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Exploring Digital Literacy Levels and Technology Integration Competence of Turkish Academics

Pinar Ayyildiz
Ankara Science University, TURKEY

Adem Yilmaz*
Kastamonu University, TURKEY

Hasan Serif Baltaci
Başkent University, TURKEY

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Abstract: Today's individuals are expected to have skills in many areas as a natural consequence of the advances that have been taking place in society and technology. Particularly in developed countries, these skills are also called 21st century skills. Critical, creative and reflective thinking, problem solving and keeping up with the digital age (digital literacy) are some of these skills. Universities play a significant role in raising qualified individuals in our country. Updating the training programs, keeping up with the era and having a say in the digital world makes it a necessity for people who give education in these areas to be competent. From this point of view, this study aimed to explore the digital literacy levels of Turkish academics working in faculties of education and the perceptions of students towards technology integration competence of the academics. In this study, quantitative cross-sectional design was preferred. While selecting the participants, purposeful sampling method was used, and two different participant groups (academics and prospective teachers) were included in the process. Two scales with validity and reliability in the literature were used as data collection tools in the research. In the data collection process, firstly, a survey was administered to academics working in faculties of education, and then another one was conducted with prospective teachers. The results obtained were subjected to quantitative data analysis via SPSS 24 and AMOS 24 software, and descriptive and inferential statistics were generated. The results revealed that the variables of department, age and grade level created a significant difference in the digitalization of academics, whereas the gender variable significantly contributed only to the perceptions of prospective teachers.

Keywords: *Digital literacy, technology integration competence, Turkish academics.*

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Introduction

Plato's all-time-famous Academy (the *Akadēmeia*) is also well-known for the sign that reads 'Let no one ignorant of geometry enter.' which was engraved at the entrance. This was in fact a sign-if not a warning-for the potential enterers-the ones who had the intention of going in. One can assume that Plato declared a prerequisite to be a part of the Academy, which must have urged anyone planning to go inside to stop and think for a while, also increasing the likelihood of causing some to recant. For sure, countless changes have taken place under the ancient Sun to date with respect to instruction, knowing, knowledge, and university and as a result of all these, changes occurred in terms of 'prerequisites' as well. Hundreds of years later, currently academia is entailing novel skills and new forms of knowledge to 'enter in' and even more importantly, to survive inside. To put it in a different way, today becoming a member of academia as well as making the best of it necessitate being equipped shareholders *viz.* qualified learners and academics.

It goes without saying that being capable of using technologies both in a meaningful and purposeful fashion for academic and scientific purposes is amongst those critical skills (Carpenter et al., 2020). It is underlined that digital literacy is highly important for everyone in higher education institutions and that the academy must address incorporating digital literacy as a core, foundational competency (Murray & Pérez, 2014, p.85). To that end it would be fair to state that in near future the ontology of digital competencies will act as gate keepers of 'the Academy' and there may be a sign emerging: "Let no one digitally illiterate enter". What is more, it is accentuated that digital literacy is indeed "a gate skill, demanded by many employers when they first evaluate a job application" (Karpati, 2011, p.1).

*Corresponding author:
Adem Yilmaz, Kastamonu University, Education Faculty, Department of Educational Sciences, Division of Measurement and Evaluation in Education, Kastamonu, Turkey. ✉ yilmazadem@kastamonu.edu.tr

This hints at the fact that being digitally literate is inherently a fundamental element of lifelong learning skills expected to be developed by individuals for them to comply with the post-modern world (González-Sanmamed et al., 2017; Mangione & Cannella, 2020; Yilmaz, 2021). Having said that, it is also significant to highlight the jargon that oftentimes used interchangeably which may result in the possibility of confusion for the related parties.

Digital Literacy

There has been plentiful endeavor to define and frame the term: digital literacy through research. This is not surprising at all bearing in mind that the closest notion to it; digital competence already ‘seems to be a ‘loose’ concept: one that is not well-defined, still emerging, with meanings varying based on users from different approaches.’ (Ilomäki et al., 2014, p.656). One reason for this is the ‘flexibility’ of the very term (Hbaci et al., 2020). As a matter of fact, apparently no consensus has been reached so far on what it really means to be digitally literate, and the actual reason behind this is perhaps the term’s going beyond being flexible by reaching the outer edges of being ‘squishy’, thusly it might be a good suggestion to ‘accept digital literacy as a genre, a format and tool to be found within the domain of standard literacy, rather than a concept standing at odds.’ (Chase & Laufenberg, 2011, p.535). With that being said, casting a little light on the relatively recent definitions found in the relevant literature can be helpful to solidify the discussions to be made in this regard. The Table 1 below presents several definitions of digital literacy by different researchers shared in their studies in the field of education i.e. within the context of teaching and learning:

Table 1. Recent Definitions of Digital Literacy

Scholars who defined the term	Definitions
Murtafi’ah and Putro (2019)	the cognitive, socio-emotional and technical abilities to use digital technologies
Soto and Gutiérrez (2019)	being aware of continuous changes and dynamics in terms of culture and communication
Yazon et al. (2019)	carrying out basic computer-based operations and accessing resources for everyday use
Akayoglu et al. (2020)	technical skills (how to use digital tools) and functional skills (how to use these tools for professional and personal benefit)
Otieno (2020)	the advocacy and application of information communication technologies in online settings

The definitions above suggest that digital literacy is innately a broad term encompassing varying dimensions of being conscious again stretching to various extents about the *raison d'être*; the role and function of digital technologies and those of any related resource in relation to everyday situations e.g. their simple uses to communicate with others along with uses on more formal occasions (Bladergroen & Chigona, 2019; Yilmaz, Ayyildiz & Baltaci, 2020). It is clear from Table 1 that conceptualizing digital literacy inevitably calls for situating such a word that is very much linked to cognition (with decision making processes and higher-order thinking skills involved) within socio-cultural settings at macro and micro levels. From this point-of-view, the visual of Canada’s Centre for Digital and Media Literacy, which is representative of the aforementioned characteristic of being digital literate can shed light to the work of situating it within altering environments at the same time embracing its key components that come into play:

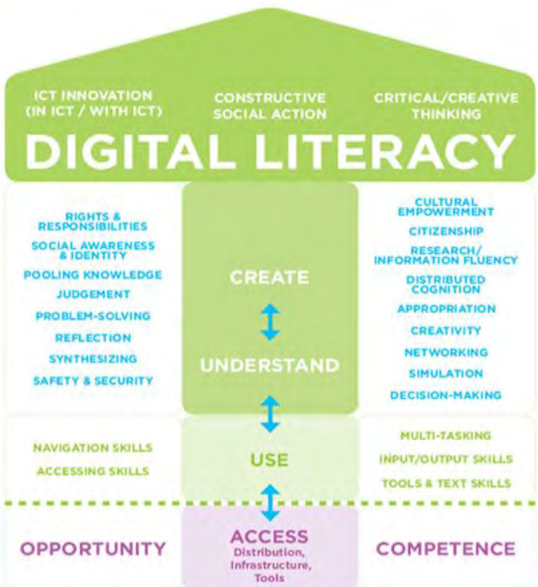

Figure 1. A Model for Digital Literacy (Media Smarts, 2020)

Digital Literacy in University Settings

Needless to mention the fact that the traditional understanding and hence the form of teaching and learning have been modified to a great extent in years in the field of education. Schools of all sorts used to be the centers serving for communities whose foremost functioning aimed at making citizens literate. Thereupon being literate was most often associated with schooling (Jiménez-Becerra & Segovia-Cifuentes, 2020). The thing is, reaching almost the end of the first quarter of the 21st century, schools are attributed to some similar responsibilities. Notwithstanding in spite of the fact that the main operations of educational organizations remain basically the same, the idea of becoming literate and being called literate both have evolved in particular with the advent of technology (Gudmundsdottir & Hatlevik, 2018; Guillén-Gámez & Mayorga-Fernández, 2020). Julien (2015, p.2141) pinpointed that 'contemporary understandings of literacy have expanded the traditional definition that includes reading and writing (possibly also including numeracy and oralcy), to include interpretive and creative abilities or competencies across a range of texts, in written and other forms'. In that case, as she announced, being literate at present is far beyond owning the ability to read and write; nowadays it means possessing the necessary skills and competence to access and comment on a(ny) text preferably via executing the required critical thinking skills. Taking into account the place of digital technologies, this conception can easily be connected to having access to a text of any kind-be it digital or not-and to comprehending it fully; furthermore, to coming up with ideas of exploiting it (only if the worth is calculated) such as sharing it with many others for the sake of the dissemination of the information it carries over e.g. through the Internet.

If one is to interpret all these through the lens of the academia, they can comfortably say that being the biggest producers and circulators of knowledge, higher education institutions are the emanating headquarters of literacy with no exception of digital literacy (Helleve et al., 2020). For that reason, to accomplish this newest duty of universities, academics need to catch up with what is going around and also need to foresee what is yet to come amidst the array of developments in technology occurring at a dizzying speed. For them, being digital literate carries deeper meanings like being digital confident and being proficient users of digital technologies in and outside the classroom so as to conduct research and contribute to the improvement of their areas of study, also to chase *scientiae* and, on top of everything, to be role models for their students, who are mostly digital natives.

Academics do not only carry out educational activities (McGarr & Gallchoir, 2020). Besides, they perform many activities such as being role models, exhibiting exemplary behaviors, and guiding prospective teachers to achieve multidimensional personal development (Helleve et al., 2020; Spoel et al., 2020). From this point of view, in fact, academics have aimed to develop prospective teachers as a whole. Today as has been mentioned earlier in the text, technology is advancing at an incredible pace, which has increased mutual interaction and has made it mandatory for teacher candidates and academics to collaboratively develop each other and to offer educational activities in an accountable way (Guillén-Gámez et al., 2020a). This process can be considered as a double-sided mechanism. In the past, this mechanism was realized only in a unilateral system where academics provided education and training services, and teacher candidates received this service. However, considering that today the new generation was born into and raised in an integrated manner with technology to the greatest extent, it is undeniable that this system must be operated bilaterally (Fernández-Batanero et al., 2020). Surely education has plentiful stakeholders (Cheng et al., 2020). To name a few, there are teacher candidates, academics, administrators, technology infrastructures, parents, and legislators. Yet, it would comfortably be accentuated that the stakeholders who are at the coalface are teacher candidates and academics. Therefore, the views and mutual interaction of these two stakeholders are crucial. Illustrating this very situation with an analogy could be meaningful: *Think of a best quality restaurant with extremely competent award-winning chefs. Imagine walking in there as a customer and visualize that you are placing an order. There the entire restaurant team that will provide you with this service has completed their preparations with their hearts and souls. At this point, the whole restaurant team will inevitably focus on you and your comments about the food served. In the end, all these services are for satisfying your needs and expectations and also for the restaurant to improve itself for better.* Based on this example, the educational activities offered by academics using the technology infrastructure available can be compared to the restaurant above and teacher candidates/students, then, constitute the customers. Thence, the opinions of teacher candidates are also of vital importance in this process. Although there are studies in the literature on technology integration and the digital literacy competencies of academics (Falloon, 2020; Guillén-Gámez et al., 2020b; Masingila et al., 2019), the lack of studies involving teacher candidates' feedback/perspectives/opinions is another reason justifying the design and conduct of this research.

On the other hand, it is emphasized that the ever-continuing tendency to 'position students within the Millennial or Net generation as being inherently tech-savvy and ubiquitous consumers and producers of technologies' can be wrong and academics' providing 'a conceptual framework for developing a robust set of knowledge and skills within the domains of digital literacy' (Smith et al., 2018, p.510) is of utmost importance. That signifies the accountability of the academics to their learners and to the society. These academics should ensure that their students are mindful digital literates who refer to informed uses of digital technologies. Revisiting the metaphor of a headquarter, faculties of education can arguably assume the charge of the Research and Development department of the 'headquarter', in other words that of the university. This is because a faculty of education embodies the present time and future agents of knowledge; that is, lecturers as well as learners who are prospective teachers. This gives these faculties a unique mission in that sense and one can comfortably utter that being digital literate for these agents is vital, as they are the creators and disseminators of knowledge, and this is particularly valid for the 'teachers of the prospective teachers'. It can be underpinned by staying away from the buzz phrase that 'teachers will be replaced by computers soon', education faculties in Turkey and abroad appear as if they managed to welcome the digital reform and within these faculties, departments have been established solely focusing on Information and Communications Technology (ICT). These faculties (referring to both of the meanings of the word faculty here) seemed to have attempted to integrate technologies in and outside classroom learning and into the curricula in the form of courses that concentrate upon the development of educational technologies and on the effective uses of these. Generally, it is hoped that through encouraging prospective teachers as learners to get involved in model tasks that foster digital literacy, schools can experience digital reforms in the long run as these individuals start the profession.

Purpose of the Study and Problem Statement

This study investigates the digital literacy levels of academics working in the faculties of education in Turkey and the opinions of prospective teachers about academics' technology integration competence. In this sense, answers were sought for the following research questions within the bounds of the current study:

1. What are digital literacy levels of Turkish academics working in faculties of education?
2. Do their digital literacy levels differ significantly concerning the sub-dimensions?
3. Do their digital literacy levels differ significantly in terms of demographic variables?
4. What are the perceptions of students towards academics' technology integration competence?
5. Do the perceptions of students towards academics' technology integration competence differ significantly according to sub-dimensions?
6. Do the perceptions of students towards academics' technology integration competence differ significantly in terms of demographic variables?
7. Is there a significant difference and a correlation between academics' digital literacy levels and students' perceptions towards their technology integration competence?

Methodology

In this research, we aimed to examine digital literacy skills, which are among the essential skills of the 21st century and required to be possessed by academics, in terms of various variables. In this regard, academics working in faculties of education in Turkey constituted the focus of this study. Their digital literacy skills were investigated by considering both the academics' opinions and the perspectives of the prospective teachers who interacted with them (Gudmundsdottir & Hatlevik, 2018; Helleve et al., 2020).

Research Design

This study had a cross-sectional design, which is oftentimes preferred in quantitative research methodology. There are many studies in the relevant literature in which the survey method is used on technology integration (Cheng et al., 2020; Fernández-Batanero et al., 2020). Through the cross-sectional survey method, data can be collected from participants at once. In this respect, a large pool of participants can be included in the research, and the borders of the study can be expanded (Atalmis, 2019). In the study, the opinions of academics and prospective teachers were scrutinized on account of the fact that utilizing two different perspectives is quite helpful in establishing cause-effect relationships.

Sampling and Sampling Procedures

While selecting the sample of the current research, purposeful sampling method was preferred among the non-random sampling methods since the selection of the participants who provide the researcher with the most accurate information according to certain characteristics comes into prominence (Yildirim, 2019). Within the scope of the research, academics and prospective teachers in Faculties of Education were preferred. The demographic characteristics of the participants are presented in Table 2.

Table 2. Demographic features for the research sample

Groups	Sampling Method	Variables	Sub-variables	(f)	%
Academicians	Non-random Sampling - Purposeful Sampling	Gender	Female	557	54.7
			Male	462	45.3
			Total	**1019**	**100**
		Department	Mathematics and Science Education	200	19.6
			Educational Sciences	98	9.6
			Elementary Education	211	20.7
			Fine Arts Education	103	10.1
			Computer Education and Instructional Technology	94	9.2
			Special Education	60	5.9
			Foreign Language Education	75	7.4
			Turkish and Social Sciences Education	178	17.5
			Total	**1019**	**100**
		Age	20-30	194	19.0
			31-40	474	46.5
			41-50	228	22.4
			51-60	98	9.6
			61-70	21	2.1
			71 years and above	4	.4
			Total	**1019**	**100**
Prospective teachers	Non-random Sampling - Purposeful Sampling	Gender	Female	503	59.45
			Male	343	40.55
			Total	**846**	**100**
		Department	Mathematics and Science Education	226	26.71
			Educational Sciences	77	9.10
			Elementary Education	106	12.53
			Fine Arts Education	79	9.34
			Computer Education and Instructional Technology	89	10.52
			Special Education	59	6.97
			Foreign Language Education	86	10.17
			Turkish and Social Sciences Education	124	14.66
			Total	**846**	**100**
		Grade level	1st grade	180	21.28
			2nd grade	267	31.56
			3rd grade	234	27.66
			4th grade	165	19.50
			Total	**846**	**100**

Participant Characteristics

There are two different participant groups that comprised the sample of the present study. The first group is academics. In order to raise qualified individuals, academics are required to have digital literacy skills as well. In this regard, we endeavored to reach the academics working in faculties of education via e-mail to ensure the maximum level of participants. The second group of participants is the prospective teachers studying in faculties of education. Apparently, both the prospective teachers and the academics are in need of holding adequate digital literacy levels. Therefore, two different groups having their own peculiarities were selected.

Data Collection Tools

Two different data collection tools were utilized in this study. Firstly, the "Academician's Digitalization Scale" developed by Koc (2018), was used to determine the digital literacy levels of academics. The scale formed in a 5-point Likert type is comprised of 15 items and three factors (use of technology in education, technology, and professional development, use of technology in social life). The other data collection tool that was employed in the present research is the "Students' Perception Scale About Instructors' Technology Integration Competence" developed by Artun and

Gunuc (2016) in order to reveal the opinions of prospective teachers. The scale prepared in a 5-point Likert type consists of 25 items and two factors (benefiting from technology and use of technology).

Application Process and Data Collection

The research data were collected in the 2019-2020 academic year (before and during the pandemic). The data collection process consisted of two different stages. Firstly, data were collected from academics in faculties of education. In this sense, academics were awaited for three months to respond to the invitation to participate in the study. In the second stage, the scale regarding the prospective teachers was also administered online, and they were awaited to partake in the study. Both administrations of the scales were carried out online. Social media platforms were actively used to improve the impact factor and the widespread impact of the study. While the application for academics was being executed, the e-mail addresses of the academics in faculties of education were collected, and they were requested to fill in the scale within the framework of academic courtesy. This procedure continued at certain intervals for three months, and efforts were made to keep the data pool large. In the phase of the study conducted with prospective teachers, it was attempted to collect the data similarly to the first stage, by means of distance education and online platforms due to the COVID-19 outbreak, which has influenced the whole world.

Data Analysis

Quantitative data analysis methods were used in this study. Descriptive and inferential statistics were generated with the help of SPSS 24 and AMOS 24 software. Before carrying out inferential statistics, the normality distribution of the collected data was checked. The Kurtosis and skewness values were found in appropriate value ranges (between -1 and +1). In addition, the extreme values were examined, and no residual values that violated normality were found. Besides, before performing inferential statistics, we checked whether the data met the necessary conditions. Hence, parametric tests were carried out as a result of meeting the required conditions.

Reliability

Scientific studies need to be reliable as well as being of good quality. For this reason, it might be useful to pay attention to many issues such as the method used and data collection tools, and others. In order to increase the reliability of this study, firstly, the literature was reviewed, and it was investigated whether there were data collection tools with a high degree of serving the purpose. As a result of the review, two scales were found which were compatible with the objectives of the study and whose validity and reliability had previously been ensured. Even though the reliability of the data collection tools had been checked before, the aforementioned scales were re-subjected to reliability analyses within the scope of the current study. First of all, the usability of the scales in the study was investigated, and five field experts were consulted. As a result of the positivity of the opinions received, Cronbach's Alpha internal consistency coefficients were recalculated both in the pilot and actual applications. Moreover, the 27% sub/upper group means were also determined. In addition to the reliability analyses, so as to increase reliability, firstly, simple, clear, and detailed information was given at every stage, well-known research methods were preferred, the qualifications and experiences of the researchers (data collection and processing skills) were reflected on the process, and comparisons were made with the findings from the literature. The results of the reliability analyses are presented in Table 3.

Table 3. The Results of the Reliability Analyses

Data Collection Tools	Factors	Item-Total Correlations	t-value of Sub/Upper Group Mean Difference	Cronbach's Alpha Value		
				Original Scale	Pilot Study	Final/Actual Research
Scale 1	1	.643**	7.149*	.836	.817	.764
	2	.579**	6.475*	.709	.776	.711
	3	.794**	11.027*	.700	.811	.709
	Total	.614**	8.421*	.801	.816	.834
Scale 2	1	.479**	5.879*	.909	.867	.889
	2	.698**	9.478*	.904	.899	.902
	Total	.541**	6.327*	.940	.927	.931

*$p<.01$ **Correlations .05 significance level
Scale 1= Academician's Digitalization Scale
Scale 2=Student's Perception Scale about Instructors' Technology Integration Competence

Validity

Ensuring validity requires standard processes for some studies and different processes for others, as in reliability procedures. First of all, the opinions of field experts were obtained for the content and face validity of the data collection tools. As the opinions received turned out to be positive, the construct validity of the data collection tools and the results were reviewed. Confirmatory factor analyses were carried out, and construct validity was examined both in the piloting stage and after actual research in order to check the construct validity in the survey method and to find out whether the tools served the purpose (Yilmaz & Yanarates, 2020). The statistical results obtained were included in the results section. In addition to these studies conducted within the scope of validity measures, other measures stated in the relevant literature and also included in this application are as follows (Batdi, 2019; Ozkan, 2019): The research data were presented in a neutral, objective, and literal manner, and attention was paid to the high degree of reality. We attempted to compare the research data and the findings in the relevant literature on generalizable/external validity, to make the results generalizable and to demonstrate them consistently. The results of the validity analysis are presented in Table 4.

Table 4. The Results of Validity Analysis

Apps	Data Collection Tools	Stages	X^2/Df	RMSEA	NFI	CFI	GFI	RMR	P	AVE	CR
Pilot Study	Scale 1	Original	2.57	.06	-	.92	-	.06	.00	-	-
		New Result	2.99	.07	.86	.91	.87	.07	.00	.69	.81
	Scale 2	Original	2.00	.07	.94	.97	.80	.07	.00	-	-
		New Result	3.14	.10	.89	.90	.87	.08	.00	.63	.84
Final Research	Scale 1	Original	2.57	.06	-	.92	-	.06	.00	-	-
		New Result	2.77	.06	.93	.94	.89	.06	.00	.73	.90
	Scale 2	Original	2.00	.07	.94	.97	.80	.07	.00	-	-
		New Result	2.49	.07	.92	.90	.90	.06	.00	.77	.88

$p<.05$ significance level, Scale 1= Academician's Digitalization Scale
Scale 2=Student's Perception Scale About Instructors' Technology Integration Competence

The confirmatory factor analysis results within the scope of validity analysis are presented in Table 4. The Goodness of fit index values is utilized to ensure the scales' construct validity and determine their current use status (Cokluk et al., 2014). In the literature, X^2/Df value that is 3 and below, RMSEA and RMR values that are .08 and below, NFI, CFI, GFI values that are .90 and above, AVE value that is .50 and above, CR value that is .80 and above considered to show that there is perfect fitness (Erkus, 2012; Ozdamar, 2016; Uysal & Yilmaz, 2019). This has shown that the existing scales are applicable both in the pilot phase and the implementation. Accordingly, it can be said that the index values of the goodness of fit are within appropriate ranges and at an acceptable level.

Results

The results of the current research were analyzed sequentially with regard to the research questions. The first research question is, "What are digital literacy levels of Turkish academics working in faculties of education?" Descriptive statistical analyses were performed to answer this question. The results regarding the "Academician's Digitalization Scale" are provided in Table 5.

Table 5. Results Regarding the Academician's Digitalization Scale

Items	Pilot			Final		
	x̄	Std. Error	S.D.	x̄	Std. Error	S.D.
Item 1	2.41	.035	1.12	3.12	.042	1.39
Item 2	1.78	.029	.93	2.05	.026	.84
Item 3	3.13	.037	1.21	3.67	.029	.91
Item 4	2.83	.035	1.14	3.42	.036	1.19
Item 5	4.12	.027	.88	4.41	.041	1.27
Item 6	4.27	.029	.92	4.33	.056	1.58
Item 7	4.34	.023	.74	4.54	.034	1.09
Item 8	4.21	.025	.82	4.17	.041	1.44
Item 9	4.15	.023	.75	4.29	.021	.79
Item 10	4.22	.023	.74	4.49	.029	.92
Item 11	4.12	.024	.77	4.57	.037	1.08
Item 12	4.28	.024	.78	4.37	.042	1.18
Item 13	3.74	.034	1.10	4.01	.035	1.17
Item 14	4.19	.024	.77	4.36	.039	1.23
Item 15	2.36	.042	1.35	3.05	.036	1.14
Total	3.61	.033	1.01	3.92	.041	1.27

When Table 5 is examined, it is seen that the scores of the participants vary between 1.78 and 4.34 as a result of the pilot application, and the general average of the responses to the scale is 3.61 (*SD*=1.01). When the actual application results are examined, it is seen that the scores of the participants vary between 2.05 and 4.57, the general average of the responses to the scale is 3.92 (*SD*=1.27). The item *"I share the locations of my visits."* turned out to have the lowest mean (*M*=2.05) whereas the item "Making use of ICT in teaching-learning environments is relatively more motivating." was the one with the highest mean score (*M*=4.57).

The second research question of the study is, "Do digital literacy levels differ significantly according to sub-dimensions?" To answer this question, descriptive statistics (arithmetic mean and standard deviation) of each group and inferential statistics (ANOVA) results are given together as in the first question. The results of the analysis of academics' opinions in terms of sub-dimensions are presented in Table 6.

Table 6. Results regarding the sub-dimensions of the Academician's Digitalization Scale

Apps	**Factors**	**Descriptive Statistics Results**				
		x̄		**Std. Error**		**S.D.**
Pilot	Factor 1	2.85		.047		2.14
	Factor 2	4.23		.064		3.39
	Factor 3	3.73		.054		2.89
Final	Factor 1	3.34		.088		2.41
	Factor 2	4.36		.076		4.41
	Factor 3	4.07		.091		3.15
		ANOVA Test				
Apps	**Factors**	**x̄**	**S.D.**	**F**	**p**	**Dif.**
Pilot	Factor 1	2.85	2.14	14.425	.02	2>3 3>1
	Factor 2	4.23	3.39			
	Factor 3	3.73	2.89			
Final	Factor 1	3.34	2.41	17.642	.00	2>1 2>3
	Factor 2	4.36	4.41			
	Factor 3	4.07	3.15			

p<.05 significance level,
Factor 1 = use of technology in education
Factor 2 = use of technology in professional development
Factor 3 = use of technology in social life

As can be seen in Table 6, it is seen that the participant averages vary between 2.85 and 4.23 in the pilot application and between 3.34 and 4.36 in the actual research. Besides, a significant difference was found as a result of the ANOVA test among the factors for the scale. The significant difference appeared in favor of the second and third factors in the pilot application [$F_{(2-1016)}$ =14.425, *p*=.02<.05], and only at the second factor level in the final application [$F_{(2-1016)}$ =17.642, *p*=.00<.05, which signals that the academics use technology more for their professional development.

The third research question of the research is, "Do Digital literacy levels differ significantly in terms of demographic variables?" In this regard, independent groups t-test and one-way ANOVA were carried out because the basic assumptions were met for answering this question. The results for academics' digital literacy levels in terms of demographic variables are shown in Table 7.

Table 7. Results of Academics' digital literacy levels in terms of demographic variables

				Independent Samples t-test			
Variables	**Sub-Variables**	**$\bar{x}$**	**S.D.**	**F**	**p**	**Dif.**	
Gender	Female	3.62	.49	.845	.45	-	
	Male	3.60	.52				
				ANOVA Test			
Variables	**Sub-Variables**	**$\bar{x}$**	**S.D.**	**F**	**p**	**R^2& η^2**	**Dif.**
Department	Mathematics and Science Education = 1	3.58	.46	6.253	.00	.14 & .07	5>1 5>2 5>3 5>4 5>6 5>8
	Educational Sciences = 2	3.55	.50				
	Elementary Education = 3	3.57	.48				
	Fine Arts Education = 4	3.54	.53				
	Computer Education and Instructional Technology = 5	3.92	.55				
	Special Education = 6	3.52	.47				
	Foreign Language Education = 7	3.68	.52				
	Turkish and Social Sciences Education = 8	3.59	.53				
Age	20-30 = 1	3.70	.47	8.733	.00	.11 & .09	1>3
	31-40 = 2	3.65	.46				1>4
	41-50 = 3	3.52	.55				1>6
	51-60 = 4	3.48	.50				2>3
	61-70 = 5	3.53	.53				2>6
	71 years and above = 6	2.51	1.22				3>6

p<.05 significance level

When Table 7 is examined, it is seen that the opinions of the academics do not differ significantly in terms of the gender variable [$t_{(1017)}$=.45, p>.05] and have a similar trend. When the academics' opinions are looked into in terms of the department variable (Scheffe test used), significant differences stand out between departments [$F_{(7-1011)}$ =6.253, p=.00<.05]. Among these departments, the department of Computer Education and Instructional Technology was found to differ from other departments significantly except for Foreign Language Education. When the academics' opinions are investigated in terms of the age variable, it is seen that there are significant differences [$F_{(5-1014)}$ =8.733, p=.00<.05]. These differences (Scheffe test used) can be said to be in favor of academics in the age groups 20-30, 31-40, and 41-50. A fundamental point in studies in which quantitative research approaches are used is the effect size (Ozsoy & Ozsoy, 2013). In other words, at what level the study with the determined sample can be generalized to the population is a necessary issue to bear in mind. Effect size measurements are generally collected in two categories (Fan, 2001). These are effect size measurements (Cohen's d, Glass's g, and Hedge's d) and strength of relationship (R-square [R^2], eta-square [η^2]) measurements. In educational sciences, correlation strength measurements are often preferred because of their easy and practical use (Dunleavy et al., 2006). When the "Effect Size Formula" was used to determine the effect size, the R^2 value of this study ($f^2 = R^2/1-R^2$) was found to be .14 for the department variable, and the η^2 value was .07, for the age variable, the R^2 value was .11, and the η^2 value was .09. If these values are examined within the scope of the relevant literature, whereas R^2 value is accepted as .019 small, .13 as medium and .26 as large effect value; for η^2 value, .010 is accepted as small, .059 as medium and .138 as large (Kline, 2004). These results show that the research samples in the current study sufficiently represent the universe, and the results might be generalizable.

The fourth research question we endeavored to answer is, "What are students' perceptions towards the technology integration competence of Turkish academics working in faculties of education like?" to answer this question, descriptive statistical analyses were performed. The results of students' perceptions of the technology integration competence scale are illustrated in Table 8.

Table 8. Results of students' perceptions of technology integration competence

Items	Pilot			Final		
	x̄	Std. Error	S.D.	x̄	Std. Error	S.D.
Item 1	3.18	.045	.92	3.96	.027	.97
Item 2	3.89	.027	1.17	4.06	.033	1.24
Item 3	4.03	.034	1.06	4.17	.029	1.14
Item 4	4.11	.042	.95	4.29	.027	.88
Item 5	3.33	.039	.76	3.78	.046	.89
Item 6	3.78	.042	1.24	4.03	.030	.93
Item 7	3.65	.029	.63	3.99	.045	.79
Item 8	3.07	.033	.89	4.09	.027	.94
Item 9	4.41	.029	.96	4.78	.034	1.16
Item 10	3.34	.027	.74	4.07	.042	.88
Item 11	3.46	.033	1.06	3.96	.039	.79
Item 12	3.88	.029	.82	4.32	.042	.89
Item 13	4.14	.027	.89	4.65	.029	1.12
Item 14	4.19	.046	.69	4.47	.033	.76
Item 15	3.33	.030	1.26	3.83	.029	.79
Item 16	3.74	.027	.92	4.29	.027	1.27
Item 17	3.71	.033	.96	4.47	.046	.93
Item 18	3.65	.042	.81	4.68	.030	.96
Item 19	3.47	.035	1.17	4.32	.027	.86
Item 20	4.03	.029	1.10	4.44	.042	.89
Item 21	4.29	.022	.84	4.46	.039	.91
Item 22	3.89	.023	.90	3.93	.042	.97
Item 23	3.76	.027	.77	4.27	.029	.86
Item 24	3.20	.032	.86	3.89	.042	1.03
Item 25	4.07	.041	.76	4.58	.039	1.15
Total	3.74	.039	.87	4.23	.046	.96

As shown in Table 8, the scores of the participants vary between 3.18 and 4.41 as a result of the pilot application, and the general average of the responses to the scale is 3.74 (*SD*=.87). When the actual application results are examined, it is seen that the scores of the participants vary between 3.78 and 4.78, the general average of the responses to the scale is 4.23 (*SD*=.96). These findings revealed that the least rated item (*M*=3.78) turned out to be "Faculty *members design class environment in line with technology use.*" while the item "*Faculty members guide students through developing digital instructional materials (powerpoint, animations, educational sites and so on)"* had the highest average (*M*=4.78).

When it comes to the fifth research question, "Do the perceptions of students towards technology integration competence of Turkish academics working in faculties of education differ significantly according to sub-dimensions?" descriptive statistics (arithmetic mean and standard deviation) and inferential statistics (independent samples t-test) are stated together. The results of the examination of prospective teachers' opinions in terms of sub-dimensions are presented in Table 9.

Table 9. Results of sub-dimensions of student's perception scale about technology integration competence

Apps	Factors	Descriptive Statistics Results		
		x̄	Std. Error	S.D.
Pilot	Factor 1	3.47	.067	1.79
	Factor 2	3.89	.049	2.08
Final	Factor 1	4.24	.076	2.02
	Factor 2	4.43	1.26	2.78

		Independent Samples t-test				
Apps	**Factors**	**x̄**	**S.D.**	**F**	**p**	**Dif.**
Pilot	Factor 1	3.47	1.79	7.862	.01	2>1
	Factor 2	3.89	2.08			
Final	Factor 1	4.24	2.02	8.425	.00	2>1
	Factor 2	4.43	2.78			

p<.05 significance level, *Factor 1* = benefitting from technology, *Factor 2* = use of technology

Table 9 indicates that the participants' averages vary between 3.47 and 3.89 in the pilot application and between 4.24 and 4.43 in the actual application. Additionally, a significant difference was found between the factors of the scale as a result of the independent groups t-test. A significant difference was observed in favor of the second factor in the pilot application [$t_{(1\text{-}844)}$ =7.862, p=.01<.05], and similarly at the second factor level in the actual application [$t_{(1\text{-}844)}$ =8.425, p=.00<.05, which means that the students believe that their instructors are more successful in using technology rather than integrating it into instruction.

Regarding the sixth research question, "Do the perceptions of students towards technology integration competence of Turkish academics working in faculties of education differ significantly in terms of demographic variables?", independent groups t-test and one-way ANOVA were carried out since the basic assumptions were met to answer this question. The results of students' perceptions towards technology integration competence in terms of demographic variables can be seen in Table 10.

Table 10. Results of students' perceptions of technology integration competence in terms of demographic variables

				Independent Samples t-test			
Variables	**Sub-Variables**	**x̄**	**S.D.**	**F**	**p**	**Dif.**	
Gender	Female = 1 Male = 2	4.18 4.36	1.37 .99	5.416	.03	2>1	
				ANOVA Test			
Variables	**Sub-Variables**	**x̄**	**S.D.**	**F**	**p**	**R^2& η^2**	***Dif.***
Department	Mathematics and Science Education = 1	4.42	.86	4.137	.01	.19 & .10	1>6 1>4 1>7 5>6 5>4 8>6
	Educational Sciences = 2	4.12	.92				
	Elementary Education = 3	4.20	.71				
	Fine Arts Education = 4	4.03	1.14				
	Computer Education and Instructional technology = 5	4.32	.60				
	Special Education = 6	3.78	.58				
	Foreign Language Education = 7	4.17	.69				
	Turkish and Social Sciences Education = 8	4.26	.73				
Grade level	1st grade = 1	4.14	.73	3.783	.00	.12 & .11	3>1 3>4
	2nd grade = 2	4.29	.96				
	3rd grade = 3	4.48	.58				
	4th grade = 4	4.21	.82				

p<.05 significance level

As shown in Table 10, it is observed that the opinions of the prospective teachers create a significant difference in terms of the gender variable [$t_{(1\text{-}844)}$ =.03, p<.05] and have a tendency at a different level. When the prospective teachers were examined in terms of the educational department variable, significant differences are observed between departments [$F_{(7\text{-}838)}$ =4.137, p=.01<.05]. Among these departments (Scheffe test used), Mathematics and Science Education, Computer Education and Instructional Technology, and Turkish and Social Sciences Education departments were found to differ significantly from other departments. When the prospective teachers are examined in terms of the grade level variable, it is seen that there are significant differences [$F_{(3\text{-}842)}$ =3.783, p=.00<.05]. This difference can be stated to be in favor of prospective teachers at the third-grade level. When the effect size was delved into, the R^2 value for the department variable was .19, and the η^2 value was .10; for the age variable, the R^2 value was .12, and the η^2 value was .11. These results unveil that the research samples adequately represent the universe, and the results might be generalized.

The seventh research question this study aimed to answer is, "Is there a significant difference and correlation between the digital literacy levels of Turkish academics working in faculties of education and students' perceptions towards technology integration competence?". To be able to answer this question, the structural equation modeling was used via AMOS 24, and regression and correlation coefficients were examined over construct validity. SEM model for the scales utilized is illustrated in Figure 2, whereas regression and correlation coefficients are presented in Table 11.

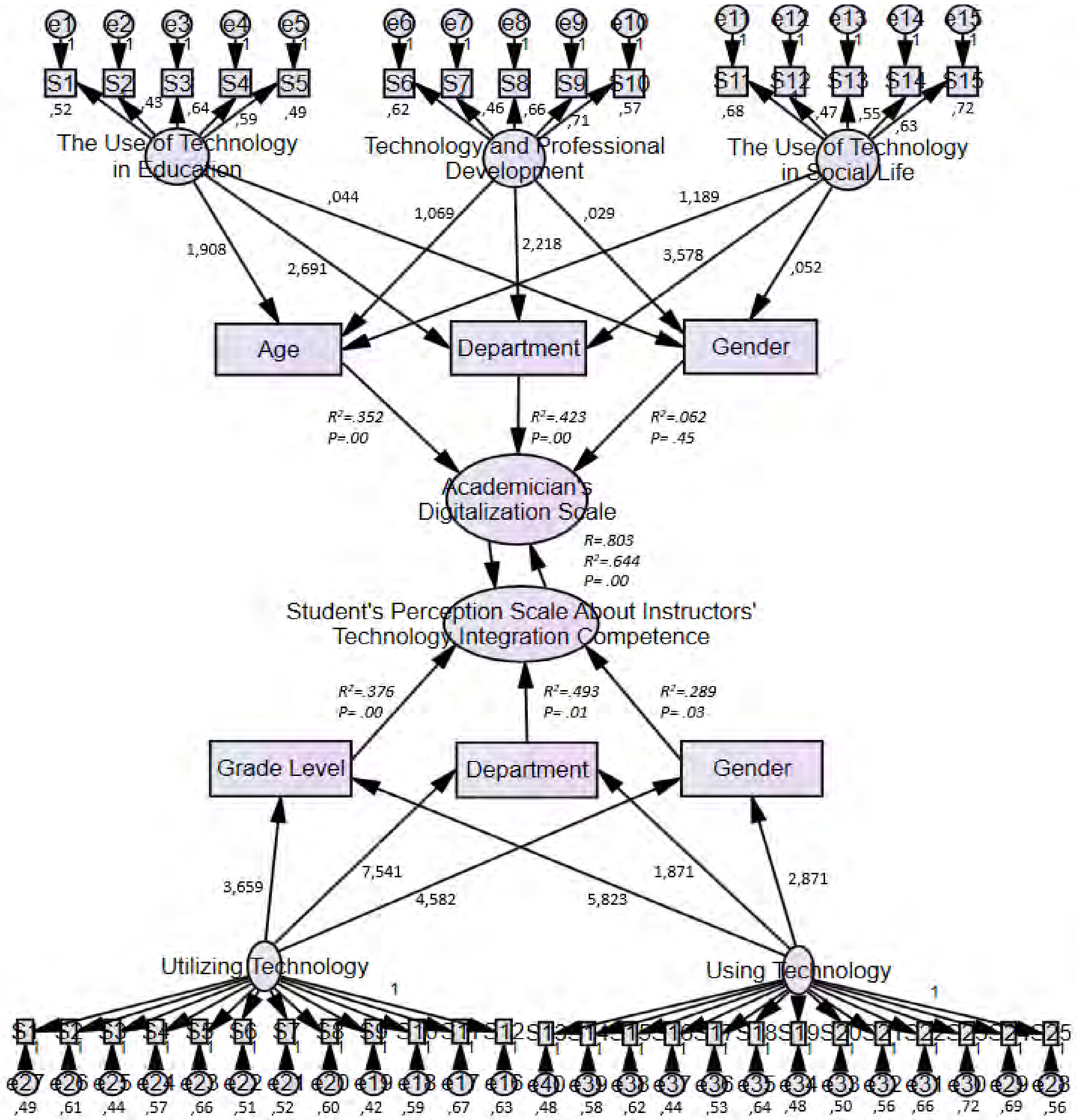

Figure 2. Path diagram for SEM

When Figure 2 is examined, it is observed that the item factor loads of the first scale are within the appropriate range, and the non-standardized regression coefficients are acceptable. In terms of the variables, it can be said that variables other than the gender variable contribute positively to the digitalization of academics. When the second scale is scrutinized, it is seen that the item factor loads are within the appropriate range, and the non-standardized regression coefficients are still acceptable as on the first scale. In terms of the variables, it can be said that all the variables contribute positively to the digitalization of prospective teachers and academics.

Table 11. Results of Regression and Correlation Analyses

		Multiple Regression					Correlations	
	Variables	**B**	**SE**	**β**	**t**	**p**	**R**	**R^2**
Scale 1	Constant	4.652	2.621	-	17.14	.000	-	-
	Gender	.027	.068	.12	1.026	.45	.248	.062
	Department	.681	.140	.42	26.18	.00	.650	.423
	Age	.721	.410	.54	34.46	.00	.593	.352
	F=20.38, p<.05							
	Variables	**B**	**SE**	**β**	**t**	**p**	**R**	**R^2**
Scale 2	Constant	7.632	1.128	-	42.41	.001	-	-
	Gender	.590	.260	.14	27.45	.03	.537	.289
	Department	.463	.389	.36	32.71	.01	.702	.493
	Grade level	.347	.423	.28	19.75	.00	.613	.376
	F=33.27, p<.05							

Scale 1= Academician's Digitalization Scale
Scale 2=Student's Perception Scale About Instructors' Technology Integration Competence

As can be seen in Table 11, it is clear that the gender variable does not create a significant difference for the first scale, as in the structural equation model, while the department and age variables constitute a significant difference. The correlation values for the department and age variables are moderate and within acceptable ranges. In the second scale, all the variables make a significant difference. Similarly, when the correlation values are examined, it can be said that there are medium and high levels of correlations.

Discussion

The results of the Academician's Digitalization Scale revealed that the general average of academics' opinions is $\bar{X}$=3.92, and they were at the "mostly" level. While the item with the lowest tendency of the academics was "I share the locations of my visit," the item they showed the highest tendency was "Using Information-Communication Technologies in learning environments is more motivating." It can be said that academics have a low tendency to share location because they have a desire to use technology appropriately and in line with the purpose (Barron et al., 2001; Carpenter et al., 2020). The high tendency to use technology in learning environments may result from the fact that they see technology integration in the field of education as an indispensable element of our lives (Bauer & Kenton, 2005; Guillén-Gámez & Mayorga-Fernández, 2020; Ng, 2012).

When the opinions of the academics are examined in terms of sub-dimensions, significant differences come to prominence. The opinions of the academics drew attention to technology and professional development, the use of technology in social life, and the use of technology in education, respectively (Sadaf et al., 2016). The academics mostly pay attention to technology and professional development, which may be due to the fact that technology has become a necessity rather than a privilege in this era (Pegalajar-Palomino, 2018; Teo, 2009). When it comes to the demographic variables, it is seen that the gender variable did not create a significant difference. The fact that the gender variable did not create a significant difference is similar to many studies in the literature. This is mostly because academics approach this issue more professionally and think universally compared to prospective teachers. However, the department and age variables yielded a significant difference. In terms of the department variable, it is seen that the Computer Education and Instructional Technology department differs significantly from all other departments. This can be seen as a natural result of the study as a predisposition to using technology and digital literacy require additional skills. Most of these skills are already existing in academics working in the Computer Education and Instructional Technology department (Mama & Hennessy, 2010; Michos & Hernández-Leo, 2020). For this reason, the lower tendency of other departments can be considered normal. As far as the age variable is concerned, it is seen that academics between the ages of 20 and 30 differ significantly, particularly compared to the groups aged 40 and above, and this is partially observed in the 30-40 age group. A significant differentiation of the digital literacy level by age has been a common situation in the relevant literature (Chen et al., 2010; Gorder, 2008; Helleve et al., 2020; Kajuna, 2009). This is because skills and efforts to keeping up with technology might decrease over time by age. The emergence of new programming languages and the unbelievable progress of digital life can be shown as the factors that support this situation (Hbaci et al., 2020; Koc, 2018).

The second scale applied within the scope of the study is the subject of technology integration competence of the academics from the perspective of the prospective teachers. When the results were examined in this scope (see Table 8), the item in which prospective teachers had the least interest was "Organizing the classroom environment in compliance with the use of technology," whereas the item they were most interested in was "Guiding students in developing digital teaching materials (such as PowerPoint, animation, educational site). When the reasons for these opinions of the prospective teachers are examined, it can be mentioned that classroom environments in all schools do not have similar facilities, academics can deal with the technology available in the classroom environment to some extent, and they tend to use the technology that is already available in the classroom environment (Falloon, 2020). Similarly, when the reasons why prospective teachers were intensely interested in developing digital teaching material are examined, it can be stated that the courses in faculties of education mainly consist of vocational and content knowledge courses, and prospective teachers should take an active role in courses focusing upon issues such as making presentations, classroom management and material development (Aldosemani, 2019). When the opinions of the prospective teachers are examined in terms of sub-dimensions, it is seen that both the pilot application and the actual application differ significantly, and this difference is in favor of the use of technology rather than benefitting from technology. There may be some reasons why prospective teachers show such a tendency. Academics can continuously benefit from technology, but prospective teachers can observe this situation mainly in the classroom. However, using technology is a situation encountered by prospective teachers more often in the classroom environment. For this reason, it is not surprising that they concentrate on the dimension of using technology instead of benefitting from technology (Chen, 2008; McGarr & Gallchoir, 2020).

In terms of demographic variables regarding technology integration competence, it is seen that all the variables differ significantly. Firstly, when the gender variable was examined, it was found out that men were more interested in technology than women. This is similar in many studies in the literature (Asliyuksek, 2016; Aydogan, 2014). In terms of the department variable, it was revealed that the prospective teachers studying in the departments of Mathematics and Science Education and Computer Education and Instructional Technology differ significantly from the prospective teachers studying in the other departments. This situation is supported by some reasons such as the fact that the technological inclination of students studying Mathematics and Science Education and Computer Education and Instructional Technology is high, there are more course contents integrated with technology as a field of science, and there are many alternative technology-related job opportunities available in the professional terms (Nelson et al., 2019; Serin, 2019). In terms of the grade level, especially 3rd grade students stand out. The reasons supporting this result can be stated as follows: Courses with technology integration (material development, science teaching, etc.) are mainly taught in the 5th and 6th semesters, and prospective professional interventions and projects are implemented more intensively in these grade levels.

Conclusion

As a result of the research, two different study groups and two different research results were revealed. SEM analyses, correlation, and regression analyses in Figure 2 and Table 11 were carried out in order to establish a link between the similarity rates and cause-effect relations of these results. In Figure 2, the previously obtained results were supported, and all other variables except for the gender variable (only for academics) were found to create a significant difference for both prospective teachers and academics. The correlation results of both scales were found to be .80, and a high level of correlation was found out. In social sciences studies, correlation values of .50 and above are considered at an acceptable level. When Table 11 is examined, it is seen that the highest correlation is in favor of the department variable for both scales.

Recommendations

Some recommendations can be proposed in light of the results obtained within the scope of the current study;

1. In order to increase the digital literacy of academics, platforms can be formed to support them in the field of technology, and universities might be advised to open technology offices.
2. Technology programs and application areas can be created for prospective teachers and academics to work collaboratively.
3. Further studies including semi-structured interviews, metaphor analysis, open-ended questions and focus group interviews may be suggested intending to examine prospective teachers' views and academics in more depth.
4. It may be recommended to carry out future studies by considering the studies involving technology applications (STEM applications, coding applications, and others) in the courses managed by teacher candidates and teachers in coordination.

Limitations

This research was carried out by considering the variables of age, department, grade level, and gender with academics working in the faculty of education. The scope of the study reflects only a certain academic profile. This limitation can be eliminated, and the scope of the study can be expanded through a larger sample and various alternative variables. Another limitation of the study is that the data belonging to a part of the application was collected on the internet due to the COVID-19 pandemic. These limitations can be eliminated through face-to-face data collection.

Disclosure of Interest Statement and Ethical Declaration

The authors herein report that they have no conflict of interest. The present study was carried out adhering to ethical and scientific conduct. All the referencing and in-text citations in the manuscript are in line with the related academic conventions. For all data collection instruments; the scales, all the relevant permissions were obtained from the shareholders and could be documented upon demand.

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