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Digital Text/Tool Selection and Integration: What Professors Teach

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Abstract

The DigiLit Framework suggests criteria for digital text and tool selection (content accuracy, intuitiveness, interactivity, quality) and integration (model a literacy skill or strategy, guide a literacy skill or strategy, model digital feature use, guide digital feature use) in literacy lessons. Using survey research, we explored which DigiLit criteria literacy professors prepared preservice teachers to use in K-12 settings. Participants included 199 literacy professors (194 from USA and one each from Australia, Canada, Caribbean, Middle East and Europe). We used a multivariate outcome logit/probit model to analyze how this was related to (a) professor characteristics, (b) institution characteristics, and (c) time. Findings showed that certain professor characteristics (e.g., interest in integrating technology, being knowledgeable about digital literacies), institution characteristics (e.g., access to equipment, professional development, technical support, incentives), and time to plan and practice integration were related to literacy professors' increased preparation of preservice teachers to use digital text or tool selection and integration. These findings provide specific ways to improve literacy teacher preparation by providing specific kinds of supports.

Keywords: literacy, teacher preparation, technology selection, technology integration, survey study

1. Introduction

Teachers are expected to integrate digital texts and tools in their literacy instruction (Chaudron et al., 2018; International Literacy Association, 2009). However, they have difficulty doing this (Hutchison & Colwell, 2016; Kaalberg, 2014). Often teachers use an overly tech-centric approach and failed to connect the technology meaningfully to engage the broader instructional objectives (ibid.). Also, teachers sometimes expressed that they did not feel competent with technology (McVee, 2008). The DigiLit Framework is a research-based guide for teachers' digital text or tool selection and integration in literacy instruction (Baxa & Christ, 2018). It focuses specifically on literacy instruction, as compared with other frameworks that encompass multiple areas of education (e.g., Mishra & Koehler, 2006; Puentedura, 2010). Additionally, it focuses more broadly on digital text and tool selection and integration, as compared with frameworks that focus solely on app, e-book, or website evaluation (Dragulanescu, 2002; Israelson, 2015; Morgan, 2013). The DigiLit framework presents criteria for (a) text and tool selection (i.e., content accuracy, quality, intuitiveness, interactivity), and (b) integration (i.e., model a literacy skill, guide the student to use the literacy skill, model digital feature use, guide the student's digital feature use) in literacy lessons (see Figure 1).

Digital Text or Tool Selection Criteria

- Literacy content is accurate
- High quality texts have features that support reader processing
- Intuitive means that how to use the features is clear or explicitly supported
- Interactive means that the features allow user to actively interact with or create content

Digital Text or Tool Integration

- Model a literacy skill or strategy
- Guide the use of the literacy skill or strategy
- Model the use of digital affordances
- Guide the use of digital affordances

Figure 1. DigiLit Framework Criteria (Baxa & Christ, 2018)

In one study, when the professor taught teachers these criteria, teachers used them moderately to highly effectively in their literacy lessons, as measured quantitatively by scoring videos of their instruction using the DigiLit Framework Rubric (Christ et al., 2020). However, while previous research has explored more broadly how education professors integrate technology in their coursework (Foulger et al., 2013; Husbye & Elsener, 2013; Mouza et al., 2014; Wetzel et al., 2014), we found no research that explores what factors support or hinder literacy professors' teaching of these criteria to the teachers in their courses. Our study aims to explore this issue by surveying literacy professors to understand what factors support or hinder their preparation of teachers to use the components of the DigiLit Framework.

2. DigiLit Framework

To guide our analysis of how education professors prepare teachers to select and integrate digital texts and tools in literacy instruction, we adopt the text/tool selection and integration criteria from the DigiLit Framework (Baxa & Christ, 2018). The framework includes five criteria that guide digital text/tool selection, and four criteria that suggest how teachers should integrate these into literacy instruction. We chose the framework because the criteria focus specifically on pedagogical decisions for *literacy instruction*, rather than across disciplinary contexts, more broadly, such as does the Technological, Pedagogical, and Content Knowledge Framework (Mishra & Koehler, 2006). This specific focus on decision-making especially for literacy instruction is useful because there are distinct considerations for digital text/tool selection and integration. For example, considering literacy content accuracy (e.g., correct application of phonic patterns) and quality of text (e.g., developmental appropriateness) as part of digital text/tool selection is critical to their utility for instruction. Likewise, considering teachers' modeling and guiding a student's engagement with a literacy skill/strategy during digital text/tool integration is imperative for students' success in meeting the lesson objectives. These selection and integration criteria are discussed in more detail in the sections that follow.

2.1 Digital Text and Tool Selection Criteria

The DigiLit Framework includes five criteria that suggest what education professors should prepare teachers to evaluate when selecting digital texts and tools (Baxa & Christ, 2018). These include the following:

- *Literacy content accuracy*: Evaluate that the spelling, grammar, and phonetic or phonic patterns are correct. For example, if a phonics app feature divided the word by phonemes (each discrete sound in the word) and reads each phoneme correctly, it would be considered accurate. However, if the app feature read any of the phonemes incorrectly, it would be inaccurate.
- *Digital text quality*: Evaluate text's developmental appropriateness, whether it provides continuous and authentic text (vs. 1–2 sentence excerpts), and whether hotspots support comprehension. For example, if a text presented an authentic story that was developmentally appropriate for the student, such as the *Three Little Pigs*, it would be considered good quality. However, if the text presented a few decontextualized sentences or content that was not age appropriate, then it would be considered poor quality.
- *Digital tool quality*: Evaluate whether the digital text/tool features support learning the objective. For example, an animated hotspot that demonstrates a vocabulary word meaning, which can support a vocabulary word learning objective, would be considered high-quality.
- *Intuitiveness*: Evaluate how easily a student could figure out how to use the digital text/tool features. For example, a hotspot that lights up to draw attention to the user to touch it is an example of a feature

that is highly intuitive, or easy to know how to use.

- *Interactivity*: Evaluate to what extent the digital text/tool features promote active learning. For example, text with several hotspots that children can press on each to activate animation and sound would provide potential for high interactivity. However, a text that has very few or no hotspots or other features that children can activate would have low potential for interactivity.

2.2 Digital Texts and Tool Integration Criteria

The DigiLit Framework provides four criteria that suggest what education professors should prepare teachers to do when integrating digital texts and tools in literacy lessons (Baxa & Christ, 2018). These are as follows:

- *Model a literacy skill or strategy* (e.g., long vowel magic-e pattern) *or strategy* (e.g., comprehension monitoring using text structure, making in an inference, etc.)—i.e., teachers use the skill/strategy, and students watch.
- *Guide a student's use of a literacy skill or strategy*—i.e., students use the skill/strategy, and teachers support them as needed.
- *Model digital feature use* (e.g., use a hotspot in an app book to support determining a meaning for an unfamiliar word)—i.e., teachers use the features, and the students watch.
- *Guide a student's use of digital features*—i.e., students use the features, and teachers support as needed.

3. Factors that Impact Professors Preparation of Teachers to Integrate Technology

Research that examines factors that affect literacy professors' preparation of teachers to integrate technology in their literacy lessons is very limited (Christ et al., 2021; Voogt & McKenney, 2017). However, research more broadly shows that several factors affect professors' integration of technology in their own university instruction: (1) professor characteristics, (2) institutional characteristics, and (3) time. Research has demonstrated a set of variables related to both professor characteristics and institutional characteristics, whereas time is a single variable factor that encompasses issues related to both professors and institutions. We review this broader research to inform which factors to explore in our more targeted study of literacy professors' preparation of teachers to integrate technology in their literacy lessons.

3.1 Professor Characteristics

1) Professor Demographics

Age is one factor that researchers have considered in relation to professors' use of technology. Two studies show that professors who are younger are more likely to broadly use technology in their courses and discussion boards in learning management systems such as Blackboard (Meyer & Xu, 2009; Woods et al., 2004). Another study finds that older professors are more likely to use multimedia videos (Christ et al., 2017).

Gender is another factor that researchers consider in relation to professors' use of technology. One study shows that professors who are male had more positive attitudes toward integrating technology (John, 2015). Two other studies show that female professors use video case-studies more often (Christ et al., 2017) and are more likely to use the administrative features of course management systems, as compared to male professors (Woods et al., 2004).

Job rank is a third factor that researchers consider in relation to professors' use of technology. Research shows that there is nuance in how rank and technology use are related (Arya et al., 2016; Christ et al., 2017). For example, two studies find that professors who are at higher ranks and have more experience teaching at a university used more technology, especially video case-studies and multimedia (ibid.). However, these same studies also show that assistant professors are more likely to use videos for peer discussions (ibid.).

2) Professors' Technological Expertise

Knowledge about technology is another factor that researchers consider in relation to professors' technology use. One study finds that professors' greater knowledge about learning management systems is related to their using its interactive features, as compared to just posting the syllabus and course readings when professors are less knowledgeable (Woods et al., 2004). Another study shows that professors who do not know how to integrate technology into their discipline area are unlikely to do so (Alfalah, 2018).

Experience using technology is also a factor that researchers explore in relation to professors' technology use. For example, two studies find that professors' experience using technology and teaching online support technology integration in their courses (Foulger et al., 2015; Khin, 2021). Additionally, a few studies show that several kinds of professor experience result in more technology use, including using computers (Musbah &

Karsh, 2018), using Blackboard (Woods, 2004), or using Web applications (Alsadoon, 2018). However, two other studies show that when professors lack technical skills, this hinders their ability to integrate technology in their courses (Alfalah, 2018; Khin, 2021).

3) Professors' Technological Sentiments

Interest is one aspect of professors' sentiments about technology that researchers explore. Several studies show that when professors are uninterested in integrating technology, they are less likely to do so (Adnan & Tondeur, 2018; Alfalah, 2018; Cheok et al., 2016; Marzilli et al., 2014). Fortunately, only 7.1% of faculty surveyed in one study report that they have a "limited" interest in using technology (Marzilli et al., 2014).

Comfort is another aspect of professors' sentiments about technology that researchers explore. Several studies find that when professors are uncomfortable using technology (e.g., Blackboard), they are less likely to develop technology-based instructional materials or design lessons with technology integration (Adnan & Tondeur, 2018; John, 2015; Woods et al., 2004).

Perceptions is a third aspect of professors' sentiments about technology that researchers explore. One study shows that when professors think a technology is useful (e.g., web applications), they integrate it in their courses more often (Alsadoon, 2018). Another study shows that professors' perceptions that technology will enhance their students' learning further increases their integration of these technologies (Chittur, 2018). However, in contrast, two studies show that when professors perceive that students will struggle to use technologies effectively to support their learning, this reduces professors' use of these technologies (Khin, 2021; Marzilli et al., 2014).

3.2 Institution Characteristics

1) Institutional Demographics

The relation between institutional demographics and professors' uses of technology are explored in a limited number of studies. One study shows that professors who teach at private institutions use more video technologies in their courses than those who teach at public ones (Arya et al., 2016). The same study also shows that professors at doctoral granting institutions use more videos technologies and a wider range of these than professors at institutions whose highest degrees are bachelors or masters (Arya et al., 2016). Additionally, that same study and another show that teaching both undergraduate and graduate courses, or just graduate courses, is related to professors' use of more video technologies in their courses (Arya et al., 2016; Christ et al., 2017). Finally, two other studies find that teaching fewer courses is related to professors' use of more technology (Birch & Burnett, 2009; Kenney & Newcombe, 2011).

2) Institutional Support and Policies

The relation between institutional supports and policies and professors' uses of technology are explored by several researchers. Two studies show that when institutions support technology integration, professors' technology use increases or improves (Kampov-Polevoi, 2010; Nelson et al., 2019). Additionally, a survey of teacher educators across various content areas shows that their use of technology increases by 67% when they are provided support to integrate specific technologies (e.g., videos) in their courses (Arya et al., 2016). Further, another study shows that when institutions have policies that incentivize professors for integrating technology in their teaching (e.g., sustained financial support), they are more likely to do so (Lee & Son, 2018).

However, some studies find that when university support is inconsistent and policies regarding technology integration are unclear, they act as a hindrance to professors' use of technology in their courses (Alfalah, 2018; Luongo, 2018; Tshabalala et al., 2014). For instance, sometimes professors feel that they do not have their administration's support to integrate certain technologies (Alfalah, 2018; Luongo, 2018). Further, sometimes professors feel that institutions do not reward technology integration and it does not add value towards achieving tenure and promotion (Luongo, 2018).

3) Colleagues and Technical Staff Supports

The relation between colleagues and technical staff supports and professors' uses of technology are explored by researchers. A few studies find that colleagues and technical staff are frequent sources of support for technology integration in courses (Chittur, 2018; Harbin, 2019; Lee & Son, 2018). Additionally, one study shows that teacher educators improve their technology integration and use more effective methods for preparing preservice teachers to integrate technology in their K-12 instruction when they receive professional development (Foulger et al., 2015).

However, several studies show that universities frequently (52%) do not provide technical support or

professional development (Cheok et al., 2016; Khin, 2021; Luongo, 2018; Musbah & Karsh, 2018), despite professors express a desire for this (Luongo, 2018). Additionally, one study finds that lack of communication and collaboration between professors and technology experts hinders professors' technology use (Voogt & McKenney, 2017).

4) Access to Technology Equipment, Software, and Digital Materials

The relation between access to technology equipment, software, and digital materials and professors' uses of technology is considered by researchers. A few studies show that when technology resources are available and accessible, professors are more likely to use technology in their courses (Arya et al., 2016; Lee & Son, 2018). Yet, just 35% of professors report access to adequate resources (Arya et al., 2016). Further, several studies show that not having adequate university technology resources (e.g., computers, tablets, platforms, software, etc.) acts as a barrier to professors' technology integration (Cheok et al., 2016; Kampov-Polevoi, 2010; Khin, 2021; Luongo, 2018; Marzilli et al., 2014). For example, a survey of business professors report lack of computers as a "moderate" barrier to their technology integration (Musbah & Karsh, 2018, p. 11). Likewise, lack of high-quality materials (e.g., video case studies) also hinders professors' technology integration (Arya et al., 2016). Another study shows that when technology resources are not available, this often has to do with their high cost (Alfalah, 2018).

3.3 Time

Time is a variable that several studies consider in relation to professors' use of technology. One study shows that when literacy teacher educators have time to plan for technology integration, they are more likely to teach teachers specific types of technologies and strategies that they could use in K-12 instruction (Arya et al., 2022). In contrast, when professors report that they "don't have time to experiment" with technology (Voogt & McKenney, 2017, p. 77), several studies find that this reduces their likelihood of integrating technology in their courses (Alfalah, 2018; Cheok et al., 2016; Luongo, 2018; Mandernach, 2006; Musbah & Karsh, 2018; Voogt & McKenney, 2017). Professors in two studies report that it takes significant time to develop an online course, or redesign a course for online format, which is challenging due to their already heavy workloads (Kampov-Polevoi, 2010; Luongo, 2018). Additionally, in another study, some professors report that they feel pressure to constantly be available to students online, which makes them feel more pressure to engage in a heavier workload as compared to teaching face-to-face (Marzilli et al., 2014).

4. Research Questions

Our research aims to expand existing research by answering the following research questions:

1) How do professor and institution characteristics, and time predict what DigiLit text/tool *selection* criteria literacy professors teach teachers to use?

2) How do professor and institution characteristics, and time predict what DigiLit text/tool *integration* criteria literacy professors teach teachers to use?

5. Methods

5.1 Participants

Participants included 199 literacy professors who were between 24–74 years old (mean = 47) and had taught between 1 and 45 years (mean = 10). Table 1 presents participants' demographic information.

Table 1. Summary statistics (N = 199)

Continuous Variable	Mean	SD	Min	Max
Professor				
Age	46.81	10.67	24.50	74.50
Years teaching	10.20	7.63	1	45

Nominal Variable	%
Professor	
Female	89
Male	11
Education	
Doctorate	89
Masters	11
Academic rank	
Distinguish professor	1
Full professor	14
Associate professor	20
Assistant professor	44
Full-time lecturer	8
Part-time lecturer	13
Comfort with using Technology	
Very high comfort using Technology	40
High comfort using Technology	50
Neutral comfort using Technology	4
Low comfort using Technology	6
No comfort using Technology	0
Digital Literacies	
Extremely knowledgeable	21
Very knowledgeable	29
Moderately knowledgeable	41
Slightly knowledgeable	9
None	0
Institution	
Global Region	
Australia	1
Canada	1
Caribbean	1
Europe	1
Middle East	1
USA	194
Kind of Community	
Urban	50
Suburban	33
Rural	17
Type of Institution	
Private	22
Public	76
Both Public and Private	2
Degrees Offered by Institution	
Doctoral granting - High research	46
Doctoral granting - Low research	34
Masters only	13
Undergrad only	7
Students	
All graduate students	11
Mostly graduate students	14
Equally graduate and undergraduate	0
Mostly undergraduate students	26
All undergrad	9
Criteria that professors teach teachers for selecting digital text/tools	
Content accuracy	67
Intuitiveness	31
Interactivity	50
Text or tool quality and ability to support learning beyond paper and pencil tools	77
No criteria	9
Strategies that professors teach teachers for instruction in K-12 settings	
Model the literacy strategy or skill that is the objective of instruction	77
Provide guided practice for the literacy strategy or skill in the objective of instruction	68
Model how to use the digital text or tool features	63
Provide guided practice for how to use the digital text or tool features	61

Helps to improve use of technologies	
Time to plan/practice integration	69
Access to equipment	71
Knowledge about technology integration	73
Professional development	49
Technical support	47
Incentives for using technology	9
Interest in integrating technology	66

5.2 Technology Integration in Literacy Instruction Survey

The Technology Integration in Literacy Instruction Survey is an online survey. Its online format allowed us to (a) overcome social desirability bias such as are problematic with phone interviews, (b) lower costs as compared to mail surveys, and (c) use branching/skip question patterns to increase appropriateness of the questions asked (Fowler, 2014).

Previous research and related surveys guided the design of our survey questions. For example, four previous studies (Adnan & Tondeur, 2018; Arya et al., 2016; Christ et al., 2017; John, 2015) informed our asking about professors' characteristics. The specific connections between survey questions and their variables, and previous research, are presented in Appendix A, Table A1.

Predictor variables included professors' responses to questions about professor characteristics, institution characteristics, and time. Outcomes variables included professors' responses to survey questions concerning what criteria from the DigiLit Framework they taught teachers for (a) selecting digital texts and tools, and (b) integrating these into literacy instruction. Appendix A, Table A1 presents the survey questions for which responses were used in our analysis.

Our survey design addressed many common survey errors identified by Fowler (2014). First, professors were screened to ensure they met eligibility criteria (i.e., literacy professor). Second, we used skip logic to ensure logical flow and contingency of questions, thus reducing the total time for survey completion. Third, to reduce response errors, we created closed, objective questions. Also, we did not include a *do not know* option. Further, our ordinal responses were organized along a clear continuum.

We piloted our survey with a small group of professors who we knew from disciplines other than literacy, and asked them for their candid feedback about the survey design. No professors from the pilot were included in the dataset. The pilot helped us to identify questions that were poorly worded and issues related to construct validity. Using the pilot feedback, we revised questions to improve the reliability and validity of the survey (Fowler, 2014).

5.3 Data Collection

Data were collected via the online survey tool Qualtrics (http://www.qualtrics.com). To increase recruitment of participants, the link to the survey was posted five times across five months on several literacy organization listserv and Facebook pages to reach literacy professors: Literacy Research Association, International Literacy Association, American Educational Research Association Division K, Michigan Reading Association, and National Council of Teachers of English (Fowler, 2014). Survey completion was 10–15 minutes. No identifying information was collected from participants.

5.4 Data Analysis

We modeled the criteria that professors taught teachers when selecting digital text/tools (*content accuracy*, *intuitiveness*, *interactivity*, *and text or tool quality*), criteria that professors taught teachers to use in K-12 instruction (*modeling the literacy strategy or skill*, *providing guided practice for the literacy strategy/skill*, *modeling how to use the digital text or tool features*, and *providing guided practice for how to use the digital text or tool features*), via a mixed response model (Goldstein, 2011).

$$\mathbf{Outcomes}_{yi} = b_{y0} + e_{yi}$$
$$P(\mathbf{Outcomes}_{yi}) = F(b_{y0}) \quad (1)$$

For continuous outcomes in the vector of $\mathbf{Outcomes}_{yi}$, outcome *y* by professor *i* has a grand mean intercept b_{y0}, with *residual* e_{yi}. For discrete outcomes, the probability $P(\mathbf{Outcomes}_{yi})$ that the outcome *y* used by professor *i* is the expected value of $\mathbf{Outcomes}_{yi}$ via the Logit or Probit link function (F) of the overall mean b_{y0}.

First, we enter **Institution** characteristics (students: *all graduate students*, *mostly graduate students*, *equally*

graduate and undergraduate students, mostly undergraduate students [vs. all undergraduate students]; location: *urban, suburban* [vs. rural]; type: *public, private* [vs. both]; graduation degrees: *doctoral—high research, doctoral—low research, master's only* [vs. undergraduate only], *access to equipment, access to programs or apps, professional development, technical support, incentives for using technology, internet connectivity*).

$$\mathbf{Outcomes}_{yi} = b_y + e_{yi} + \mathbf{Institution}_{yi} + \mathbf{Professor}_{yi} + \mathbf{Time}_{yi}$$

$$P(\mathbf{Outcomes}_{yi}) = F(b_{y0} + \mathbf{Institution}_{yi} + \mathbf{Professor}_{yi} + \mathbf{Time}_{yi}) \quad (2)$$

A *nested hypothesis test* (c^2 log likelihood) indicates whether each set of explanatory variables is significant for $\alpha = .05$ (Kennedy, 2008). As omitting *non-significant* variables does not cause *omitted variable bias*, we safely remove them to increase precision and reduce *multicollinearity* (Kennedy, 2008).

Next, we enter the **Professor** characteristics (gender: *female, male* [vs. prefer not to respond], *age*, education level: *doctorate* [vs. master's], *years of teaching, squared years of teaching*, rank: *distinguished professor, full professor, associate professor, assistant professor, full time lecturer/instructor* [vs. part time adjunct/lecturer/instructor], digital literacy knowledge: *extremely knowledgeable, very knowledgeable, moderately knowledgeable* [vs. slightly knowledgeable], comfort level using technology: *extremely comfortable, somewhat comfortable, neither comfortable nor uncomfortable* [vs. somewhat uncomfortable], and *interest in integrating technology*). Finally, we enter **Time** (*lack of time, time to plan and practice integration*).

6. Results

6.1 DigiLit Criteria that Professors Taught for Selecting Digital Texts and Tools

Digital text/tool selection criteria were taught to teachers by professors at the following rates: content accuracy (67%), intuitiveness (31%), interactivity (50%), text/tool quality (77%), or none of the criteria were taught (9%) (see Table 1 for summary statistics).

Content accuracy was 30%, 15%, and 1% more likely to be taught for digital text/tool selection when professors (a) had time to plan and practice integration, (b) had interest in integrating technology, or (c) were one year older than the mean, respectively (see Table 2 for analytic model results).

Table 2. Summary of final mixed responses model modeling criteria that professors teach teachers for selecting digital text/tools or strategies to include in K-12 instruction

	Assess digital texts/tools					For K-12 instruction			
Explanatory variable	Content accuracy	Intuitiveness	Interactivity	Text/tool quality	No criteria	Model literacy skill/strategy	Guide literacy skill/strategy	Model digital feature use	Guide digital feature use
Mostly undergraduate Students									-0.666 * (0.295)
Private									0.794 * (0.348)
Master's only									
Reasons: Lack of time				-2.266 *** (0.585)	3.496 *** (0.628)				
Reasons: Lack of access to Equipment					3.256 ** (1.092)				
Helps: Time to plan/practice Integration	1.469 *** (0.291)							1.423 *** (0.312)	
Helps: Access to equipment						0.616 * (0.286)		0.928 ** (0.312)	1.669 *** (0.323)
Helps: Knowledge about technology integration						0.845 ** (0.285)			
Helps: Professional Development						1.054 ** (0.322)	1.082 *** (0.288)		
Helps: Technical support									0.667 * (0.296)
Helps: Incentives for using Technology							-1.406 ** (0.409)		
Helps: Interest in integrating technology	0.820 ** (0.286)		1.418 *** (0.287)	1.686 *** (0.348)		1.290 *** (0.341)	1.808 *** (0.300)		1.254 *** (0.322)
Age	0.055 *** (0.013)			0.039 * (0.016)					

Full professor									
Extremely knowledgeable in digital literacies		0.993 (0.328)	**						
Very knowledgeable in digital literacies									
Master's only									
* Extremely knowledgeable in digital literacies									
Explained variance	0.260	0.047	0.121	0.341	0.370	0.356	0.266	0.206	0.374

Note. Each regression model included a constant term. *$p < .05$, **$p < .01$, ***$p < .00$.

Intuitiveness was 23% more likely to be taught for digital text/tool selection when professors were extremely knowledgeable about digital literacies.

Interactivity was 34% more likely to be taught when professors had an interest in integrating technology.

Quality of a digital text/tool was 26% and 1% more likely to be taught when professors were (a) interested in integrating technology and (b) one year older than the mean age. However, it was 40% less likely to be taught by professors when they had insufficient time to plan and practice integration.

Professors were 54% and 48% more likely *not to teach any criteria* for selecting digital text or tools if they (a) had insufficient time to plan and practice integration or (b) inadequate access to equipment.

The variance for the digital text or tool selection criteria that professors taught to teachers were as follows: content accuracy (26%), intuitiveness (5%), interactivity (12%), text/tool quality (34%) and none of the criteria (37%).

6.2 DigiLit Criteria that Professors Taught for Integrating Digital Texts and Tools

Digital text/tool integration criteria were taught to teachers by professors at the following rates: modeling a literacy strategy or skill (77%), modeling digital feature use (63%), guiding literacy strategy or skill use (68%), guiding digital feature use (61%) (see Table 1 for summary statistics).

Modeling a literacy strategy or skill, as part of digital text/tool integration, was 8%, 12%, 7%, and 20% more likely to be taught when professors had (a) access to equipment, (b) knowledge about technology integration, (c) professional development, or (d) interest in integrating technology, respectively.

Guided practice for using a literacy strategy or skill was 14% and 42% more likely to be taught when professors had (a) professional development or (b) interest in integrating technology. In contrast, when professors integrated technology to gain an incentive, they were 32 % less likely to teach teachers to use guided practice.

Modeling digital texts/tool feature use was 32% and 19% more likely to be taught if professors had (a) time to plan/practice integration or (b) access to equipment.

Guided digital text/tool feature use was 39%, 10%, and 29% more likely to be taught if professors had (a) access to equipment, (b) technical support, or (c) an interest in integrating technology. Further, professors were 12% more likely to teach teachers to guide students' digital text/tool features use if they taught in private institutions. In contrast, professors were 14% less likely to teach this if they taught mostly undergraduate students.

The variance for the digital text or tool integration criteria that professors taught to teachers were as follows: model literacy strategies or skills (36%), use guided practice for the literacy strategy or skill (27%), model use of digital text/tool features (21%), and use guided practice to use the digital text/tool features (37%) in K-12 instruction.

7. Discussion

Across our findings, three factors supported or hindered literacy professors' preparation of teachers to use the DigiLit criteria for their literacy instruction: professors' characteristics, institution characteristics, and time. These findings and their implications are discussed across the following sections.

7.1 Professor Characteristics

Interest in technology supported professors' instruction about several aspects of digital text/tool selection and integration: content accuracy, interactivity, text/tool quality; modeling a literacy skill/strategy, guiding a literacy skill/strategy, and modeling digital feature use. Our findings extend previous research by showing that literacy professors' interest in integrating technology had positive effects on their preparation of teachers to use the

DigiLit criteria. Previous research had focused on professors' lack of interest in technology and how that negatively impacted their own use of technology in their college instruction (Alfalah, 2018; Adnan & Tondeur, 2018; Cheok et al., 2016; Marzilli et al., 2014). An implication of this is that universities should provide opportunities and resources to develop literacy professors' interest in technology, knowing that this will enhance their teacher preparation practices.

Knowledge about technology acted as a support for professors' preparation of teachers to use both the digital text/tool selection and integration criteria, but only for certain criteria. For example, professors' knowledge about technology was an important predictor of their teaching teachers to *model* a literacy strategy or skill while using digital texts/tools in K-12 instruction. We conjecture that this might be related to professors' need to be knowledgeable themselves in order to model this. Likewise, professors who are knowledgeable about technology may be more likely to be aware of the impact of the *intuitiveness* of particular digital text/tools, and thus teach teachers to attend to this in their digital text/tool selection. Our findings that professors' knowledge selectively impacts their teacher preparation for digital text/tool selection and integration aligns with previous research, which also found professors' knowledge had an impact on certain kinds of technology use (e.g., using Blackboard's interactive features; Woods et al., 2004), rather than all technology use. The implication is that hiring professors who are more knowledgeable about technology, and providing support to increase professors' knowledge could improve their preparation of teachers to select and integrate digital text/tools in literacy lessons.

Being **one year older** than the mean had a statistically significant connection with professors' preparation teachers to use criteria from the DigiLit framework to select digital text/tools. However, given that this only increased professors' likelihood of preparation of teachers to use DigiLit Framework criteria by 1%, this finding is probably not of much practical significance. Thus, we conclude that the age of professors probably does not matter much. This extends previous research that has been inconsistent in identifying the impact of professor age on their technology use (Meyer & Xu, 2009; Woods et al., 2004).

7.2 Institution Characteristics

Access to equipment supported professors' instruction about several aspects of digital text/tool integration: modeling a literacy skill/strategy, modeling digital feature use, and guiding digital feature use. Additionally, lack of access to equipment was related to professors not teaching any digital text/tool selection criteria. This aligns with previous research that found lack of access to equipment hindered professor's use of technology in their classrooms (Cheok et al., 2016; Kampov-Polevoi, 2010; Khin, 2021; Luongo, 2018; Marzilli et al., 2014); whereas, access supported it (Arya et al., 2016; Lee & Son, 2018). Additionally, our findings extend the previous literature by showing that access to equipment is also important for professors' preparation of teachers to integrate technology in K-12 literacy instruction.

Further, for professors' attention to DigiLit Framework text/tool integration criteria, our findings suggest that some supports may be more fruitful than others. For example, both **professional development** and **technical support** significantly increased the likelihood of professors' preparation of teachers to provide modeling and guiding for both literacy skills/strategies and digital feature use. This coheres with previous research that found professional development and technical support increased professors' use of technology in teacher education and the types of methods they used to prepare teachers (Chittur, 2018; Foulger et al., 2015; Harbin, 2019; Lee & Son, 2018). So, our findings further bolster the implication of previous research, which is that universities should address the lack of professional development provided to professors for technology integration (Cheok et al., 2016; Khin, 2021; Luongo, 2018; Musbah & Karsh, 2018) and heed professors' requests to provide this (Luongo, 2018). In contrast, **incentives** were not significantly related to professors' increased likelihood of teacher preparation for any of the DigiLit integration criteria. In fact, it decreased the likelihood of preparing teachers to engage in guiding a literacy strategy or skill use. This contrasts with previous research, which found that incentives increased professors' own use of technology (Lee & Son, 2018). We suggest that future research might explore why these differential findings may have occurred. Nonetheless, it seems that professional development and technical support would be better suited to supporting professors' preparation of teachers to integrate digital texts/tools in literacy lessons, as compared to using incentives.

Finally, we found that professors who taught **undergraduate** students were less likely to teach teachers to engage in guiding digital feature use. To better understand this finding, future research might interview professors. This could inform professional development to improve professors' teacher preparation.

7.3 Time

We found that lack of time hindered professors' instruction of any digital text/tool selection criteria. This coheres

with previous research that showed integrating technology was challenging due to being time consuming (Alfalah, 2018; Cheok et al., 2016; Luongo, 2018). Thus, our finding that time to plan and practice integration supported professors' preparation of teachers to select digital text/tools with accurate content, and model digital feature use during integration was not surprising. Based on these findings, it is imperative that universities provide adequate time for professors to plan and practice technology integration if they want them to prepare teachers to effectively integrate technology in K-12 literacy instruction.

8. Conclusion

In this study, we explored how professor characteristics, institution characteristics, and time supported or hindered literacy professors' preparation of teachers to select and integrate digital texts or tools in literacy lessons. Survey data showed that professors' characteristics, including interest in technology and knowledge about technology, were key variables in supporting their teaching of DigiLit Framework criteria to teachers to guide their digital text/tool selection and integration in K-12 literacy lessons. Additionally, institution characteristics, including access to equipment, professional development, and technical support increased the likelihood of literacy professors teaching teachers DigiLit criteria to guide their selection and integration of digital texts/tools in instruction. In contrast, incentives were not effective. Finally, time played a key role in supporting or hindering literacy professors' teaching teachers the criteria for digital text/tool selection and integration. When literacy professors had adequate time to plan and practice, they were more likely to teach teachers DigiLit criteria. However, when they had inadequate time, they were less likely to do so, and more likely to not teach any criteria for digital text/tool selection at all. Implications include hiring professors who are interested and knowledgeable about technology, and providing professional development and technical support to build professors' interest and knowledge. Additionally, our findings strongly support that time should be provided for professors to plan and practice technology integration to support their instruction of teachers to use DigiLit criteria to select and integrate technology in K-12 literacy lessons.

9. Methodological Limitations and Future Research Directions

Our study has three important limitations. We align these with future research directions. First, we focused only on literacy professors' teacher preparation practices. Future research might potentially consider teacher preparation for technology integration across different discipline areas. Second, our survey respondents may have included more professors with greater interest in technology integration, since they were willing to complete a survey about this. Surveys often have this kind of limitation (Fowler, 2014). Future research might gather data in different formats (e.g., interviews) to avoid the self-selection bias of survey data. Third, the scope of our study was limited to quantitative survey data. Future research might collect a broader array of data, including qualitative data. This would extend understanding of our findings.

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Appendix A

Table A1. Survey Questions for (a) Professor Characteristics, (b) Institution Characteristics, (c) DigiLit Technology Selection Criteria that Professors Teach, (d) DigiLit Technology Integration Criteria that Professors Teach, and (e) Supports and Barriers to Teaching Technology Integration

(a) Literacy Professor Characteristics

What is your academic rank? (Author, 2016; Author, 2017)

- o Distinguished professor
- o Full professor
- o Associate professor
- o Assistant professor
- o Full time lecturer/instructor
- o Part time adjunct/lecturer/instructor

What is your highest degree? (Adnan & Tondeur, 2018)

- o Master's
- o Ph.D. or Ed.D.

What is your gender identity? (Adnan & Tondeur, 2018; Author, 2016; Author, 2017)

- o Male
- o Female
- o Prefer not to respond

What is your age range? (Adnan & Tondeur, 2018; Author, 2016; Author, 2017)

- o 20–29
- o 30–39
- o 40–49
- o 50–59
- o 60–69
- o 70 and above

How knowledgeable are you about digital literacies? (John, 2015)

- o Extremely knowledgeable
- o Very knowledgeable
- o Moderately knowledgeable

- o Slightly knowledgeable
- o Not knowledgeable at all

How comfortable do you feel using multiple kinds of technologies? (Adnan & Tondeur, 2018)

- o Extremely comfortable
- o Somewhat comfortable
- o Neither comfortable nor uncomfortable
- o Somewhat uncomfortable
- o Extremely uncomfortable

(b) Institution Characteristics

Where is your institution located? (Author, 2017)

- o USA
- o Europe
- o Canada
- o Africa
- o Asia
- o Australia
- o Middle East
- o South America

Is your institution… (Author, 2016; Author, 2017)

- o Urban
- o Suburban
- o Rural

Is your institution… (Author, 2016; Author, 2017)

- o Public
- o Private
- o Both

Is your institution… (Author, 2016; Author, 2017)

- o Doctoral granting - High research
- o Doctoral granting - Low research
- o Master's only
- o Undergraduate only

At what level are the students in the courses you teach? (Author, 2016; Author, 2017)

- o All graduate
- o Mostly graduate
- o Equally graduate and undergraduate
- o Mostly undergraduate
- o All undergraduate

(c) DigiLit Selection Criteria that Professors Teach (Authors, 2018)

Q2.10 Which of the following criteria do you explicitly teach your preservice/inservice teachers to analyze when selecting digital texts or tools? (Check ALL that apply)

- o Content Accuracy
- o Intuitiveness
- o Interactivity

o Text or tool quality and ability to support learning beyond what could be accomplished with paper and pencil tools

o None of the above

(d) DigiLit Technology Integration Criteria that Professors Teach (Authors, 2018)

Q2.11 Which of the following do you explicitly teach your preservice/inservice teachers to include in instruction when they teach using digital texts or tools? (Check ALL that apply)

o Model the literacy strategy or skill that is the objective of instruction (e.g., inference)

o Provide guided practice for the literacy strategy or skill that is the objective of instruction (e.g., inference)

o Model how to use the digital text or tool features (e.g., hyperlinks or hotspots)

o Provide guided practice for how to use the digital text or tool features (e.g., hyperlinks or hotspots)

o None of the above

(e) Supports and Barriers to Technology Integration (e.g., Authors, 2017; Chittur, 2018; Folger et al., 2015; Khin, 2021; Lee & Son, 2018; Mercader, 2019; Nelson et al., 2019; Taimalu & Luik, 2019)

Please check ALL the reasons that explain what hinders you to prepare your preservice/inservice teachers to use technology in K-12 literacy instruction:

▢ Lack of time

▢ Limited or no access to equipment

▢ Limited or no access to programs and apps

▢ Poor internet connectivity

▢ Lack of knowledge about technology integration

▢ Lack of technical support

▢ Lack of professional development

▢ Lack of incentives for using technology

▢ Lack of interest in integrating technology

Please select ALL of the following that have helped you improve your use of technologies in teacher education, and your preparation of teachers for their integration of technology in K-12 teaching:

▢ Time to plan/practice integration

▢ Access to equipment

▢ Access to programs and apps

▢ Knowledge about technology integration

▢ Professional Development

▢ Technical Support

▢ Incentives for using technology

▢ Interest in integrating technology