.	p	%95-CI	
								Lower	Upper
Media literacy	--->	Self-Efficacy Scale for STEM	0,20	0,21	0,05	3,81	***	0,04	0,39
Technology Integration Skills	--->	Self-Efficacy Scale for STEM	0,79	0,66	0,07	9,94	***	0,65	0,89

***p<0.001, S.E.= Standart error, C.R. =Critical rate, β=Standardized beta, B = unstandardized beta

DISCUSSION

In this study, visual art teacher candidates' media literacy, technology integration skills, and STEM application self-efficacy were examined on a relational basis. According to the research findings, the media literacy, high technology integration skills, and STEM application self-efficacy of the participating visual arts teacher candidates were found to be at a medium level. Thus, Doğru (2020) conducted a study on visual arts teachers and teacher candidates and found that the technology literacy of the participants was high and their technology integration skills were at a medium level. Similarly, similar findings to the present study were obtained in the literature on media literacy and technology competence (Doğru, 2020; Koh and Chai, 2013; Kara, 2021; Koyuncuoğlu, 2021; Vosough Matin, 2023). These findings show that visual art teacher candidates generally perceive themselves as competent in technology literacy, skills, and use. However, in the study, visual art teacher candidates' STEM application self-efficacies was found to be at medium or below average levels. In fact, in the research of Geng et al. (2019), in which they aimed to determine the self-efficacy and concerns of Hong Kong teachers about STEM education, they concluded that very few of the participants saw themselves as well prepared and sufficient for STEM education. Çolakoğlu and Günay Gökben (2017) mentioned studies on STEM training given to teacher candidates in education faculties in Turkey, foreign examples of STEM education, and suggestions about the necessary program to train teachers who can carry STEM education to schools. Because of the research, it was observed that faculty members in education faculties were aware of STEM education but believed that their application competence was low.

Another finding of the research is the relationship between visual art teacher candidates' media literacy, technology integration skills, and STEM application self-efficacy. According to the analyses carried out in the AMOS program, media literacy and technology integration skills, separately and together, significantly affect STEM application self-

efficacy. As visual art teachers' technology integration skills and media literacy increases, their self-efficacy in STEM applications also increases. Thus, studies of Demirbağ and Bahçıvan (2021), Greene et al. (2018), Le et al. (2022), Murphy & Kelp (2023), and Voda et al. (2022) had similar findings. To be digitally literate, it is necessary to be able to use technology at a social level as well as examine and integrate digital information (Margaryan et al., 2011). According to Greene et al. (2018) and Tang and Chaw (2016), realizing media literacy and technology integration skills, such as digital access, content creation, and resource sharing, positively affects the effectiveness of students and teachers in new and contemporary teaching practices like STEM. According to Margaryan et al. (2011), being familiar with technology alone is not enough for success in learning; having the right competencies and attitudes is equally important. Technological and digital competence gaps in teacher education have made it important for them to be able to integrate contemporary practices related to technology and teaching practices (Instefjord & Munthe, 2017). The study of Seferoğlu and Akbyk (2005) reveals the importance of pre-service and in-service training of teachers and teacher candidates on this subject.

In the literature, new approaches and effective integration of developing technologies have come to the fore in bringing developing technologies into the classroom (Goos and Bennison, 2008; Liao, 2007). These studies show that the use of technology in education requires teacher candidates and teachers to have competencies in the integration of technology into education. However, the implementation of technology integration skills on the basis of new teaching approaches is a dynamic, complex, and partly slow process (Harris and Hofer, 2009).

CONCLUSIONS AND RECOMMENDATIONS

It is important for Visual Arts teacher candidates to feel competent in understanding their media literacy and technology integration skills and in integrating technology into STEM applications in their classrooms. According to the research findings, the media literacy of the participating Visual Arts teacher candidates was high, but their technology integration skills and STEM application competencies were moderate. The important result of the study is that media literacy and technology integration skills in Visual Arts teacher candidates are an important factor in their proficiency in STEM applications. In this regard, it is important to design Visual Arts teacher training programs such that students can use technology at an adequate level during the learning process. Visual Arts students who feel sufficient in their technology adaptation process skills will be equipped with the skills to use the teaching approaches and digital processes required by the age in the learning-teaching process when they begin teaching. This research was conducted using the quantitative research method. In a future study, a more detailed study can be conducted using a combination of mixed methods such as observation and interview. Convenience sampling method and conducting the research on a certain number of participants are the two important limitations of this study. The small number of teacher candidates studying

in visual arts teaching departments in Turkey affected the number of participants in the sample. In this context, it is recommended that future studies should be conducted on a larger sample.

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Data Availability Declaration

The data can be shared upon request.

Author Contributions

The sole author of this research, Zeliha Canan Özkan, was responsible for the conceptualization, methodology formulation, data collection, analysis, and interpretation. Furthermore, Zeliha Canan Özkan took charge of drafting the initial manuscript, revising it critically for vital intellectual content, and finalizing it for publication. The author has read and approved the final manuscript and takes full accountability for the accuracy and integrity of the work presented.

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