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Literature Review

The aim for this literature review was to analyze the struggles that teachers faced while engaging in virtual education. The sudden and abrupt shift to online education left many shellshocked, especially since a large portion of educators were, and still are, not entirely confident in their abilities when teaching through an online medium. The perspective of students is briefly visited with a study on college students and their acceptance of technology mediated teaching. In addition to that, the digital divide that socioeconomic status creates is taken in to account, as the lack of technology is one of the main reasons why many students from low socio-economic households missed months of school. This divide not only affects the access that learners have to technology but also affects the access that the educator has in the classroom. Although educators that work in Title I schools can have access to advanced technology tools, it doesn't mean that their school district has widespread access, therefore rendering personal access useless. The self perceived notion of digital skills, and self efficacy when utilizing technology for teachers, as well as students, is also explored. From there we move toward a study conducted world wide every 5 years by the IEA, this is the ICILS, and it explores the digital competency of participating educators and students on a global scale. The results that are used in the review are from the 2018 study, and provide a glimpse as to how teachers were going to perform during the COVID-19 pandemic in online environments, as well as students. Finally, we close the literature

review with the best practices that educators can engage in when holding synchronous/ asynchronous courses online, as well as a competency framework that can be followed and used as guidance in order to identify what is required to become a digitally competent citizen or educator.

Students' Acceptance of Technology-Mediated Teaching – How It Was Influenced During the COVID-19 Pandemic in 2020: A Study From Germany

Vladova et al. conducted a study among four major universities in Germany (2021). They surveyed 875 students from two different fields, information systems, and arts and music, on three specific premises: students' feelings towards accepting the sudden and abrupt shift to utilizing technology as the main tool for learning, and communicating with others. The changes, if any, of their feelings on relying on technology so heavily for collaboration and instruction throughout the duration of the semester, and finally, the differences in the acceptance of technology between the two domains they surveyed (information systems, music and arts). Three new variables were added to original model, which include, time flexibility, learning flexibility, and social isolation. Over time *Vladova et al*. detected differences between the two disciplines. When "soft" sciences (e.g., social sciences, educational sciences, and humanities) are compared to "hard" sciences (e.g., engineering sciences) in a blended learning modality, students engaging in "soft" sciences perform better (*Vo et al*., 2020, as cited by *Vladova et al*., 2021). According to *Derouin et al*., (2005), as cited by *Vlodova et al*., (2021) the benefits of online learning have been explored, but there has been no convergence on research agreeing that online learning environments are more effective than the traditional brick and mortar setting. The main benefits appear to be the flexibility, ease of access to materials, and the time savings associated with

driving (Vlodova et al., 2021). Technology-mediated teaching and learning requires self-motivation, time management and a focused approach and self-directed learning and organization skills of learners (*Hameed et al*., 2008; Jefferson and Arnold, 2009). It is more difficult for educators to show their methodological and professional competencies through the use of media in the same way as an in person approach (*Vladova et al*., 2021). The chosen career of students affects their technology acceptance. Information systems students are more familiar with technology, since their studies require it, while music and arts students don't rely as heavily on technology as their counterparts (ibid). The results obtained by *Vlodova et al*., show that depending on how appropriate technology mediated learning was with regard to the major of students, that is a factor that influences their acceptance of the heavy technology utilization for learning (2021). People tend to adopt what is familiar to them in an easier manner compared to something that's unfamiliar to them (cf. *Janssen et al*., 2009 as cited by *Vlodova et a*l., 2021). One can infer that the level of technology utilization by music and arts students isn't to the same degree as information systems students, from there, a speculation can be made that if other majors, not entirely dependent on technology utilization, relied more on it, students of those disciplines would be more likely to accept technology mediated learning. However, it doesn't go without mentioning the social isolation between peers, as well as between teachers and students continue to be an issue as reported by both student groups in the study.

A study of higher education students' self-perceived digital competences for learning and everyday life online participation

Martzoukou et al., conducted a student survey with the Library and Information Science from three higher education schools in Scotland, Ireland, and Greece (2020). The premise of the study focused on the higher education skills in digital competency, and it also drew from students' self-perceived digital competencies when it comes to learning, everyday life digital contexts involving, electronic leisures, electronic learning, electronic democracy, e-government, and e-health activities. The survey allowed students to asses their digital competencies from their perspective as digital users. The survey found that students were lacking in areas that involved the development of information literacy, digital creation, digital research and digital identity management. After analyzing the data, there appeared to be a link between digital competencies and experiences in everyday life involving vital tasks; this link also applied to digital competency related to other digital areas in their field. Even though efforts have been made to understand what makes a digitally competent individual, not much has been actionable in terms of comprehending students' existing digital competencies.(Martzoukou et al., 2020). As stated by Bennett et al. (2008), and cited by *Martzoukou et al*., (2020)

. . .there also appears to be a significant proportion of young people who do not have the levels of access or technology skills predicted by proponents of the digital native idea.... Such generalisations about a whole generation of young people thereby focus attention on technically adept students. With this comes the danger that those less interested and less able will be neglected, and that the potential impact of socio–economic and cultural factors will be overlooked (*Bennett et al*., 2008, pg.7).

Some of the problems that young people face, and struggle with while engaging in online environments is the validity and reliability of information (*McGrew et al*., 2018, pp. 4–5; National Literacy Trust, 2018; Picton and Teravainen, 2017, as cited by *Martzoukou et al*., (2020). What it means to critically think, and read through pieces of information, instead of accepting it as good enough (*Rowlands et al*., 2008, as cited by *Martzoukou et al*., (2020). In the survey, none of the students reported themselves to be experts in any of the domains they were questioned on (*Martzoukou et al*., 2020). In the domain of "information literacy," students had a hard time adequately referencing information they found in the internet in order to comply with APA standards, and avoiding the plagiarism of information (ibid). In the domain of "digital identity management" students comprehended the effect their direct words and actions had on themselves, and others, but what they failed to analyze was their digital impact on their digital footprint across other digital tools (ibid). In addition to this, students reported they were advanced in the tasks of "organising and storing digital research data and following ethical, legal, and security guidelines when using research, but they struggled on the basis of analysing digital research data using simple tools" (*Martzoukou et al*., 2020). The lack of ability in performing "analysis" in both of the previous domains indicate that a deficiency performing analysis of information is present. Digital creation is another domain where students require additional support. The digital divide among the distribution of resources and access to equal levels of pieces of technology seem to play a role on the amount of technology competence students seem to display as they grow older. Another issue at the collegiate level is that digital competency is taken for granted, and assumed, where instead it should be, as Braveman (2016) has observed as cited by *Martzoukou et al*., (2020) "At most universities digital literacy is either

taken for granted or assumed to be at an adequate level, rather than being assessed, remediated, and amplified."

What this then translates to, is that those educators, which were once college students, did not possess an advanced degree of digital competency in varying domains by the time they reached their professional studies. This indicates that teachers, face a deficiency in digital competency before they become educators, and this digital knowledge gap is exacerbated by economic divides.

Disengagement, engagement and digital skills in technology-enhanced learning Nina Bergdahl & Jalal Nouri & Uno Fors

Bergadahl, Nouri, and Fors set to investigate engagement and disengagement in Technology-Enhanced Learning (TEL) environments in . They had a sample size of 410 participants, and hypothesize that students that report high and low levels of general engagement display difference in terms of their engagement in TEL. They also found a significant correlation between students' digital skills and engagement in TEL, showing that the possession of high levels of digital skills is related to engagement in TEL. However, digital skills were not related to disengagement. Variables that reflect both engagement and disengagement in TEL were also found; they predict student performance as measured via final grades. Recalling the work of *Wang et al*. (2017), *Bergdahl et al*. (2019), engagement can then be broken down in to two separate, but related constructs which can be conceptualized as follows (*Bergadahl et al*, 2020):

Behavioral engagement: This can be observed in the use of digital technologies to support and manage learning, or unauthorized of technologies, and/or passivity due to limited access to (functional) technology.

Cognitive engagement: this may be noted as a student who concentrates easily when working with technology and takes the initiative to use such technology, or who becomes distracted by notification and/or overwhelmed by information overflow.

Emotional engagement: This is reflected by a student who relies on technologies for school work, and has an emotional desire, satisfaction and eagerness to use digital technologies or who uses technologies to escape feelings of boredom, is emotionally drawn to the tool, feels frustration when using digital technologies for learning and/or resists the use of digital technologies.

Social engagement: This includes students' preferences for technology-mediated participation and communication with teachers and peers or study's tendencies to experience group work with technologies as upsetting or dispiriting, individual work with digital technologies as irrelevant and does not wish to be left to manage tools without support.

Bergdahl et al. states that:

After conducting a study of secondary school students' Digital skills, *Verhoeven et al*. (2016) concluded that students believe their digital skills are mainly the result of self-study, and when needing help, they prioritize turning to peers, then to parents, and only as a last resort do they ask their teachers (ibid). Students have reported that teachers do not

offer adequate support in using digital technologies" (*Heerwegh et al*., 2016, as cited by *Bergdahl et al*., 2020)

Bergadahl et al. concluded with their study that student digital skills do play a role, and influence student engagement, however, what it does not entail is whether or not it affects student disengagement (2020). In addition to this, the social aspect of in person interactions between peers and teachers plays beneficial role in student engagement and outcomes (ibid).

The last quote by the students suggests that students feel as though their teachers are not armed with the tools to assist them when engaging online, or when utilizing technology for academic purposes.

Teacher Digital Literacy: The Indisputable Challenge after COVID-19

Sanchez-Cruzado et al. present their findings in a quantitative study in which 4,883 Spanish teachers of all grade levels participated in order to have their digital skills measured during the last school years. The paper also proposes a "digital skills teacher training plan," from the INTEF (Spanish acronym for the National Institute of Educational Technologies and Teacher Training) as the reference point. They mention that DigComp as "The tool ACDC (Analysis of Common Digital Competences) was used for data collection." The main primary domains that were assessed in the survey somewhat aligns to that of the Digital Competency Framework 2.0, Information and Information Literacy, Communication and Collaboration, Creation of digital Content, Security, and Problem Resolution. The results of descriptive analysis show an overall low self perception that teachers place on their digital competencies. In addition to this, the paper also explores the relationship between qualities that define the population and the teachers'

digital skills level. The results for this relationship are obtained through a multiple linear regression model. The study expresses the need for a training solution that would help educators pick up on their current ability level, based on their results, and address the skills in which there is a deficiency present.

Teachers' Technology Competency and Technology Integration in 1:1 Schools

Sauers and McLeod (2017) set out to discover the effects that 1:1 initiatives have on education. The affect that is being observed is how did it affect teachers' technology competency, and instructional. Propensity score matching was used in order to have similar control (non-1:1) and treatment (1:1) schools in the sample. 110 high schools along with 922 secondary school teachers made up the sample size and all resided in the state of Iowa. Two main questions were set out to be answered, the first was, do teachers at 1:1 schools report that they integrate technology differently than teachers at non-1:1 schools? And the second was

do teachers at 1:1 schools report higher levels of technology competency than teachers at non-1:1 schools? For the first question which dealt with the integration of technology, a 14 question survey was administered, where each item could be answered on 4 point scale; the maximum amount of points being 56, and the minimum of 14. The overall mean score for this question among 1:1 schools and non 1:1 schools was a 27.33, with 1:1 schools having a mean of 30.38, and non 1:1 schools with a mean of 25.73. For the second question, the dependent variable of competency was generated from survey questions that asked educators about their skill level when using technology. The same 4 point scale as the first question remained, however the competency scores were combined to create a raw competency score, which was then converted to a standard deviation score. The minimum score was a 2.00 and the maximum score

was a 8.00. Teachers from 1:1 districts scored an overall mean of 6.32, while their non 1:1 counterparts scored a mean of 5.96; an overall mean of 6.08 was record for both groups.

Overall, the 1:1 teachers reported having a significantly higher technology integration and competency when compared to their non 1:1 counterparts.

New challenges in higher education: A study of the digital competence of educators in Covid times

In this paper Núñez-Canal et al., (2021) set out to reflect on the evolution of Educator's Digital Competence (EDC) and the relationship with students' digital skills and the impact on the learning process. In addition to that, an analysis of digital competence learning in the context of student centered learning approach is studied. The paper analyzes the response from 251 participants who happen to be professors from Madrid's universities in business administration, and sets out to ultimately answer four main questions, "What are the relevant factors of EDC that have a greater impact on student learning process and digital learners' competences, and to what extent does an improvement in EDC impact the student's learning process? The extent to which a positive attitude toward ICT use as a pedagogical instrument, as well as toward self-improvement in EDC, impact the student learning process. The more promotion of digital activities by educators, the greater the digital competence improvement in students' learning. Impact of data security on digital technology in the learning process." Three of the four proposed hypotheses were answered, teacher EDC impacts their feelings when adopting the online medium as their primary way of teaching. Teachers with more advanced EDC were more accepting toward online instruction, as opposed to their counterparts. A positive attitude and positive feelings to the usefulness of digital skills, and the commitment to utilizing ICT in the

classroom greatly enhances student learning. The impact that data security has on the learning process was not verified by this paper, but it is stated that others previously have.

Examining K-12 Teachers' Digital Competency and Technology Self-Efficacy During COVID-19 Pandemic

Ogodo et al., (2021) surveyed 109 K-12 teachers across twelve states, across the United States, with the goal of examining teachers' experiences, digital competency, and technology efficacy as they transitioned from a traditional in classroom model to an online mode of teaching. In addition to this they also conducted a literature review to present, what the data had to say about varying aspects of education that impacted instruction, pre, and during the COVID-19 pandemic . Three discoveries were made, many teachers had the digital competency for classroom instruction, but they could not engage effectively with heir students due to inadequate training for online instruction, and possessed limited tools and resources to provide proficient instruction. The second discovery was that teachers' level of digital competency corresponded with their self efficacy, and the final was that the COVID-19 pandemic emphasized the existing digital divide, the inequity the exists throughout education, and how this affects the availability and distribution of resources. The researchers used three questions to examine the experiences, digital competency, and instructional technology self efficacy of K-12 teachers during the pandemic. The first question, what access to digital tools did K-12 teachers and students have at the onset of the COVID-19 Pandemic as they transitioned to a virtual learning environment? The second question addressed the teachers' technology competency and self-efficacy, "what were K-12 teachers' technology competency and self-efficacy levels as they transitioned to remote teaching during the school closings? The third question examined the challenges associated with

teaching in the virtual education space, “how did K-12 teachers describe the process of remote teaching during the transition to a virtual learning environment? A 16 question model was used for the survey, and some of the sample questions included, a) how has the current Coronavirus pandemic impacted your teaching, b) what aspect(s) of your teacher training education prepared you for virtual teaching, and c) in general, what has been the most challenging aspect of teaching and learning in a virtual environment? These are the results with regard to digital competency, and self efficacy, “About 52.3% of the former, who self- described as digitally competent, have been using advanced digital tools and applications, including LMSs, before the pandemic.” As for self efficacy, “Bandura (1977) noted that individuals who believe that they do not possess the necessary skills to execute a given course of action often display a low self-efficacy to produce the expected outcome” as cited by *Ogodo et al*., (2021)

Increasing Student Engagement in an Online Setting

Trainer-Nilsen examines the differences in face to face interactions that occur in the traditional “brick and mortar setting” and the online environment. In addition to this, best practices and recommendations for the online setting are examined (2017). A comparison is also made between the various modes of communication and the delivery of them in an online setting and in an in person setting. A sample schedule is also provided to the reader with an example of the type of forms of communication that an online course would take, where Mondays consist of interactions and communication with students in the various mediums online, Tuesdays students engage in an discussion board assignment, Wednesday students engage in a synchronous session with the professor, Thursdays are office hours, Friday and Sunday are open to interpretation to the reader, and Saturdays are due dates for assignments.

Designing Personalised, Authentic and Collaborative Learning with Mobile Devices: Confronting the Challenges of Remote Teaching During a Pandemic

Kearney, Burden, and Schuck, created an online article to serve as guidance for educators who were attempting to meet the individual needs of their students in an online environment during the COVID-19 shut down. The goal, as the title states, is to create a personalized, authentic and collaborative learning environment through the utilization of mobile devices. The resource provides educators with a pedagogical framework, free online resources underpinned by their framework, a mobile learning toolkit, surveys for evaluating tasks, and a set of evidence-based principles for effective innovative teaching with mobile devices.

DigComp: 2.1

The spread of the COVID-19 pandemic affected educational systems in a drastic manner. In person interactions were no longer a viable option for some time, and because of this there was a sudden shift to online education. Prior to the pandemic, the International Computer and Information Literacy Study (ICILS) was conducted in 2013 and again in 2018. The aim of the survey was to gain an idea as to the level of digital competency that students and teachers possessed throughout the globe. The results stated that teachers were primarily comfortable in finding online resources to use in their class, but were not confident at all in their abilities to manage a Learning Management System (LMS). A Learning Management System is a crucial component of online education, and considering that this was one of the areas in which teachers felt least confident in their abilities, speculations can be made as to how many educators faired during the mandatory shift to online education. The aim of this text is to analyze the Digital Competence Framework for Citizens by the Joint Research Centre and the European

Commission, and to provide teachers with a guide, and personal examples that exemplify each of the subsections, in to developing their digital competence. In addition to that, free and paid resources will be provided at the end that can be used in order to create a road of digital skills to develop.

The framework has 5 domains and each domain also has several subsections, with 8 levels of mastery, and are in chronological order as follows. The framework also provides readers with proficiency levels in two areas of use: employment and learning, the latter will be our focus; scenarios are also provided in order to contextualize the dimensions as well as the mastery, and autonomy per dimension.

Further Discussions

Recalling the study of student's acceptance of using technology by Vlodova et al., as their main form of learning during the covid pandemic, one can infer that those fields that utilize technology on a daily basis, and is for the most part a mandatory aspect of their work or study, are more likely to be accepting of an online only mode of learning. At the same time, a similar argument can be made for students who don't rely as heavily on technology integration in the classroom. These students, as they were referred to in the study by Vlodova et al., students of soft sciences, they tend to excel more than their hard science counterparts in a blended learning type of environment.

The research conducted by Martzoukou et al., put to the forefront some of the doubts and digital competency gaps that students arrive with once they reach their professional studies. There is a notion about the digital native idea, where the majority of young people that grew up in the age of technology are automatically adept at utilizing technology to advanced degrees

when that isn't the case. Technology competency is a skill that is developed just like any other skill through practice. The socioeconomic divide present in the U.S. and other parts of the world exacerbates the development of digital skills due to the availability of resources. The ICILS study revealed that computer information literacy varied more between students of the same country, than the highest and lowest scoring countries. The distribution of resources is larger within countries, than outside of them.

The paper by Bergadahl, Nouri, and Fors sets to explore if the level of digital skills possessed by students affected the level of engagement they displayed when learning from a technology enhanced learning environment. Digital skills do play a role in engagement, but they don't play a role in disengagement. The results of the study state that students believe their digital skills are a result of self study, and when they require assistance they prioritize their peers, parents, and lastly their teachers. This does not entail, that students believe their teachers are not skilled enough to aid them in resolving technology related issues, but it does leave to interpretation that students may perceive their teachers as less skilled at utilizing technology than themselves.

On the teacher's perspective, it was noted by several papers, that a large portion of teachers did not feel confident in their abilities to perform adequately in an online environment. Although the pedagogy exists to teach in the traditional setting, teaching in an online medium is much more difficult due to the way in which information is adequately conveyed. This left educators feeling frustrated, and due to inadequate district trainings prior to the pandemic, and rushed trainings during the pandemic, educators were left to "figure it out."

The lack of experience can be one of the contributing factors as to why there was a huge decline in student performance outcome on standardized tests. Another major contributing factor is the distribution of resources and availability of them. Schools from higher economic status districts faired better in the distribution of resources to their students, as well as the fact that many of these students were already affluent at navigating technology, and possessed their own devices. Those from low economic status districts had a harder time getting devices on hand, distributing them to students, and leaving it up to parents to ensure internet access was available at home. Eventually once students did make a return, about a third to one half of them remained virtual, and educators had to now transition their skills to a hybrid model of learning, where some students are in person, and others are attending online.

All of these struggles have emphasized the necessary work that remains to be made in education, in terms of equity, digital knowledge development on teachers' part as well as students'. The digital competency frame work is an excellent resource that can serve as the basis for needed training for both teachers and students. Professional development for educators should include trainings addressing the domains outlined in the framework. For students, a digital literacy course should be provided or allow educators to integrate varying aspects to help students prepare for the digital world they will inevitably take part in upon graduation.

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