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Is a 1:1 Environment Good Enough?

Bryan Artman
University of Nebraska

Abstract

Technology in today's world impacts every facet of our lives, including the job market, the skills students need for future career success, and the skills teachers need to help their students acquire. This research paper aims to understand what technology skills pre-service teachers who graduated from 1:1 technology high schools possess. This paper will address the implications of technology skill deficiencies on future teaching practices. Finally, the authors will discuss teacher perceptions and misconceptions of teaching with 1:1 technology and the career ready technology skills students need. Findings show that students attending 1:1 technology high schools do not meet their potential. These findings also indicate the types of teaching practices and technology implementation that the teachers of the respondents preferred. This also suggests that teachers of the respondents lack an understanding of the career ready technology skills that students need. The literature on 1:1 technology has been historically focused on the benefits and challenges of 1:1 technology integration in an isolated grade level or subject matter studies. This paper addresses the gap in the literature by focusing on students who have graduated from a 1:1 high school and their subsequent lack of career readiness skills.

Keywords: *1:1 Technology; career ready skills, teacher perceptions/misconceptions, technology integration practices*

Society has grown accustomed to technology integrated into several facets of everyday life. Over the past twenty years, the usage of technology in the classroom has increased exponentially. It may come as a surprise that the terms 'Digital Immigrant' and 'Digital Native' are now 20 years-old. These two phrases are synonymous with instructional technology and were coined by Marc Prensky (2001). The term Digital Native refers to a person who grew up surrounded by technology and who is likely to have a preference for it in their education. In this study, it refers to college students who attended a 1:1 technology high school or middle school. A Digital Immigrant, refers to anyone who did not grow up surrounded by technology. In this study, the term Digital Immigrant refers to teachers who have the challenge of teaching Digital Natives.

An entire generation of Digital Natives has experienced PK-12 education while being taught by Digital Immigrants. This information provides a unique opportunity to examine the effects of technology usage on student growth. There is sufficient data available regarding this dichotomy in the educational setting and the opportunity exists to identify whether students are exiting the public education sector with proficiency in career ready technology skills. Additional data was also collected on the preeminent technology skills mastered at the conclusion of academic studies in the public education system. This research study was developed around the central questions: What are the most common career ready technology skills students lack who graduate from 1:1 high schools. How comfortable are the identified students using these career ready technology skills?

Importance

The role of automation and technology, including automation, in changing the workforce, both now and in the future - is undeniable. Robot workers can replace five manual labor workers, or more (Shin, 2012), and they are being used across industries such as automotive, agriculture, aviation, and healthcare. This shift in the workforce is a major cause for concern amongst workers their potential for future employment (Harbert, 2020). Employers are also concerned with finding the employees with the necessary skills for the changing job landscape (Heltman, 2017). Given the changes taking place in the workforce, and the need for qualified workers, the demand for career ready technology skills instruction in schools is clear.

Literature Review

Arguably, the largest amount of literature on 1:1 technology is focused on highlighting how it can benefit students. The literature repeatedly shows how 1:1 technology can improve student academic performance across grade levels and subject matter (Andresen, 2017; Crook et al., 2015; Varier et al., 2017). The literature also reveals how 1:1 technology enhances student communication and collaboration (Lee et al., 2016; Oliver & Corn, 2008; Varier et al., 2017). Additionally, 1:1 technology has been shown to increase student motivation and school attendance (Debevec et al., 2006; Keengwe et al., 2012; Powers et al., 2020; Thieman & Cevallos, 2017).

A considerable amount of the literature on 1:1 technology and its implementation, has been dedicated to the study of the challenges teachers face and how to assist educators on how best to utilize technology to improve student academic performance. Three of these challenges will be highlighted here. The first challenge is how teachers view 1:1

technology integration. The literature shows that teacher views on the importance and/or usefulness of technology in the classroom can positively or negatively impact their integration practices (Ertmer et al., 2012; Kwon et al., 2019). The second challenge is teacher self-efficacy, or a teachers' belief in their capacity to integrate technology strongly influences success or failure. Teachers with a lower self-efficacy are shown to be less successful in technology integration than teachers with a higher self-efficacy (Barten & Dexter, 2020; Kao et al., 2020; Kwon et al., 2019; Ottenbreit-Leftwich et al., 2010).

The third challenge to teacher technology integration is teacher knowledge and the need for professional development (PD). A lack of training and need for more PD is commonly cited as a factor influencing low levels of technology integration (Almekhafi & Almeqdadi, 2010; Hennesy et al., 2010; Lexia Learning, 2018). The literature reveals information that teachers need consistent, on-going PD (Urbina & Polly, 2017) that focuses on pedagogical practices (Lindsay, 2016) in order to improve their technology integration practices.

The literature on 1:1 technology has historically shown isolated studies focused on specific grade levels (Chang, 2016; Kirkpatrick et al., 2018; Oliver & Corn, 2008; Urbina & Polly, 2017) and/or specific subject matter (Chandra, 2014; Ismajili et al., 2020; Lee et al., 2016;). In order of importance, the literature reveals the 21st century technology skills high school graduates need include the ability to conduct research, evaluate data and information, maintain the privacy and security of data, website creation skills (Equip Team, 2020; Moll, 2014; Staufer, 2020), and their importance to our students (Day et al., 2019; Hiltner, 2015). The literature does not currently address the career ready skills students who attend 1:1 high schools possess upon graduation. It is this gap in the literature this paper seeks to address.

Theoretical Framework

The theoretical framework for this study centers on Piaget's (1972, 1990) Theory of Cognitive Development, which, along with Vygotsky (1986), Dewey (1997), Bruner (1966), and Neisser (1967), create the constructivist theory of learning. The cognitive development theory identifies the adaptability of an organism to its environment using schemas (what is known based on experiences) to achieve equilibrium (Huitt & Hummel, 2003). This adaptability and equilibrium are what Piaget refers to as intelligence, or constructed schemas. Human beings, much like animals, are born with reflex schemas that control behavior. Unlike animals, human beings learn and adapt to their environment. They build upon their existing knowledge and replace reflex schemas with more complex ways of understanding through individually constructed schemas. Piaget (1972) identified four stages of cognitive development through which reflex and constructed schemas, and, as learning continues and becomes more complex, hierarchical structures are achieved. These stages include the Sensorimotor (infancy), Pre-operational (toddler/early childhood), Concrete operational (elementary/early adolescence), and Formal operational (adolescence and adulthood).

In this current study, the authors are interested in identifying the technology knowledge gaps of first year undergraduate students who graduated from a public 1:1 technology PK-12 school system. The current generation of students in post-secondary education were born into a technology-rich environment and one of the earliest constructed schemas acquired during the Pre-operational stage is interacting with and communicating with others using technology. In this stage of cognitive development, toddlers adapt to their technology-rich environment and quickly achieve equilibrium. As they move through the subsequent stages and identify more ways in which their environment requires them to adapt, the emphasis becomes more on the social and cultural factors that will lead to equilibrium (Rutherford, 2011). When students enter a PK-12 school system, their constructed schemas have been founded upon the social and cultural environments with which they have interacted since birth. Their cognitive development has incorporated technology into their ways of being and doing, but primarily as tools for socializing. Once in school, students experience what Peter and Hull (1969) identify as the four levels of competence:

> *Level One* - Unconscious Incompetence: Not knowing how to do a task without knowing you don't know.
> *Level Two* - Conscious Incompetence: You still don't know how to do the task but now you know you don't know. You are aware of a gap in your knowledge.
> *Level Three* - Conscious Competence: You can now do the task, but it requires a lot of concentration.
> *Level Four* - Unconscious Competence: You can perform the task with ease. This is achieved by repeated practice. (Fulbrook, 2019)

Gleason and Manca (2020) sought to summarize the research on using social media as an educational tool in higher education, and developed three conclusions based on this summary: 1) pedagogical aims and social media usage should be intentional and aligned; 2) the use of social media should be framed as a way to develop digital citizenship; 3) social media offers an opportunity for students, instructors, and teaching assistants to develop a social presence when used “as a tool for humanizing pedagogy” (Gleason, 2016, as cited in Gleason and Manca, 2020, p. 6). Humanizing the stakeholders by developing curricula that utilizes students’ previous knowledge and constructed schemas is the foundation of good teaching. By identifying the gaps in student technology knowledge — and elevating them to the level of Conscious Incompetence — educators can work with them to develop curricula that are data-driven and informed by students’ constructed schemas, experiences, and previous knowledge in order to increase their cognitive development and hierarchical structure of technology usage.

Methods

A confidential 1-5 Likert Scale survey was created for this project, the survey consisted of 35 items which include two qualifying questions and six background questions. The two qualifying questions eliminated potential participants who did not attend a 1:1 high school or who had already taken a college level course on instructional technology. For the purposes of this project, the qualifying questions, one background question, and 15 relevant technology skill questions were analyzed. The survey was completed by 90 teacher education students. An additional 13 students did not complete the survey because they did not attend a 1:1 high school or middle school, 10 students did not complete the survey because they had previously completed college level instructional technology coursework. Data was collected on 15 different variables related to career ready technology skills. Responding students were also asked to rate the extent to which they felt instructional technology was a central part of their educational experience. The data was collected at a regional mid-western university that is part of a state university system during the fall semester of 2020 and the spring semester of 2021.

After gaining instructor approval, the researchers presented the subjects with the opportunity to participate in the study. Subjects were asked during an introductory education course for their voluntary participation. The introductory course was selected because the students in the course were most likely to have had the most recent high school experience with 1:1 technology. Due to the introductory level of the course, students were less likely to have taken college level instructional technology coursework which would have impacted their perceptions and skewed the results. Subjects were provided online access to the survey via a Qualtrics link.

Quantitative Results

Table I. Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Please rate your comfort level/ability to create a presentation (PowerPoint, Google Slides, video, etc.) to present to your classmates.	90	3	5	4.42	.687
Please rate your ability to use Microsoft Office (Word, PowerPoint, Excel, etc.), or the Google Suite (docs, slides, sheets, etc.).	90	2	5	4.18	.829
Please rate your ability to give editing/viewing rights to an online Document, Presentation, Form, etc. to a classmate or teacher.	90	2	5	4.09	.830
Please rate your ability to cite sources and give credit to the author or creator of content.	90	2	5	4.04	.792
Please rate your ability to conduct research and/or find academic information on the internet.	89	2	5	3.99	.832
Please rate your ability to use online calendars and scheduling tools to organize and maintain your academic or social schedule.	90	2	5	3.97	.867

Please rate your comfort/ability level collaborating with classmates on an academic project using technology tools.	90	2	5	3.93	.761
Please rate your comfort level/ability collaborating with classmates using technology tools to communicate instead of being in the same location.	90	2	5	3.88	.859
Please rate your ability to use cloud storage (Google Drive, OneDrive, iCloud, etc.) to store, organize, share your documents, photos, files, etc.	90	2	5	3.79	.906
Please rate your ability to evaluate the credibility of the source(s) you use when conducting research or finding academic information online.	90	2	5	3.77	.780
Please rate your ability to evaluate the data or academic information that you gather by conducting online research.	90	2	5	3.76	.812
Please rate your ability to find images (jpg, png, gif, etc.) on the internet that are legal to insert into a class presentation or project.	90	2	5	3.74	.955

Please rate how much you agree with this statement: Instructional technology was a central part of my education in middle school and/or high school.	89	1	5	3.74	1.006
Please rate your ability to change the format of a document or image. (i.e change a document to a pdf or change a jpg to a png, etc.).	90	1	5	3.68	1.150
Please rate your ability to type on a computer keyboard quickly with fewer than 2 errors per minute.	90	1	5	3.58	1.027
Please rate your ability to maintain the privacy and security of your data and identity online.	89	2	5	3.56	.852
Please rate your ability to create media (artwork, images, video, music, etc.) using online or digital tools.	90	1	5	3.34	1.040
Please rate your ability to learn how to use a new software program on your own.	90	1	5	3.22	1.058
Please rate your ability to create a website (create pages, add text, video, images, etc) using a website builder such as Google Sites, Wix, Weebly, etc.	90	1	5	2.87	1.153
Valid N (listwise)	87				

Reliability

Since this was the first use of this instrument, a reliability analysis was conducted. Generally, a Cronbach Alpha score above .7 is acceptable, a score above .8 is preferable. It was found that the internal consistency of the instrument was excellent with a Cronbach Alpha coefficient of .889.

Table II. Reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.889	.892	16

Correlation

Correlations were computed among 15 technology skills questions and the background question on 90 students. The results suggest that 13 out of 15 correlations were statistically significant at the p<.05, two-tailed level. Of the 13 significant variables, 5 were significant at the p<0.01 level and 8 were significant at the p<.05 level. Two technology skills variables did not reach significant levels, “Please rate your ability to create a website” and “Please rate your ability to find images on the internet that are legal to insert into a class presentation or project.” In general, the results suggest that students who felt that instructional technology was a central part of their education in middle school and/or high school positively correlated with their ability to perform various technological tasks.

Table III. Correlation Data

Background Question: Instructional technology was a central part of my education in middle school and/or high school.	
Variable- Technology Skill	Strength of Correlation
Sharing Online Documents	0775**
Microsoft Office/Google Suite	.369**
Cloud Storage	.318**
Conduct Online Research	.298**
Online Scheduling/Organization Tools	.279**

Data Evaluation	.265*
Security/Privacy of Data	.259*
Evaluate Credibility of Online Data Sources	.258*
Source Citation	.240*
Digital Media Creation	.233*
Novel Software Use	.228*
Typing Skills	.212*
Document and Image Formatting	.212*
Website Creation	0.138
Legal Use of Images	0.095
** p<0.01 (2-tailed); * p<0.05 (2-tailed)	

Factor Analysis

The 16 items of the 1:1 Technology Survey were subjected to a principal components analysis (PCA) using SPSS Version 26. Prior to performing the PCA, the suitability of data for factor analysis was assessed. Inspections of the correlation matrix revealed the presence of many coefficients of .3 and above. The Kaiser-Meyer-Olkin value was .836 exceeding the recommended value of .6 (Kaiser, 1970; Kaiser, 1974) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance (.000), supporting the factorability of the correlation matrix.

The principal components analysis reveals the presences of four components with eigenvalues exceeding 1, explaining 39.369%, 9.458%, 7.326, and 6.759% of the variance respectively. An inspection of the scree plot revealed a clear break after the second component. It was decided, therefore, to retain two components for further investigation.

The two-component solution explained a total of 48.827% of the variance with component 1 contributing 39.369%. To aid in the interpretation of these two components, an Oblimin rotation was performed. The rotated solution (after convergence in seven iterations) suggested the presence of a simple structure with both showing a number of strong loadings. Both of the factors suggested a more detailed explanation of the detected factors. There was a strong correlation between the two factors.

Table IV. KMO & Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.836
Bartlett's Test of Sphericity	Approx. Chi-Square	538.160
	df	105
	Sig.	.000

Before conducting a factor analysis, it is important to make sure that the data is suitable for this type of analysis. The Kaiser- Meyer-Olkin Measure of Sampling Adequacy (KMO) should be .6 or above our score is .836. In addition, the Bartlett's Test of Sphericity should be statistically significant, in the case of this study, the value is .000 (Pallant, 2007)

Table V. Variance

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.905	39.369	39.369	5.905	39.369	39.369	4.943
2	1.419	9.458	48.827	1.419	9.458	48.827	4.655
3	1.099	7.326	56.153				
4	1.014	6.759	62.912				
5	.875	5.836	68.749				
6	.784	5.229	73.978				
7	.765	5.102	79.080				
8	.628	4.184	83.264				
9	.575	3.832	87.097				
10	.497	3.311	90.408				
11	.434	2.891	93.298				
12	.353	2.356	95.655				
13	.248	1.656	97.311				
14	.237	1.579	98.890				
15	.166	1.110	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Using the standard of an Eigenvalue of 1.0, this data produced 4 factors (5.905, 1.419, 1.099, 1.014).

Table VI. Pattern Matrix

Pattern Matrix[a]

	Component	
	1	2
Please rate how much you agree with this statement: Instructional technology was a central part of my education in middle school and/or high school.	.603	
Please rate your ability to give editing/viewing rights to an online Document, Presentation, Form, etc. to a classmate or teacher.	.755	
Please rate your ability to use Microsoft Office (Word, PowerPoint, Excel, etc.), or the Google Suite (docs, slides, sheets, etc.).	.816	
Please rate your ability to use cloud storage (Google Drive, OneDrive, iCloud, etc.) to store, organize, share your documents, photos, files, etc.	.764	
Please rate your ability to create a website (create pages, add text, video, images, etc) using a website builder such as Google Sites, Wix, Weebly, etc.	.484	
Please rate your ability to conduct research and/or find academic information on the internet.		-.828
Please rate your ability to evaluate the data or academic information that you gather by conducting online research.		-.729

Please rate your ability to evaluate the credibility of the source(s) you use when conducting research or finding academic information online.		-.774
Please rate your ability to find images (jpg, png, gif, etc.) on the internet that are legal to insert into a class presentation or project.		-.600
Please rate your ability to cite sources and give credit to the author or creator of content.		-.698
Please rate your ability to maintain the privacy and security of your data and identity online.	.402	
Please rate your ability to learn how to use a new software program on your own. Please rate your ability to type on a computer keyboard quickly with fewer than 2 errors per minute.	.469	
Please rate your ability to change the format of a document or image. (i.e change a document to a pdf or change a jpg to a png, etc.).	.711	
Please rate your ability to use online calendars and scheduling tools to organize and maintain your academic or social schedule.	.414	

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 7 iterations.

To determine usable factors, a pattern matrix was created using a principal components extraction method, rotation and an Oblimin with Kaiser Normalization (Pallant, 2007). The pattern matrix determined that there are two factors.

Table VII. Component Correlation Matrix

Component Correlation Matrix

Component	1	2
1	1.000	-.508
2	-.508	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

In order to determine the relationship between the two factors a Component Matrix was created which shows an inverse relationship between the two factors.

Results

Based on the data, a Factor Analysis was conducted. Factors extracted resulted into two sets. For this project, the sets are defined as "Research and Organizational Skills" and "Technology Tool Skills." Research and Organizational Skills includes skills such as conducting research, evaluating the credibility of data, correctly citing sources, etc. Technology Tools Skills includes skills such as sharing online documents, word processing, website creation, image, and document formatting, etc.

Factor Analysis shows an inverse correlation between the two skill sets. This means that, as students gain knowledge or confidence in one skill set, they do it at the expense of knowledge or confidence in the other skill set. This inverse correlation is indicative of teacher preferences and practices that limit student growth in technology skills. What the data indicates is that the teachers of the participants had certain perceptions or misconceptions about the importance of technology integration in the 1:1 setting. These perceptions and misconceptions impacted their use of the technology and ultimately impacted what skills their students gained.

The data indicates that the opportunity presented by the 1:1 setting is not fully realized (Lindsay, 2016). According to Lindsay, 1:1 technology has the potential to transform teaching practices, but it depends on the pedagogical practices applied. The data also indicates that the teachers of the participants preferred traditional uses of technology, (teach faster, make presentations, create visuals, etc.) over transformational or skill building practices, (Dawson, 2012; Drayton et al., 2010). It is the preference for these types of instructional practices and technology use that has created the inverse correlation shown in the data.

What this shows is that teachers in these settings perceive 1:1 technology not as a way to enhance their students' learning and career skills, but as a way to make their jobs faster and easier, or to keep students busy (Dawson, 2012; Drayton, et al., 2010; Urbina and Polly, 2017). The data also raises the possible misconception that the teachers do not view instructional technology or technology skills as beneficial to their students (Kwon et al., 2019; Ottenbreit-Leftwich et al., 2010). Another potential misconception is that the teachers do not believe that their students need instruction on technology use or help developing technology skills because they are Digital Natives (Prensky, 2001; Walters & Fehring, 2009), a misconception disproven by the data collected by this study.

Discussion

This research study set out to answer a central question: Is a 1:1 technology environment robust enough to produce graduates with career ready skills?

Does simply providing students and teachers with access to 1:1 technology ensure that students will gain the necessary technology skills for career and education success? The answer, according to the data is no, a 1:1 technology environment alone is not sufficient to develop the necessary technology skills. The result of this investigation is that technology integration issues that have plagued schools and educators for decades still exist. School and district access to affordable devices, while beneficial, is not enough to resolve these long-standing issues. In order to gain the needed 21st century skills, students need assistance from their teachers. Students need to engage with technology in a manner that builds 21st century skills, in addition to making presentations clearer and saving the teacher time.

Just as gaps in the literature on 1:1 technology have been identified and highlighted, gaps in students' skills have also been identified and highlighted. The data reveals gaps in proficiency of career ready technology skills of all participants. The participants in the study are planning careers in the education field. If these gaps in their knowledge and skills base are not addressed, they run the risk of incorporating these deficiencies into their instructional practices, potentially repeating the same knowledge and skill gaps with their future students.

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If the knowledge and skill gaps of practicing teachers are not addressed via ongoing professional development or some other type of learning experience (Artman, et al., 2020) their students may experience similar knowledge and skill deficiencies. Professional development for practicing teachers should not just focus on the how, but also the why, knowing the why (student technology skills for future career and academic success) is more likely to encourage teachers to integrate technology in meaningful, skill building experiences. Professional development sessions on technology integration should also serve as a time for curriculum building. This curriculum building will allow teachers to find and create ways to use instructional technology in a way that benefits them, builds the needed technology skills in their students, and ensures curricular success.

Further Research

The data collected by this research project and the issues it brings to light indicate other areas that warrant investigation. These areas include, what are the long term ramifications of these knowledge and skill gaps for the students? How will these gaps impact the student success in higher education and/or career training and career success? What are the implications for higher education? What must be done or is being done at higher education institutions in order to address these knowledge and skill gaps? Are public PK-12 teachers aware of the skills students need for future career and education success? Finally, what professional development initiatives are in place, or need to be put in place, to help teachers make better use of 1:1 technology environments and to better serve their students?

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