University students' rankings and reflections on technologies value to their learning
Classificações e reflexões de estudantes universitários sobre o valor das tecnologias em sua aprendizagem

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Abstract

The Measuring Technologies Value to Learning (MTVL) survey instrument was developed and deployed to collect data on the value learners place on 37 specific technologies and in some cases, the processes they facilitate. Administered to university students in three different locations in the spring of 2014, findings provide evidence to educators on the value to learning of measured items. Surprisingly, "writing with a word processor" was rated number one for its value to learning (n=386). The constructivist and didactic deployment of technologies was also surveyed for their value to learning. Constructivist usages *with* technology ranked four of the top five and didactic learning *from* technology occupied four out of the top ten and eight of the top 15 value rated positions, indicating value of both types of use. Respondents indicated a high degree of meta-awareness of technologies value to learning and a higher degree of ability to communicate and collaborate in-person compared to through social networking or any other online tools. Findings support the pedagogical use of technologies and show relative value of different tools.

Key words

Technology. Value. Learning.

Resumo

O instrumento de pesquisa "Valor de Mensuração das Tecnologias para a Aprendizagem" (MTVL) foi desenvolvido e implantado para coletar dados sobre o valor que os alunos atribuem a 37 tecnologias específicas e, em alguns casos, aos processos que elas facilitam. Aplicado a estudantes universitários em três locais diferentes na primavera de 2014, os resultados fornecem evidência aos educadores sobre o valor para a aprendizagem dos itens mensurados. Surpreendentemente, "escrever com um processador de texto" foi classificado número 1 de valoração para a aprendizagem (n = 386). A implantação construtivista e didática das tecnologias também foi levantada como um item de valoração para a aprendizagem. Os usos construtivistas com tecnologia foram classificados quatro dos cinco primeiros e a aprendizagem didática a partir da tecnologia ocupou quatro classificações entre as 10 primeiras e 8 classificações entre as 15 primeiras, indicando valor a ambos os tipos de uso. Os respondentes indicaram um alto grau de meta-consciência em relação ao valor das tecnologias para a aprendizagem e um grau maior à habilidade de se comunicar e de colaborar via face-a-face comparada à via rede social ou a outras ferramentas *online*. Os resultados sustentam o uso pedagógico das tecnologias e mostram valor relative das diferentes ferramentas.

Palavras-chave

Tecnologia. Valor. Aprendizagem.

1 Introduction

In the United States, educators are routinely bombarded with messages in the popular and trade press claiming that technology will "transform", "revolutionize," and recently, "disrupt" education. For many of these thinkers, education is constantly in need of upheaval, as if that were a desired state. For example, one popular source of the drive to upheaval is Prensky's claim that in our increasingly digital age, people may be divided into two groups: digital "natives" and digital "immigrants. Digital natives were born roughly after 1980 and digital immigrants born before 1980. To Prensky, digital "immigrant" teachers speak a "heavily accented, unintelligible" language like "foreigners" who "lecture" to a monolithic group of digital "natives," all of whom have had or are having their brains rewired by phones, tablets, and laptops (PRENSKY, 2001a). Digital natives think and learn in a way that reflects their conditioning by digital technology. They prefer non-linear access to hyper-linked resources. They prefer "multi-tasking" to focusing on one task at a time, pictures to words, collaboration and constant connectivity and active learning rather than reading or listening. According to Prensky, education needs to be transformed to adapt to the traits of digital natives. Another popular source of predictions that technology should increasingly be the form of education comes from Christensen, Horn and Johnson (2008), claims that schools and teachers need to migrate to a better business model. In promoting online high school courses and individualized, computer-based learning, in their work *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns*, Christensen et al. predict a future modeled on education as a market with products, customers, and services and where teacher pay can be indexed to student performance as measured on computers. Learning can be individualized with computer-based resources that will "intrinsically" motivate learners. Funding can be tied to "individual mastery" while allowing time to be variable and holding "learning as a constant" (CHRISTENSEN et al., 2008, p. 245). While many of these ideas do suggest what may be an inevitable progression of computer technology in schools toward "smarter" technology that can "read" the student and deliver just what they need at the time, they speak of schools as if they existed in a vacuum. Their technology-based model, like so many other technology advocates, generally ignores the tremendous range of abilities and home lives that distinguish each learner, among other contextual matters that teachers and professors must deal with every day. Disrupting class, as so many other technology-centric proposals for transforming education also ignores the tremendous but incremental change that has occurred in education since the birth of a monolithic generation of so-called "digital natives." They take an

almost ahistorical approach to the many ways technology has been integrated into education leading one commenter to write that, "almost nothing that is done with technology by schools is good, according to *Disrupting Class*. The authors' philosophy appears to be, 'heads, we are right; tails, schools are wrong'" (ZUCKER, 2008, p. 4).

A third example of calls to revolutionize, transform, and disrupt education that forms the backdrop to the present research comes from Anant Agarwal, the CEO of the Harvard-MIT edX program. EdX is the prominent online platform and MOOC-centered product source created at Harvard and the Massachusetts Institute of Technology (https://en.wikipedia.org/wiki/EdX). Although an accomplished computer scientist and electrical engineer, Agarwal's background includes little preparation or experience in the domain of "education" spanning from pre-school through college. Except to teach and publish in computer science and electrical engineering, itself extraordinary achievements, Agarwal appears to have few credentials in education as a field and particularly in pk-12 education. Nevertheless, this lack of experience did not prevent him from proclaiming, "It is pathetic that the education system has not changed in hundreds of years" (RATHS, 2014). Agarwal's critique comes in a long line of advocates and non-teachers who promote their vision and prospects for gain through ignoring the changes that have occurred and engage in "teacher bashing" to do so. As Cuban observed in 1986 and again in 2001, when reformers and non-teachers fail to notice the incremental changes adopted by teachers who are also the guardians of their students as persons, not simply "data," "teacher-bashing" is an outcome of their self and program promotion (CUBAN, 1986; 2001). Particularly notable is that Agarwal speaks from atop what may the most well endowed university partnership that ever existed in human history. Perhaps from such a lofty level the changes teachers have made in effectively integrating technology into their processes of achieving instructional goals are simply beneath the clouds.

Calls for transforming education made by theorists, technologists, and technology advocates typically ignore the successes and incremental change made by responsible teachers and professors who do integrate technology into teaching to improve learning (CUBAN, 1986; 2001). As Zucker wrote in reviewing the Christensen et al. book "*Disrupting Class* will give many readers the false impression that Christensen and co-authors are the first ones to have thought carefully about this issue. Much of the useful work that has been done in the past is ignored, discarded, or disparaged" (ZUCKER, 2008, p. 3). In the popular and trade presses, the history of educational technology is largely absent from those who have a vision or product to promote. While this does not mean

that all of their recommendations are without value, Socrates observation that it is wiser to recognize one's own ignorance and to know what you do not know than to assume knowledge that you do not have plays out in this field routinely in shallow, headline grabbing critiques about the power of educational technology (Oregon State, ND). Teachers and professors are continually pressured to adopt the latest technology du jour or be seen as using outmoded methods and out of touch with some new reality they have sensed.

Pressure to adopt new technology in education often comes from "innovators" who have a product or program to market to education. Even though many of these thinkers sincerely wish to serve education, when it comes to educational technology many see education as a "market" to be "exploited." As one executive described, the educational technology market is favorable because "There's a high profit margin with no warehouses and not much cost except for research and development" (KOBA, 2015). Advocacy for educational technology is often framed so that teaching with new technologies is a sign that teachers are up to date, even if it sometimes means they are experimenting on students and more importantly, even though there is little evidence to support their claims. If an educator does not employ the "latest and greatest" technology, they are easily discounted as irrelevant and out of touch with students - unable to speak the language of so-called "digital natives" (PRENSKY, 2001a). However, evidence supporting this distinction has been elusive, as scholars have worked to research its legitimacy. Bennett, Maton and Kervin (2008), for example, in their critical review of the evidence for the digital 'native versus immigrant' argument found it to be an "academic form of a 'moral panic'." Exaggerated claims related to educational technology is nothing new and can be traced back to Socrates rejection of writing technology (SAETTLER, 1990).

Exaggerated claims for value of educational technology to learning, chronicled by Saettler (1990), Cuban (1986; 2001), Dockterman (1988), among others, is the backdrop against which the present research study was developed. Headlines in 2014-2015 include recent claims for the transformative value of MOOCs, mobile technologies, tablets, LMSs, 1:1 laptop programs, social networking, virtual reality, augmented learning, flipped classrooms, gaming, and a host of others. Although there is evidence for the value of technology to learning reported in many journals and proceedings, value to learning is typically a product of any technology's careful integration into teaching and learning processes where it is difficult to isolate the value of technology. Much of the advocacy for new technologies suggest that if you want to be a good teacher who is "transformed," you better spend a great deal of time learning how to use, and using, these technologies in your

teaching. However, be prepared, for in this manner of thinking tomorrow you will need to be transformed again. But what do these messages have to say about student learning? Does the use of new technology ensure that learning will improve, or even occur? Where is the evidence on which claims about technologies influence on learning are based? This article reports on survey research designed to address these questions. The "Measuring Technologies Value to Learning" (MTVL) research survey collected data that provides evidence for what university students reported in 2014 as the "value to their learning" of 37 different, contemporary technologies and in many cases, the processes of using them.

2 Background to the MTVL study

The MTVL survey project began by reviewing existing instruments for their usefulness in measuring technologies value to learning. Instruments for measuring technological pedagogical content knowledge or TPACK (SCHMIDT; BARAN; THOMPSON; KOEHLER; MISHRA; SHIN, 2009-10), various Project Tomorrow "Speak Up" surveys (SPEAK UP, 2013), the Educause Center for Analysis and Research (ECAR) survey of undergraduate students and information technology (DAHLSTROM; WALKER; DZIUBAN, 2013), the Levels of Teaching Innovation (LoTi) Digital-Age Survey for Teachers (LOTI CONNECTION, 2008), and various surveys on technology use deployed in high schools were reviewed to assess their focus on learning with and from technology-based resources. These instruments also informed the selection of technologies included in the MTVL survey.

MTVL aimed to capture data on the value of different products and processes to the learner that in turn would provide teachers and professors with evidence to use in selecting their assessments to optimize the use of technology for its value to learners. The aim is to provide evidence for use in deciding where to focus teaching and planning professional development regarding educational technology so that it has the highest value to learning to the learner. This aim is embedded within a historical stream showing that technology is most useful when it is integrated into teaching and learning processes and tightly linked to curriculum and overall instructional goals (DOCKTERMAN, 1988; SAETTLER, 1990; CUBAN, 1986; 2001; HIGGINS; XIAO; KATSIPATAKI, 2012; CUBAN; JANDRIĆ, 2015).

2.1 MTVL survey development

The data collection instrument was a survey developed by the researcher with assistance from a doctoral candidate. Although many pre-existing surveys were evaluated for their relevance to the project, none were found that asked respondents to rate directly the value of specific, contemporary technologies for their value to their learning. Although some pre-existing surveys did collect

data on how technology helps learners with "academics," they were primarily concerned with their value or potential value to teachers or with their frequency of use or frequency of ownership. In focusing more on "trends" related to frequency counts, these surveys did not reflect a direct attempt to assess the value to learning technology products and processes create, which may or may not relate to frequency of use. This is a gap MTVL aimed to fill through bringing greater detail to the way in which various technologies differentiate in their application to and value for learning. It is based on the concept that educational technology empowers teachers and learners and facilitates schooling as products designed to support a process of education (BRUNER, 1977) and seeks to distinguish among technologies that support processes of learning from technologies that are products either to be consumed or received and technologies employed as if education took place in a vacuum, outside of a holistic educational context. Thus, the MTVL survey collected data from learners in which they rated the 37 technologies and in some cases, the processes of their use, as activities for the degree to which they had value to their own learning. For a fuller discussion of the process of developing the MTVL survey see Whittier (2014).

The MTVL survey was designed to measure four main constructs, three of which are reported here. The primary construct was to collect data on the value of the different technology items listed for their value to learning. However, the main construct was further divided to assess value to learning *with* technology as well as their value to learning *from* technology. The prompt was neutral and the instruction to respondents was: "For each of the tools and processes, please indicate how it has helped you to learn." Learning *with* technology was addressed through listing items that involved creating, developing, building, contributing, writing, producing, communicating, collaborating, managing, organizing, and analyzing. These are active verbs where learners use technology to construct their knowledge in technology-based resources. Responses to these items indicated the degree to which more constructivist learning activities using technology, the value of which is frequently claimed both in the popular press and academic research, were rated for their value to learning. Learning *from* technology was addressed through items reflecting the value of using technology as a receiver or consumer of information rather than as a knowledge creator. Items addressing this construct employed words such as using, reading, playing, taking, completing, conducting, and recognizing. Responses to these items indicated the degree to which more didactic learning activities using technology were rated for their value to learning. The 37 items listed in the MTVL survey included 23 items classified as learning *with* technology and 14 items

classified as learning *from* technology and are listed in the findings section below. The hypothesis was that if the theories and research behind the value of learning with technology is dominant over learning from technology, then that should be evident from the rankings. The aggregation of responses in these two constructs form a basis for measuring and ranking value to learning. If students rank technologies and the processes of their use for their value to learning, then knowledge of these rankings may improve faculty use of technologies in their assessments and teaching so as to improve learning. It may also be the case that students, made aware of their values, will be better informed in their choices of educational opportunities.

The distinction between learning *with* and learning *from* technology follows from Salomon, Perkins and Globerson (1991) and Jonassen's 1995 work on "cognitive tools" and constructivist learning theory. These authors refer to learning *from* technology as representing a traditional and didactic form of learning where technology is employed to deliver or transmit what is to be learned and the learner is to receive and absorb it. Learning *with* technology is to engage in a constructivist form of learning where technology is a partner in building knowledge through analysis and representation of information. The process of constructing a resource with computing whether an essay written in a word processor, a power point constructed as a representation of the author's knowledge, or a searchable database assists the author in building their knowledge. This inquiry addressed the research question stated as: With the listed technologies categorized as either learning with technology (constructivist) or learning from technology (didactic), will there be any clear value of one over the other?

An additional construct in the MTVL survey was formed through four items asking respondents to rate their Meta-cognitive awareness of how technology affects their learning. It sought to evaluate the degree to which learners are capable of using technologies intentionally and their self-awareness of how different technologies either support or inhibit their learning. This inquiry was based on the hypothesis that if respondents are aware of the value of technology to learning, then the ranking results are triangulated to achieve greater validity. It was also theorized that knowledge of student meta-cognitive awareness of technologies value to their learning could also be helpful in evaluating claims by both advocates and skeptics of technology use in education. This inquiry also addressed interest in evaluating learners' ability to be independent learners, capable of organizing their own program of learning from the reservoirs available on the web. However, inquiry into the capabilities of learners to direct and achieve learning on their own as independent learners is not addressed in the present article. The research

question addressed in this line asked: How do university students rate their awareness of how technologies either help or hinder their learning?

A third construct presented here focused on respondents ratings of their ability to communicate and collaborate with other students either face-to-face or online. This construct was formed by three items drawn from 16 items that asked respondents to rate their ability to use different technologies such as power point and online databases as well as their ability to use technology to "manage, organize, and analyze information" to "figure out a problem," or "use multiple forms of technology." Many of these corresponded to the 37 ranked but some were directed at processes of using them for learning. Three of these questions asked respondents to rate their "ability to communicate and collaborate with other students" in three different contexts: (1) "face-to-face;" (2) "online using social networking tools such as FaceBook and Twitter;" and (3) "online using any online tool not just social networks." Respondents rated their ability on a five-point range from poor to excellent. The questions all used the same prompt of "My ability to use [x technology or process] is:" This paper focuses on the three questions directed at measuring respondents ability to communicate and collaborate using technology, often cited as a method that would improve education as well as a characteristic of "digital natives." Given the claims by advocates for the use of technology in education for communication and collaboration, especially social networking, this construct sought to provide evidence for the value of these technologies as rated by university students rather than through advocacy or theorizing. Further analysis of all 16 items for the correlation between the ranking of technologies value to learning and students rating of their ability to use them will be presented in subsequent publication. Given the promotion of online communication and collaboration by technology advocates, this line of inquiry sought to provide evidence with which to address the question of how university students rate their ability to communicate and collaborate for learning online compared to face-to-face.

3 Methods

The MTVL survey was implemented online through Qualtrics in the spring of 2014 in three university locations: an urban, private, non-profit university in the Northeastern United States, a public university in rural, upper, Western United States, and a state university in Eastern France. Summaries of the data were produced in Qualtrics and raw data was imported into SPSS for calculation of Cronbach Alpha statistics. The demographic data collected included age, gender, and year in college. Respondents for this article were overwhelmingly female.

4 Findings

4.1 Respondents' Demographics

The demographics of the respondents were: 78% were in the 18-25 age bracket; 84% female and 16% male. These, along with year in university, are reported in Table 1.

Table 1 - Demographic Data on MTVL Survey Respondents

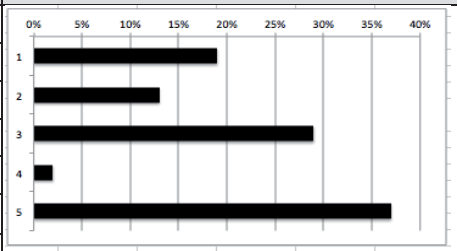
1.1. Age

#	Answer	Response	%
1	18-21	188	48%
2	22-25	118	30%
3	26-35	49	12%
4	More than 35	38	10%
	Total	393	100%

1.2. Gender:

#	Answer	Response	%
1	Male	64	16%
2	Female	325	84%
	Total	389	100%

1.3. Year in University

	Answer		Response	%
				
1	Freshman		74	19%
2	Sophomore		51	13%
3	Junior		114	29%
4	Senior		8	2%
5	Graduate student		146	37%
	Totals		393	100%

4.2 University students' rankings of 37 technologies value to their learning

The rankings were drawn from responses to the statement: "For each of the following tools and processes, please indicate the extent to which it has helped you to learn." The possible responses and their point values were: Not at all (0); Not Sure (1); A Little (2); Somewhat (3); Quite a Bit (4); and Very Much (5), creating a scoring range of 1-5. Because of the complexity of defining learning and to remain focused on university students' perception of their own learning, a sentence was added to the introduction to the survey indicating what learning meant:

> Because learning may take many forms, we ask you to decide if the actions described in the survey questions have helped you to learn your schoolwork, in whatever way or form that has meaning to you.

The ranking was ordered by mean score and addressed three objectives. First, it provides faculty and teachers with evidence on how the respondents ranked various technologies value to their learning that may inform faculty selection of assessments and activities. Second, it provides an inventory of the technologies and processes selected to be included in the survey that were found to be important in other surveys and literature in the field. Third, it provides evidence with which to address the value of constructivist use of technology or learning *with* technology, and didactic use of technology or learning *from* technology. The rankings suggest what forms teachers and professors may consider in requiring student work with technology. The prompt was "For each of the tools and processes, please indicate how it has helped you to learn. If you have not used it, select 'Not at all'". The rankings are reported in Table 2.

Table 2 - Ranking technologies value to learning by mean.

Rank	Tool and Process of Use	With or From	Total Responses	Mean	Standard Deviation
1	Create a document with a word processing software	With	386	4.12	1.19
2	Using a PowerPoint presentation a teacher or another student provided as an educational resource.	From	384	3.99	1.29
3	Creating a presentation by myself (using PowerPoint, Keynote, or another presentation software)	With	335	3.9	1.2
4	Creating a presentation with a group (using PowerPoint, Keynote, or another presentation software)	With	333	3.51	1.46
5	Undertake research through online databases	With	331	3.18	1.91
6	Professor/teacher modeling the use of technology in education. Please detail in the text box below.	From	364	3.01	1.69

Rank	Tool and Process of Use	With or From	Total Responses	Mean	Standard Deviation
7	Creating spreadsheet(s)	With	388	2.97	1.52
8	Read a discussion forum	From	333	2.94	1.53
9	Read digital texts	From	334	2.92	1.65
10	Take notes using new technologies	With	387	2.7	1.88
11	Read a blog	From	330	2.69	1.64
12	Play educational games	From	332	2.63	1.62
13	Read a wiki	From	333	2.38	1.9
14	Completing Tutorials	From	334	2.37	1.78
15	Create and / or manipulate images with iPhoto, Photoshop, or other image processing software	With	334	2.33	1.89
16	Contribute to a discussion forum	With	334	2.32	1.72
17	Social networking with Facebook	With	331	2.26	1.83
18	Use a smartphone for tasks relevant to school	With	386	2.23	1.88
19	Using educational apps	From	381	2.22	1.77
20	Use an interactive whiteboard (IWB) or a Smartboard	With	385	2.01	1.87
21	Take online courses	From	333	1.9	1.87
22	Use applications for educational purposes on an iPad or another tablet	From	386	1.88	1.81
23	Using a student response system (such as clickers or smartphone polling apps)	With	384	1.7	1.86
24	Creating a video with iMovie, Windows Movie Maker or other tool for an education project	With	334	1.67	1.82
25	Write a blog	With	332	1.67	1.77
26	Produce a poster with software (Glogster, Publisher, Scribus)	With	333	1.43	1.84
27	Create a database	With	387	1.41	1.63
28	Use any type of assistive technology such as screen readers, magnifiers, Braille displays, screens and adjustable keyboards / ergonomic, audio books, pens, trackballs.	With	384	1.36	1.72
29	Using drill and practice software	From	332	1.35	1.8
30	Use Voicethread or other voice recorder	From	333	1.17	1.67
31	Develop your own IT resources for education using authoring tools such as Dreamweaver, HTML, Weebly, Javascript, Flash, Scratch, and other similar tools	With	385	1.07	1.56
32	Build an educational website helped me to understand the concerns of teachers	With	387	1.04	1.56
33	Creating music with software to practice an instrument or for composition	With	333	0.92	1.5
34	Complete a Webquest	From	333	0.77	1.36
35	Contribute to a Wiki	With	333	0.75	1.38
36	Create an educational application for iPad, iPhone and Android	With	384	0.48	1.2
37	Social networking with Edmodo	With	329	0.34	0.99

Reliability statistics for the 37 technology items ranked for their value to learning using Cronbach's Alpha was .894, indicating a high degree of reliability.

4.3 Meta-cognitive awareness of technologies value to learning

Four questions investigated respondents' self-evaluation of their meta-cognitive awareness of technologies value to learning, serving two purposes. First, it was hypothesized that responses to these questions would reflect on the validity of their rankings of the technologies presented in the survey. The degree beyond 50% to which respondents agreed with statements reflecting meta-cognitive awareness of technologies value to learning would increase the face validity of the rankings. Second, it was hypothesized that responses to these statements would reflect on the validity of the premise that the increased use of technology in education is facilitating increased independence from teaching and teachers. The results reflect on the ability of learners to choose what resources would be most valuable to them for learning.

Findings of the meta-awareness questions on technologies value to learning demonstrate a very high degree of self-evaluated awareness. Combining the responses indicating that respondents either agreed or strongly agreed with the statements yielded the following outcomes:

> Eighty five percent (85%) of respondents either agreed or strongly agreed with the statement: **"**I understand how technology helps me learn."
>
> Seventy six percent (76%) of respondents either agreed or strongly agreed with the statement: "I understand how technologies inhibit or interfere with my learning."
>
> Eighty eight percent (88%) of respondents either agreed or strongly agreed with the statement: "I am aware that some technologies help me learn more than others."
>
> Ninety two percent (92%) of respondents either agreed or strongly agreed with the statement: "I think that learning with and from technology is different than learning face-to-face."

Because of the high degree of agreement among the respondents on the meta-cognitive awareness questions yielded a low alpha, the four questions measuring this construct were combined with responses to 16 questions using the same scale asking respondents to rank their ability to use these technologies. Reliability statistics from Cronbach's Alpha based on standardized items was .846, indicating a high degree of reliability. Data on the outcomes are reported below in Tables 3-6.

Table 3 - I understand how technology helps me learn

#	Answer	Response	%
1	Strongly Disagree	6	2%
2	Disagree	17	4%
3	No opinion	34	9%
4	Agree	255	65%
5	Strongly Agree	80	20%
	Total	392	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.98
Variance	0.60
Standard Deviation	0.78
Total Responses	392

Table 4 - I understand how technologies inhibit or interfere with my learning.

#	Answer	Response	%
1	Strongly Disagree	10	3%
2	Disagree	37	9%
3	No opinion	46	12%
4	Agree	201	51%
5	Strongly Agree	98	25%
	Total	392	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.87
Variance	0.96
Standard Deviation	0.98
Total Responses	392

Table 5 - I am aware that some technologies help me learn more than others.

#	Answer	Response	%
1	Strongly Disagree	4	1%
2	Disagree	9	2%
3	No opinion	32	8%
4	Agree	242	62%
5	Strongly Agree	102	26%
	Total	389	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	4.10
Variance	0.52
Standard Deviation	0.72
Total Responses	389

Table 6 - I think that learning with and from technology is different than learning face-to-face.

#	Answer	Response	%
1	Strongly Disagree	2	1%
2	Disagree	7	2%
3	No opinion	24	6%
4	Agree	186	48%
5	Strongly Agree	171	44%
	Total	390	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	4.33
Variance	0.51
Standard Deviation	0.72
Total Responses	390

4.4 University students ratings of their ability to communicate and collaborate with other students either face-to-face, online using social networking tools, or online using any tool

With respect to the three questions on ability to communicate and collaborate with other students, findings demonstrated that respondents clearly rated their ability to communicate and collaborate with other students face-to-face higher than their ability to do so with social networking tools or with any online tool. Percentages show that 68% rated their ability to communicate and collaborate with other students face-to-face as very good or excellent whereas 52% rated their ability to communicate and collaborate with other students through social networking sites as very good or excellent and 49% agreed or strongly agreed that their ability to communicate and collaborate with other students through any online tool not just social networking was very good or excellent. Although there are many reports that students do use social networking to collaborate, and there are many unsubstantiated claims for this value to learning, the data shows clearly that students rate their ability to use these tools for learning lower than they are in face-to-face encounters. As Dahlstrom, Walker and Dziuban (2013, p. 6) report "students resist the integration into education of technologies that they perceive to be primarily personal, clearly indicating that because some technology is used widely by students does not mean that it should be leveraged for academic use". Reliability statistics for the 16 items employing the "My ability to use [x] is:" format was .872 using Cronbach's Alpha based on standardized items. The data is reported in tables 7-9.

Table 7 - Ability to communicate and work effectively with other students or teachers through social networking sites (that is to say, Facebook, Twitter, Pinterest) and via blogs

#	Answer		Response	%
1	Poor		37	11%
2	Fair		37	11%
3	Good		85	25%
4	Very good		102	30%
5	Excellent		74	22%
	Total		335	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.41
Variance	1.57
Standard Deviation	1.25
Total Responses	335

Table 8 - Ability to communicate and work effectively with other students or teachers using any online tool, not just social networks

#	Answer		Response	%
1	Poor		14	4%
2	Fair		44	13%
3	Good		112	34%
4	Very good		112	34%
5	Excellent		51	15%
	Total		333	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.43
Variance	1.07
Standard Deviation	1.03
Total Responses	333

Table 9 - Ability to communicate and collaborate in person with other students

#	Answer		Response	%
1	Poor		2	1%
2	Fair		18	5%
3	Good		87	26%
4	Very good		133	40%
5	Excellent		93	28%
	Total		333	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.89
Variance	0.80
Standard Deviation	0.90
Total Responses	333

5 Discussion

5.1 Professor/teacher modeling of the use of technology in education

This paper reports selected findings from the spring 2014 implementation of the MTVL survey. These results provide evidence to faculty for use in selecting the form their assessments take to maximize their value to student learning. They also suggest advice for the use of technology in teaching. For example, the finding that "Professor/teacher modeling the use of technology in education" ranked sixth of 37 technologies indicates the relatively high value university student respondents placed on learning from how their faculty teach with technology. To further investigate this item, the survey followed that specific ranking by asking respondents to "Describe in the text box below any specific instance(s) where your teacher/professor used technology in a way that helped you to learn". Approximately 200 respondents made comments on this important area of how technology helps students to learn. Although it was not possible to analyze the descriptive data for the present paper, given the relatively high ranking of professor/teacher modeling and the relatively high degree of responsiveness to the request for text descriptions with more than 50% of respondents making a comment, plans call for qualitative analysis of these comments and a specific focus on professor/teacher modeling of the use of technology in a subsequent publication. That it ranked sixth out of 37 demonstrates the influence teachers

and professors still have with their students despite the increase in learning through technology independently of teachers and professors. Additionally, the value placed on professor/teacher modeling for the use of technology also informs faculty that they must not assume too much when thinking that so-called "digital natives," come to school fully prepared to take advantage of technology for learning. Further, when faculty do want their students to use certain technologies they may want to demonstrate and model how to do so to meet expectations. While the ranking of professor/teacher modeling expands the focus of MTVL to include teaching as well as value to learning, the majority of the other data remained focused on technologies value to learning as rated by learners.

5.2 Skills attributed to digital natives

The skills attributed to digital natives in Prensky's concept descrine a kind of uniformity among the generation of learners born after 1980. The language employed paints a picture of an entire generation conditioned by hyper-links, multi-tasking, and constant connectivity. However, researchers have found that no such uniformity exists. Kennedy, Judd, Churchward, Gray, and Krause, (2008) found much diversity in digital skills among students in Australia. Thinyane (2010) also found great diversity in skills and technology among students in South Africa. Thompson (2013, p. 20) also found that "contrary to popular beliefs that the digital native generation is universally proficient on all digital technology tools, this study showed that the range of technologies students use might be fairly limited". She found further that the skills associated with the digital native as described by Prensky (2001a) are associated with lower scores on the "Productive Learning Habits" scale employed in her research (THOMPSON, 2013, p. 18). Based on this evidence, students born after 1980 are far from the homogeneous group some advocates claim. Presuming the presence of digital skills among students may cause educators to assume too much about what students can do and then put them in a potentially embarrassing position when they do not know how to execute some technology operation. Additionally, even if students and teachers have generic technology skills that does not mean they know how to apply those skills to education. Teaching and learning have special requirements dedicated to learning and most technology is invented for more general use such as for its social, entertainment, commercial, or productivity value rather than for its value to education. Educators are always in the position of adapting and harnessing technology to support achieving instructional goals. Assuming too much about learners skills can cause teachers to "neglect to teach students the skills they need for academic success (BUCHANAN; CHAPMAN, 2009; GUO; DOBSON; PETRINA, 2008)" (THOMPSON, 2013, p. 13).

Findings of the MTVL survey indicate that respondents found valuable a wide range of items linked to learning *with* technology, which would require digital skills, but that they also rated highly various items associated with learning *from* technology, which requires less skill. Taken together, these sources of evidence suggest that not only are current students not uniform in the digital skills they possess but also that faculty take on elevated risk of lower performance in assuming that students have the skills proclaimed by advocates in the popular press.

5.3 Value of writing with a word processor to learning

MTVL provides evidence of student ratings of technologies value to learning. With education awash in new technology and unsubstantiated claims for its value to learning, it is surprising and grounding to see that in 2014 university students ranked "creating a document with a word processing software" as the number one, most valuable technology to learning. Although writing with a word processor appears to represent improvements of several magnitudes in the ease and reach of writing over traditional methods, organizing one's thoughts in writing as a process of learning is as old as human history itself. Thus, the MTVL survey found that with regard to learning, writing was the most valued technology. This suggests where faculty may want to focus their time in assigning assessments as well as what to utilize in their teaching. It is most interesting that amidst the great clamor for the use of technology in education, learners in the study show clearly that writing with a relatively unspectacular technology such as a word processor is the most valued to their learning. This is remarkable in that it speaks to a timeless and most valuable form of learning. The highest rated technology for its value to learning is more or less the same one valued throughout human history, only in the present form of a word processor. Of course, given the power of word processors, this is not a trivial distinction. However, the distinction is still in the line of manner and ease of use rather than its value to learning. This evidence also suggests that Agarwal's claim that it is "pathetic that education has not changed in hundreds of years" is not so valuable to learning.

5.4 Learning with and from technology – evaluating claims for the value of constructivist methods in using technology in education

The data shows how participating students rank in value to their learning the listed technologies and the processes they invoke. A key distinction embedded in this data is the one between learning *with* technology and learning *from* technology. Learning *with* technology is defined as active learning, organizing thoughts through creating or producing a technology-based artifact in the pedagogical method of constructivism. Learning *from* technology is defined as

more passive absorption or consumption of artifacts made by others in the didactic pedagogical method although again harking back to traditional methods, it does not preclude cognitive processing of this information once received. In recent years there has been a distinct emphasis on constructivist methods promoted as more effective for engaging and facilitating learning. From the introduction of personal computers in education as documented in the Apple funded Apple Classrooms Of Tomorrow (ACOT) research, computing has been associated with constructivist forms of learning (DWYER, 1995; SANDHOLTZ, 1997). The distinction goes toward illuminating any demonstrable preference for constructivist activities rather than didactic activities on the part of the learner. When considering all 37 technologies studied in MTVL, the findings do not reveal any overall preference for either method although they do suggest some indications.

Four of the top five ranked technologies and processes of their use are constructivist in nature. This demonstrates the value of using technologies in learners' active construction of their own knowledge. It tends to validate the claims that active, constructivist-based learning activities with technology tend to support student learning. However, this finding would have more impact if the proportion continued but it does not. Didactic learning *from* technology occupies four out of the top ten and eight of the top 15 value rated positions. Further, the second most highly rated form was the didactic one of "Using a PowerPoint presentation a teacher or another student is provided as an educational resource." This suggests that learners are relatively agnostic in their learning. They will learn from whatever source meets their needs. However, the findings do suggest some advice to faculty. First, they suggest that skepticism of the claims for technologies value to learning is needed. Claims are often exaggerated for the value of technology rather than grounded in evidence. Second, they do confirm the importance of learners employing technologies in the active construction of knowledge presentation. The timeless act of organizing one's thoughts in writing and the more recent act of organizing one's thoughts in creating power point presentations either as an individual (# 3), or in a group (# 4) are highly rated for their value to learning. That learners value a wide range of activities, included those more didactic in nature, suggest that educators need to focus on those activities and resources that are authentic and germane to the subject(s) at hand and should be skeptical of unsubstantiated claims for the value of technology that is employed for its value as technology rather than for its value to learning.

5.5 Learner meta-cognitive awareness of technologies value to learning.

Findings related to respondents' ratings of their awareness of technologies value to their learning demonstrate their reflections on those values. They suggest a high degree of sophistication among learners. Not only do they report a high degree of understanding how technology helps them to learn, they also report a high degree of awareness of how technology can "inhibit or interfere" with learning and a high degree of awareness of how learning through technology is different than learning face-to-face. It is a hypothesis of this research that these relatively high scores add validity to the rankings of technologies value to learning. If learners are aware of technologies value to learning then the ratings they give to different forms are more credible. The findings for these questions are repeated here for ease of discussion.

> Eighty five percent (85%) of respondents either agreed or strongly agreed with the statement: **"**I understand how technology helps me learn."
>
> Seventy six percent (76%) of respondents either agreed or strongly agreed with the statement: "I understand how technologies inhibit or interfere with my learning."
>
> Eighty eight percent (88%) of respondents either agreed or strongly agreed with the statement: "I am aware that some technologies help me learn more than others."
>
> Ninety two percent (92%) of respondents either agreed or strongly agreed with the statement: "I think that learning with and from technology is different than learning face-to-face."

Viewing the rankings of different technologies value to learning from the perspective of respondents' high degree of awareness of technologies role in their learning suggests confirmation of the value of technology-based constructivist activities to learning. Four of the top five technologies concerned active student construction with word processing, power point or other presentation software, and researching through online databases. Further, constructivist, active use of technology occupies 11 of the top 20 technologies for their value to learning. The finding that 9 of the top 20 technologies are more didactic in nature suggests that the combination of receiving and absorbing information through digital sources combined with active construction of student learning with digital tools forms a well-rounded approach to teaching and learning with technology. This finding corresponds to Higgins, Xiao and Katsipataki (2012, p. 5) conclusion from their 2012 meta-analysis of 48 studies that "synthesized primary research studies of the impact of technology on the attainment of school age learners (5-18 year olds)". They concluded:

> There is no doubt that technology engages and motivates young people. However this benefit is only an advantage for learning if the activity is effectively aligned with what is to be learned. It is therefore the pedagogy of the application of technology in the classroom which is important: the how rather than the what. (HIGGINS; XIAO; KATSIPATAKI, 2012, p. 3).

The finding that technologies requiring active construction of knowledge also occupied 12 of the bottom 17 rankings also suggests that the degree of difficulty in using theses tools is a major consideration. Constructivist activities such as creating a database, developing websites, or building an app are ranked predictably low. Given the popularity of YouTube, it is somewhat surprising that creating a video ranked 24th of 37 from the perspective of difficulty. So much video production activity suggests it is not that difficult. Thus, one interpretation of these results is that producing video is not as valuable to learning as writing or producing presentations.

Although the findings on meta-cognitive awareness of technologies value to learning tell us that learners are very aware of how different technologies affect their learning, both to enable and to inhibit, they also have limitations. They do not, for example, tell us how learners behave with respect to understanding "how technologies inhibit or interfere" with learning. Thompson cites findings that learners who are more able to control their "multi-tasking" behaviors scored higher on the scale for "productive learning habits" and conversely, those who exhibited the characteristics of the so-called digital native through multi-tasking and constant connectivity scored lower on their ability to control multi-tasking and on the productive learning habits scale (THOMPSON, 2013). Thus there is evidence that awareness is related to better self-control and focus on learning and may benefit from more explicit discussion among teachers and learners.

The findings on meta-awareness of technologies value to learning may also have implications for the organization of blended learning, where online and other computer-based learning is combined with other in-person activities (https://en.wikipedia.org/wiki/Blended_learning). Although there is no widely accepted definition of blended learning, Allen and Seaman (2007) provide a reasonable approximation in stating that blended learning "blends online and face-to-face delivery" and that a "substantial proportion of the content is delivered online, typically uses online discussions, and typically has some face-to- face meetings." They state that somewhere between 30 to 79% of content is "delivered online" (ALLEN; SEAMAN, 2007). These findings suggest the continued value of face-to-face, in person learning and suggest the value of skepticism when viewing claims for digital natives and 21st century learning.

5.6 Skepticism of claims for digital natives and 21st century learning.

Prensky bases much of his argument for the existence of "digital natives" on "neural plasticity" in the brain. Brain research does confirm that developing brains are adaptable and changeable and that even adult brains may change their "wiring" (THOMPSON, 2013). With respect to the findings of the MTVL survey, brain research indicates that uninjured brains are responsive to many, complex stimuli and attributing any change to an isolated source is difficult. However, considering the great amount of time Rideout, Foehr and Roberts (2010) found in reporting that young people ages 8 to 18 in the United States spent more than 7.5 hours a day, 7 days a week on some type of screen, and the neural plasticity of the brain, suggests that digital stimuli may have shaped some of the brain development of this population. Thus far though, there is little scientific precision on proving these claims

Prensky, however, is not limited by scientific precision and extolls the changing learning and thinking habits of the digital natives as urgent and profound. Digital natives have the characteristics of needing or wanting to receive information "really fast." They exhibit parallel processing and multi-tasking, prefer graphics before text, and like "random access (like hypertext)." They also like to be "networked" with a "preference for collaboration and constant connectivity" and "thrive on instant gratification and frequent rewards" (THOMPSON, 2013, p. 14). They also "prefer games to 'serious" work'" (PRENSKY, 2001a). Thus, to the degree that the claims for digital natives are even partially true, they not only suggest changes to education but also concerns about the effects of so much digital screen time. The proposed changes to the digital natives' brains Prensky claims suggest that "digital natives" prefer activities and interactions through their preference for "speed, nonlinear processing, multitasking, and social learning, allegedly developed through immersion in digital technology during childhood and adolescence when neural plasticity is high (PRENSKY, 2001a; 2001b, p. 442; 2001c; ROSEN, 2010)" (THOMPSON, 2013, p. 12). Thompson describes risks associated with these types of behaviors.

> Small and Vorgan (2008) also discuss the effects of digital immersion on young, highly plastic brains, but caution that it may be overdeveloping certain regions of the brain while neglecting others. In particular, they are concerned that gaming and other digital activities appear to suppress activity in the frontal lobe, the brain region responsible for planning, abstract thinking, and perspective-taking. They fear that the hours spent on the computer instead of reading books might be developing the temporal lobe at the expense of the frontal lobe, leaving a generation of

> students unable to think deeply and reflectively, control impulses, or feel empathy for others. (THOMPSON, 2013, p 13).

Concern regarding the suppression of empathy and perspective-taking is corroborated by a meta-analysis of 30 years of research on empathy and perspective-taking, among other traits, in American college students. Konrath, O'Brien and Hsing (2011) found that from 1979 to 1999 there was little change in the scores for Empathic Concern (EC) or Perspective-Taking (PT) of college undergraduates. However, from 2000 to 2009 they found an astounding 48% decline in EC and a 34% decline in PT. These dramatic reductions in just the types of brain activity associated with being suppressed by interactions in digital media and technology should concern educators and parents for they appear to suppress pro-social behaviors in exchange for anti-social behaviors. Although there is no proof that this dramatic decline is correlated with the rise of web-based hypermedia and social networking, the juxtaposition in time is evident: Google was founded in 1998, Napster music sharing technology emerged in 1999, Myspace in 2003, Facebook in 2004, YouTube in 2005, and Twitter in 2006 to name a few of the most obvious sources of identity representations and interpersonal interactions in cyberspace. However, research on empathy and perspective taking indicates the distinct possibility that increases in technology-based learning in education and overall screen time for all types of applications, not solely education, among all people is having the consequence of decreased empathy toward others and decreased perspective taking in considering other viewpoints. This view coincides with the perspective that the increased polarity in the U.S. political system is facilitated by the increase in screen time and the decrease in face-to-face communication that leads to increased empathy with and understanding of other's perspectives.

The MTVL findings neither confirm nor deny the hypothesis of the digital native. They do show that among the top 20 technologies valued by respondents, 11 were categorized as *with* technology and nine *from* technology. Of the 11, all can be associated with constructivist activity. Of the nine categorized as from, four are associated with reading: reading a discussion forum (8), reading digital texts (9), reading a blog (11), and reading a wiki (13). These point to the presence of skilled learners who draw from all available resources.

5.7 Ability to communicate and collaborate either face-to-face or online

Findings related to the value of communicating and collaborating either face-to-face or online suggest that while students use of Facebook and other social networking tools for personal reasons is prevalent, teachers and professors need both to evaluate their value to learning. It may be social networking

tools are unwelcome to learners for Dahlstrom et al. (2013, p. 6) also report that "students prefer to keep their social and academic lives separate, and they maintain those boundaries in their use of technology". If teachers and professors decide to employ social networking resources, research suggests the need to model or instruct their students on their expectations for how to use them for communication and collaboration in support of instructional goals.

6 Conclusion

The MTVL research findings are consistent with the historical trend indicating that the value of technology to learning is often exaggerated. The findings describe how university students ranked 37 technologies for their value to their own learning suggesting that teachers and professors can reliably employ writing and presentation technologies in support of student learning. Findings that students also value highly reading digital texts suggest the value of well-rounded approach to employing technology resources. Findings that respondents rate highly their meta-awareness of technologies value to learning add credibility to the rankings and suggest the continued emergence of independent learners who can select from a growing constellation of technologies for their value to learning. Findings are consistent with the conclusion that it is the pedagogical employment of technologies for their value to instructional goals that adds value to learning (SOMEKH, 2008; HIGGINS et al., 2012) and further, that no monolithic label such as "digital natives" is appropriate for describing learners.

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