INVESTIGATING CULTURAL VALUES AND EDUCATIONAL TECHNOLOGY ADOPTION IN CENTRAL ASIA: A CASE STUDY

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DEDICATION

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ABSTRACT

Although the adoption of new tools for communication and learning could reasonably be expected to influence culture, little is known about the relationship between cultural values and the adoption or diffusion of Web 2.0 technologies. This case study examines the way in which the cultural values of 59 teachers in four Central Asian countries influenced and were influenced by Web 2.0 technologies during five to eighteen months of online professional development. Data was collected through self-introductions, Likert-scale and open-ended prompts on initial and final surveys, online forum discussions, and capstone projects. This allows an examination of changes in the participants' expressed attitudes toward and use of Web 2.0 educational technology as well as the identification of cultural values (Hofstede, 1980b) associated with these patterns of adoption and diffusion. The findings are especially beneficial to decision-makers who care about the way the use of Web 2.0 educational technologies could impact educational systems and cultures.

Keywords: collaborative learning, diffusion, Hofstede, identity, innovations, ODL, pandemic, professional development, systemic reform, technology adoption, Web 2.0

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LIST OF ABBREVIATIONS

ADC	Alternate Digital Credential
AECT	Association of Educational Communications and Technology
BSU	Boise State University
cMOOC	Massive Open Online Course designed for collaborative learning
DoI	Diffusion of Innovations Theory
GDP	Gross Domestic Product
GNI	Gross National Income
GST	General System Theory
HDI	Human Development Index
HEI	Higher Education Institution
ICT	Information and Communication Technology
IND	Individualism vs. Collectivism (Hofstede)
IVR	Indulgence vs. Restraint (Hofstede)
LMS	Learning Management System
LTO	Long-Term Orientation vs. Short-Term Orientation (Hofstede)
MAS	Masculinity vs. Femininity (Hofstede)
MPI	Multidimensional Poverty Index
MOOC	Massive Open Online Course
NSD	No Significant Data
ODL	Online Distance Learning

OLPC	One Laptop Per Child
PBL	Project-Based Learning
PEOU	Perceived Ease of Use (TAM)
PDI	Power Distance Index (Hofstede)
PU	Perceived Utility (TAM)
RQ	Research Question
Rsq1	Research Sub-Question 1
Rsq2	Research Sub-Question 2
SLR	Student-Led Research
STEM	Science, Technology, Engineering, and Mathematics
TAM	Technology Acceptance Model
UAI	Uncertainty Avoidance Index (Hofstede)
VSM2013	Hofstede’s Values Survey Module 2013
WVS	World Values Survey
xMOOC	Massive Open Online Course designed for self-paced learn

CHAPTER ONE: INTRODUCTION

In 2009, after four years of work in education and health development in Central Asia, my wife and I enrolled our children in the local elementary school. The school days were only four hours long, our children were young, and we had learned the local languages well enough to talk to teachers, so it seemed like a great way to let them experience a new educational system. However, we quickly learned that many classroom resources had not been updated since the Soviet Union. Murals on elementary classroom walls depicted Marx's vision of historical progress from primitive communities to the glorious age of socialism. Homework assignments included memorizing hagiographic poems about Lenin as a child and questionable explanations of English grammar (Figure 1). Despite our concerns about the quality of education, we kept our children in the school for the next four years, during which time, they made friends, learned Russian, and developed outstanding skills in memorization and recitation. During those four years, they also missed over half a year of scheduled school days due to lack of heat and electricity resulting in emergency school closures.

Figure 1 Elementary School Murals: "Were Been Taken", "For the Sake of Life on Earth", "The Capitalist Epoch", and "The Socialist Epoch", Kyrgyzstan (2009)

The current state of education in much of Central Asia is bleak. In the USSR, a centralized Ministry of Education created standards, materials, and an *uchebni plan* (daily lesson plans intended to be used with minimal variance in every school in the USSR).

Depending on the course and grade level, about 30-60% of the curriculum – specifically the parts dealing with Soviet philosophy, history, economics, civics, and life skills – became irrelevant with the dissolution of the USSR on September 1, 1991 (Misco & Hamot, 2007; Popa, 2019). This left an educational gap, as there were few local experts in the newly independent countries trained to develop curriculum or implement new academic systems (B. Ismailova, 2004; Joldoshalieva, 2007; Misco & Hamot, 2007; Silova, 2009). In addition, most Central Asian countries have faced series of economic and political crises resulting in little infrastructure for educational reform. In Kyrgyzstan, for example, upon entering the university system, 70% of students will receive instruction and read textbooks primarily in Russian language even though most students have minimal academic Russian skills (Gul, 2019). Less than 20% of the students in higher education institutions (HEIs) pursue science, technology, education, or mathematics (STEM) (Tempus, 2012). The few who venture into STEM fields are likely to report,

> There are many deficiencies at our university. We constantly have theoretical lessons. Either we write a lot, or the lecturer tells the subject. We never see the computers. We don't even know if there are any (Gul, 2019, p. 100).

To accommodate the need to learn outside the mandated pedagogical methods and curriculum, teachers offer lessons and collect "gifts" outside of the school system to supplement their meager salaries (Cokgezen, 2004; Deyoung, 2006). Once established as normal, this can become systemic, resulting in "teachers pressuring (and sometimes blackmailing) their own students to take supplementary private tutoring with them after school hours, often threatening students with lower grades if they refuse" (Silova, 2009, p. 338).

The Soviet pedagogical model was based on behaviorist methods to promote memorization and mastery of defined skills. This method gave control of knowledge and pedagogy to a centralized body responsible for providing masses of workers with the skills they needed for jobs. Vygotsky had developed the concept of social constructivism while working at the University of Moscow in the late 1920s. However, his ideas were suppressed by the Soviet Union, in part because the theory that knowledge is a communal construct challenged the centralized control required for communist policies (Kozulin, 2003). When the USSR collapsed, local educational leaders throughout the republic were unprepared to help populations deal with a rapidly changing world (Ertmer & Newby, 2008; Huisman et al., 2018).

Since the end of the Soviet Union, pedagogical methods based on constructivism, such as discussion, collaborative learning, problem-based learning (PBL), and student-led research (SLR), have often been introduced in professional development by foreign and local educational reformers in the former USSR states (Silova & Steiner-Khamsi, 2008; Vavrus, 2009). However, these have often failed to diffuse, in part, due to the lingering demands to pass memorization-based standardized tests (Belyavina, 2017; Joldoshalieva, 2007). Moreover, such educational reforms are still often regarded with suspicion by gatekeepers in the educational system who, in many cases, began their careers under the Soviet model (Vavrus, 2009).

In May 2019, I was asked to design a one-year online training program in methods such as interdisciplinary, collective, problem-based learning (PBL) through student-led research (SLR) applied to STEM courses and English courses for STEM students (See the curriculum in Appendix B). The participants were educators in primary, secondary, and tertiary institutions across Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan. The program included a five-day face-to-face program in July 2019, a three-day face-to-face in January 2020, and a five-day face-to-face in July 2020. Between these face-to-face seminars, participants would engage in online distance learning (ODL) approximately four hours per week. The program was designed to have a capstone project in which participants implemented original unit plans demonstrating from the training in a course in April 2020. They were then to lead professional development for their colleagues in May, reflectively analyze their experience in June, and meet for the last time in July to discuss their experiences. However, in March 2020, the COVID-19 pandemic caused almost all schools in Central Asia to move to emergency remote learning. At that time, I approached the training program directors for permission to redesign and extend the final months of the training. Rather than end with unimplemented face-to-face STEM projects, the extended training would last until November 2020, helping participants apply these same methods in asynchronous ODL settings. The new capstone project was to be original ODL modules of courses that participants would pilot in September or October 2020 (Appendix B). This program was again redesigned in late August 2020, as Central Asian governments announced that all schools would begin the 2020-21 school year online. The final projects were again redesigned, and the program ended on December 18, 2020.

The ODL format for this training provides an unusual insight into the potential of professional development to act as a catalyst for the diffusion of pedagogical dispositions and educational technologies across cultural contexts. As already indicated, the pedagogical disposition of teachers and schools in Central Asia has been negative regarding the educational benefits of collaborative learning, PBL, SLR, and other methods derived from constructivism. However, this program provided explicit training in the theory and practice of these methods by means of Web 2.0 tools such as Google Docs, Wikis, YouTube video, and online forums that not only facilitated but often required applications of collaborative learning.

Problem Statement

While decreasing cost and increased access to Internet worldwide give a reason for hope of increasingly accessible education through technology, Web 2.0 ODL involved learning and communicating in ways that have no direct analogy in traditional educational systems. Since education and communication are key elements of culture (Freire & Macedo, 2000; Hofstede, 1986), it seems reasonable that a society would be likely to accept or reject specific educational technologies in part due to perceptions regarding the alignment of those technologies with cultural values. It also seems reasonable to expect that the use of new tools for communication and learning could impact cultural values. The problem is that little is known about the relationship between cultural values and the adoption or diffusion of Web 2.0 technologies. Without an understanding of this issue, educational decision-makers, especially in less developed or developing countries, lose agency in choosing which educational technologies to implement in their contexts.

Understanding the role of cultural values in the adoption and diffusion of educational technologies is essential for examining and predicting the diffusion of these technologies on a global scale. The Association of Educational Communications and Technology (AECT) defines educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (AECT, 2008). Within this definition, the terms *ethical practice* and *appropriate* have cultural nuances that are often overlooked by educational reform organizations and funders – particularly in the developing world. For instance, would cultural predispositions toward gender-based roles be reduced when interacting with Web 2.0 tools that minimize gender, or will those predispositions result in rejecting the tools? Likewise, if people value guru-like expert teachers with standardized method and assessments, will they avoid technologies that promote collaborative research or innovative solutions (Borden, 2008; Olesova et al., 2011; Sharma, 2003), or could the use of these technologies be a foot in the door for cultural change (Snyder & Cunningham, 1975)?

This case study examines 59 educators from multiple cultures' survey and reflective responses attitudes toward and use of Web 2.0, and it examines the way the participants demonstrate this by implementing core concepts in their own online courses. This allows a comparison between participants' expressed attitudes and their classroom praxis. By examining the participants' attitudes toward and implementation of these technologies during their six to eighteen months in the training, this study clarifies the relationship between underlying cultural values and the adoption of Web 2.0 educational technologies.

Purpose of the Study

Having outside experts decide which solution is best for people of different cultures degrades people in the target culture by taking away their agency (Freire & Macedo, 2000; Schein, 2011). It also tends to fail because people are often motivated by values that are difficult to define and measure. As Tolstoy pointed out in *Anna Karenina,* the "character" of a population is "one of the unalterable data of the question, like the climate and the soil," (Tolstoy, 1998, part 2, chapter 12). Rogers echoed this observation nearly a century later, noting that the adoption rate of an innovation is closely tied to "its compatibility with the values, beliefs, and past experiences of individuals in the social system" (1995, p. 4). Before recommending innovations conducive to systemic change, therefore, it is necessary to understand the cultural values of the people affected by the changes and be prepared for unforeseen applications of the reforms. For example, attempts to introduce SLR in the collectivist culture of China have sometimes failed because technicians blocked student access to Internet sites that did not support the national curriculum (J. Zhang, 2010). Likewise, One-Laptop-Per-Child presented vision of enabling self-directed education for millions of impoverished students. However, two years after implementation, 56% of the 14,000 Macedonian teachers in the program reported that they had never used the technology in class (Kozma & Surya Vota, 2014). These findings indicate that, without a deep understanding of a community's cultural values, attempts to widely implement educational technologies may waste much-needed resources.

The purpose of this case study is to examine the way in which teachers' cultural values influence and are influenced by Web 2.0 technologies used in online professional development, as demonstrated by participant attitudes toward and use of these technologies in their courses. The data examined includes open- and closed-item surveys, online forum discussions, participant reflection on their progress, and demonstration of final projects. The data begins with the introductory materials welcoming participants to the training LMS in July 2019 and ends with the completion of the training in December 2020. Although 139 people participated in various aspects of the training, this study focuses on the 59 participants from Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan who met the requirements for certificates of completion from the program.

Definition of Terms

Many of the following terms are commonly used but have technical meanings in this study. Chapter 2 provides a more comprehensive explanation for the contextual definitions of some of these terms as used in this study.

Culture

This study is built on the work of Hofstede, who defines culture as "the programming of the human mind by which one group of people distinguishes itself from another group" (Hofstede Insights, 2021b). In 1980, Hofstede's statistical analysis of survey responses of IBM employees in 53 countries resulted in a description of culture in terms of values along four dimensions. Although the 117,000 subjects worked for the same company, they displayed different attitudes toward power distance (PDI), individualism (IDV), uncertainty avoidance (UAI), and masculinity (MAS) (Hofstede, 1980b). Over the last forty years, Hofstede has expanded the cultural dimensions to include long-term orientation (LTO) and indulgence or restraint (IVR) (Hofstede & Bond, 1988; Hofstede & Minkov, 2010). This research has been expanded to include 76 countries and has been replicated in numerous situations (Beugelsdijk et al., 2015; Fernandez et al., 1997). The issue of culture is further discussed in this study's literature review.

Constructivism

Vygotsky posited that deep, meaningful changes to knowledge, attitudes, and behavior occur most frequently when learners work in a community to solve problems that are just beyond the ability of the single individuals to solve on their own. In the late 1970s, Vygotsky's work spread in the West, becoming one of the key theoretical foundations of discussion-based learning, problem-based learning, student-led research, and almost every method involving learners collaboratively solving problems in their *zone of proximal development* (Doolittle, 1997; Ertmer & Newby, 2008; Moll, 2013; van der Veer & Valsiner, 1994; Vygotsky, 1964). Constructivism is a theoretical base for many activities in which learners collaboratively break complex problems into logical steps, conduct experiments, interpret data, and integrate knowledge from various academic disciplines to solve a problem (K. L. Smith et al., 2015; H.-H. Wang et al., 2011). The STEM Methods promoted in the training program described in this study are derived from constructivism and use "mathematics and science to direct learning activities" even while emphasizing "design, media and performing arts, creative thinking or even playful problem-solving when exploring and designing solutions" (Herro & Quigley, 2017). This study uses the term *constructivism* with this broad, non-technical, definition for any methods encouraging learning through active, application focused collaboration.

Learning Management Systems (LMS)

While there is still discussion about the exact technical criteria for an LMS (Hetrick, 2019; Kerimbayev et al., 2017; Starodubtsev & Ryashenshev, 2017), this study uses the term to refer to collections of Web 2.0 tools that facilitate communication, creation, discussion, and assessment within a single digital ecosystem. The two LMS's used most extensively in this study are Moodle and G Suite for Education. Moodle is an open-source LMS that is used in over 30,000,000 courses in 242 countries (*Moodle Statistics*, 2020). It provides a wide variety of interactive educational tools within a system that integrates gradebook and student management functions. Moreover, its free versions and documentation in Russian and several Central Asian languages make it especially suited for implementation in Central Asia. G Suite for Education consists of the collaborative apps offered through Google, most commonly Docs, Classroom, Gmail, Hangouts, Meet, Sheets, Sites, Slides, and YouTube. It also offers paid versions in its G Suite for Education Enterprise Edition, which includes additional tools for data collection and analysis (Google, 2020). Google rebranded G Suite for Education as Google Workspace for Education in February 2021 (Google, 2021); however, this research was conducted with the G Suite brand and tools.

Online Distance Learning (ODL)

ODL involves student interaction with the teacher, other students, and the content primarily through the Internet and primarily when not in the same physical location (Ertmer & Newby, 2008; Moll, 2013; W. Richardson, 2010). A Massive Open Online Course (MOOC) is an ODL course designed to accommodate more than several hundred students at once. These are further defined xMOOCs, designed for independent or self-directed study, and cMOOCs, which include collaborative activities among learners. xMOOCs often run entirely asynchronously, with participants completing activities entirely on their own, while cMOOCs usually require specific start dates, dates for collaborative assignments, and end dates (Downes, 2012).

Pedagogical Dispositions

Dispositions are “relatively enduring ‘habits of mind,’” or behavior patterns that may be established only through repeated observation (Katz, 1989, p.10). Pedagogical dispositions are these long-term patterns that characterize professional learning communities, creating an ecological habitus for the community with “a depth of complexity that is difficult to shift” (Feldman J. & Fataar A., 2014, p. 1526). In this study, the term will be used specifically to focus on the participants’ perceptions and demonstrations of repeated behaviors of pedagogical practices within their communities.

Technology Acceptance Model (TAM)

The TAM is a simple explanation of the tendency for people to accept new technologies on the basis of the technology’s perceived utility (PU) and perceived ease of use (PEOU) (Davis, 1985, 1989; V. Venkatesh & Davis, 2000). Although more recent models express greater nuance than the original (V. Venkatesh & Bala, 2008), the original model retains high face validity. The TAM is further discussed in this study’s literature review.

Web 2.0

Web 2.0 includes the interactive Internet of social networks, forums, collaborative apps, and product ratings that allow the possibility of sharing resources, sharing the creative process, and recognizing the value of achievements (Bowen & Thomas, 2014).

Examples of Web 2.0 apps include Twitter, Amazon.com ratings, wikis, blogs, YouTube, Facebook, Uber, and ResearchGate. Moodle and G Suite for Education incorporate numerous apps for facilitating Web 2.0 interaction.

Research Questions and Hypothesis

The purpose of this case study is to examine the way in which teachers' cultural values influence and are influenced by Web 2.0 technologies used in online professional development, as demonstrated by participant attitudes toward and use of these technologies in their courses. This purpose leads to one primary research question:

What is the relationship between cultural values and the diffusion of educational technologies? (RQ)

Two sub-questions clarify the way that participants in the online professional development demonstrate their attitudes toward and use of the technologies:

1. How do participants' expressed attitudes toward and use of Web 2.0 technologies change during the training? (Rsq1)
2. What cultural values, as described by Hofstede, are most relevant to participants' attitudes toward and use of Web 2.0 technologies? (Rsq2)

Answering these questions involves examining the online work of 59 people from four countries who participated in the previously described professional development program. This online work includes a pre- and post-training survey, online discussions in various media, projects, and self-reporting, all within the training's Moodle and G Suite environment. This allows a qualitative analysis of the participants' cultural values and attitudes toward Web 2.0 tools for education before, during, and at the end of the program.

While the “thick description” desired for this study relies more on quotations than on diagrams (Ponterotto, 2006), it is possible that an explanatory matrix could emerge (Miles et al., 2019), looking something like Figure 2. Figure 2 illustrates the hypothesis that unconscious values and dispositions (pictured in blue) influence and are influenced by conscious beliefs and perceptions (pictured in orange). Perceptions such as the utility or ease of use of an innovation are products of both personal observation and the professional habitus (Feldman J. & Fataar A., 2014). While professional learning communities and individuals may make conscious decisions about whether to adopt or reject technologies, the decision of whether to attempt to encourage the further adoption of a technology is often made by innovators or early adopters who are somewhat outside the typical pedagogical dispositions of the community. Successful diffusion is evidenced by changing behaviors that, in turn, influence cultural values and personal beliefs. Thus, cultural values, individual beliefs and attitudes, behavior, perception, choices of initiative, and innovation are all in dynamic tension.

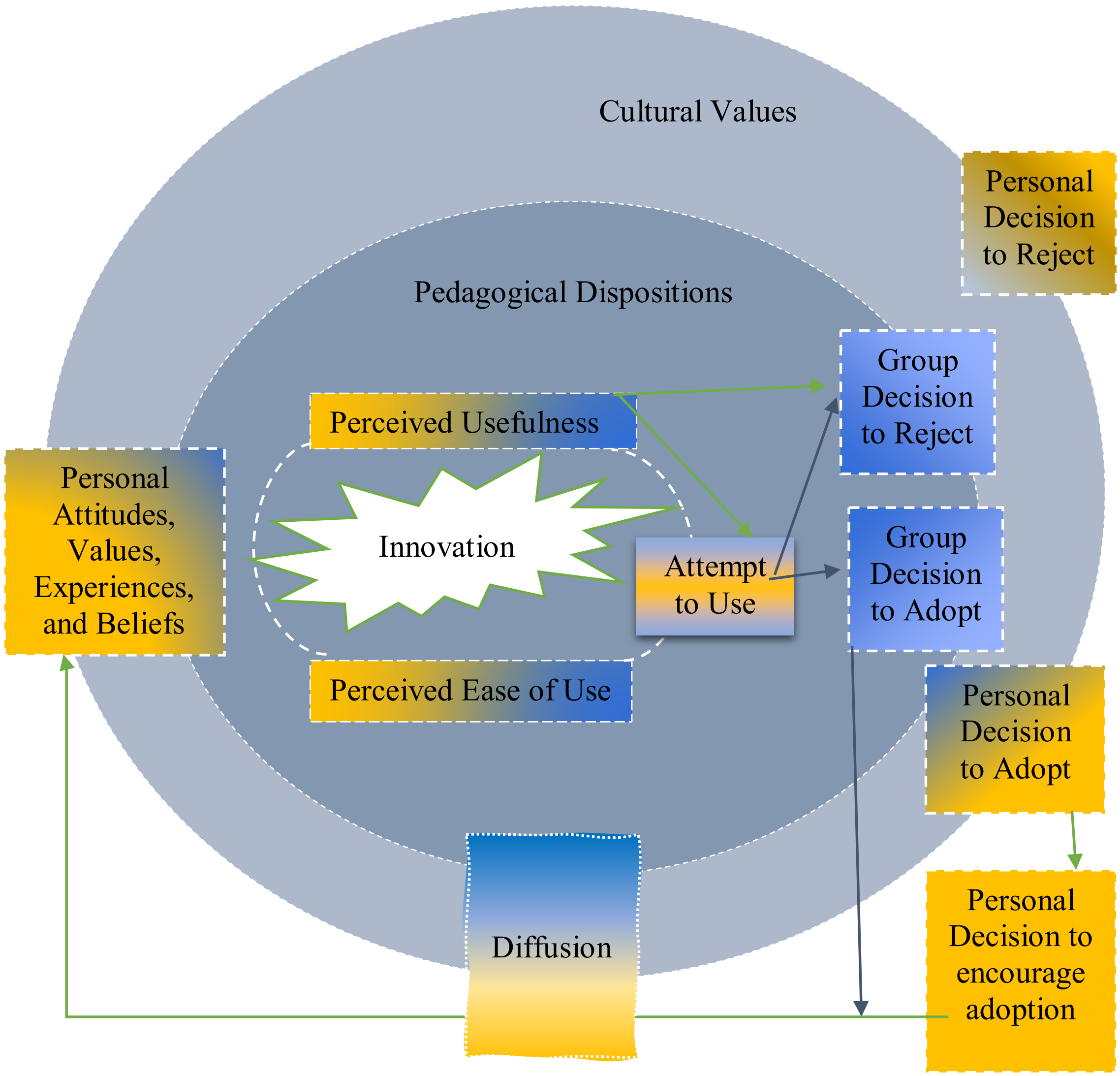


Figure 2 Factors influencing pedagogical dispositions toward educational technologies

It seems reasonable to expect that, in the same way that culture influences perception in general (D. G. Myers, 2014), specific values could influence perceived utility or ease of use. For instance, a metanalysis found that people who value formal social roles (high PDI) may be likely to appreciate apps that present a collected amount of information to be mastered, while those from low-PDI cultures may appreciate apps that promote creative, collaborative problem solving. Those who value individuality (high IDV) may prefer products with high perceived innovativeness or individual utility, while those from collectivist cultures may prefer products that are widely accepted by the group (Zhao et al., 2021). People who value clarity and stability (high UAI) may prefer technologies that aid with memorization, while people who value exploration and discovery (low UAI) may value tools for collaborative discovery. Highly masculine groups (MAS) would tend to prefer technologies that allowed clearly documented achievements, such as online objective tests, while low-MAS groups would probably prefer being assessed in a way that gave formative encouragement to all group members. A high long-term orientation (LTO) is associated with an ability to give up personal preferences or beliefs for the long-term success of the group. Therefore, learners with a high LTO may be willing to try new apps that the teacher recommended, whereas those with a low LTO would object based on beliefs that specific tools or methods were always the best. Finally, those with a high value for indulgence over restraint would be likely to benefit from gamification involving badges and scoreboards, whereas those with a high value of restraint may be more likely to appreciate augmented or virtual reality tools that allowed exploration without a focus on competition (A. Anderson et al., 2013; L. E. Ellis et al., 2016; Poondej & Lerdpornkulrat, 2016; Rahman et al., 2018). This possible relationship between cultural values and preferences for specific types of educational technology is outlined in Table 1.

Table 1 Hypothetical Relationships of Cultural Values and Technology Preference (Descriptors of the cultural dimensions are quoted from *Hofstede Insights: National Culture,* 2020.)

Educational Methods or Technologies Possibly Associate with a High Value	Cultural Dimension	Educational Methods or Technologies Possibly Associated with a Low Value
• Individual Presentation Tools • Expert-made content • OER Textbooks	Power Distance Index (PDI) "the degree to which the less powerful members of a society accept and expect that power is distributed unequally. The fundamental issue here is how a society handles inequalities among people."	• Social media • G Suite Collaborative Tools • Learner-made content • Wikis
• Individual presentations • Personalized learning • Competitive gamification • Asynchronous learning	Individualism vs. Collectivism (IDV) Individualism: "a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families." Collectivism: "a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular ingroup to look after them in exchange for unquestioning loyalty."	• Group assignments • Memorization • Technologies facilitating collaboration • Synchronous learning
• Popular, known technologies • Memorization tools • Standardized assessment	Uncertainty Avoidance Index (UAI) "the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity. The fundamental issue here is how a society deals with the fact that the future can never be known: should we try to control the future or just let it happen?"	• Innovative technologies • Creative production • Portfolio assessment
	Masculinity vs. Femininity (MAS)	

• Standardized, objective tests • Detailed rubrics • Gamification involving leaderboards and clear rewards	Masculinity: “a preference in society for achievement, heroism, assertiveness, and material rewards for success. Society at large is more competitive.” Femininity: “a preference for cooperation, modesty, caring for the weak and quality of life. Society at large is more consensus-oriented.”	• Discussion-based or narrative feedback • Collaborative learning • Gamification involving teamwork for problem solving
• Research-based innovative technologies and methods	Long-Term vs. Short-Term Orientation “Societies who score low on this dimension… prefer to maintain time-honoured traditions and norms while viewing societal change with suspicion. “Those with a culture which scores high, on the other hand, take a more pragmatic approach: they encourage thrift and efforts in modern education as a way to prepare for the future.”	• Technologies and methods based on tradition or ideology
• Gamified projects • Quick feedback • Scoreboards • Micro-credentials	Indulgence vs. Restraint “Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun. Restraint stands for a society that suppresses gratification of needs and regulates it by means of strict social norms.”	• Long-term projects • Exploration-based games and technologies

Significance of the Study

Education in Central Asia should be an issue of international concern. Many scholars view Central Asia as a key for long-term political dominance (Kaplan, 2012; Mackinder, 1904; Megoran & Sharapova, 2013; K. Meyer, 2004). At this time, the median age in Central Asia is 27.4 years, which is 11 years lower than that of the United

States (World Population Review, 2019), indicating a large school-age population. This population has been targeted by Islamic and Christian religious education projects for years (Deyoung, 2006; Puckett, 2009). More recently, the Chinese government has seen the potential for the student-aged population and has written publicly and extensively of their willingness to develop educational sectors for mutual benefit (Ministry of Education of the People's Republic of China, 2016). Such political interests add immediate relevance to questions of which types of help that local populations are likely to adopt and the extent to which “culturally sensitive design” may aid that process (Perkins, 2008). This study could help donors and decision makers better assess the types of technologies that should be encouraged in specific cultural contexts. This is immediately relevant to the implementation of educational technology the United Nations’ Sustainable Development Goals (SDGs) (Kanwar, 2018), China’s “One Road Initiative” (Li, 2018), the emergency response to the COVID-19 pandemic, issues of self-determinism and agency for the Central Asian peoples, and long-term decisions regarding ODL, MOOCs, mobile learning, and digital credentials as tools for systemic change (Kanwar, 2018; Kshetri, 2017; Kshetri & Voas, 2018; Ngugi, 2011; Umar, 2013).

Advancing Scientific Knowledge

As discussed in the literature review for this study, research on educational technology implementation in the developing world is scarce. For example, Central Asia’s population is almost twice that of Canada. However, a Google Scholar search of “educational technology”+Canada in September 2020, produced 3,870 results since the beginning of 2020. “Educational technology”+”Central Asia”, however, produced 74.

There is relatively little known about what billions of people want or are doing for education (“Global Poverty,” 2018; *Human Development Reports*, 2016).

This study adds to knowledge in the field by examining cross-cultural pedagogical dispositions and practices not only through self-reporting, but by observation in the classroom. The technologies used in the training (Moodle, Google Classroom, etc.) make data collection possible without the researcher needing to physically cross national and geographical barriers. This study also contributes to the field due to the length of time and breadth of participants in the training. The participants include professional teachers and administrators in public and private elementary, secondary, and tertiary schools. This opportunity to observe and interact with 59 people who actively participated in six to eighteen months of this ODL training makes the database for this study unusually broad and deep among qualitative studies of ODL for cross-cultural professional development.

As Friesen (2008, p. 307) observed, “’grand narratives’ of historical and technical progress” are often unreconcilable with facts about educational technology use. This study is one of “a multiplicity of intersecting, interwoven micro-narratives” leading toward a model of the whole. With that perspective, this paper is one part of answering the questions, “What are the people of Culture X likely to do with this tool?” and, “How might using this tool change Culture X?” To the extent that this research answers those questions, it may help decision-makers working at many levels of educational reform in many parts of the developing world.

Rationale for Methodology

This study relies on qualitative rather than quantitative analysis for several reasons. The question may be raised whether the Likert-scale data on the pre- and post-survey trainings could be analyzed quantitatively. However, the data was collected via instruments designed for teaching and administered in a course setting. This means that there were no controls in place for ensuring that the participants were representative of their populations or to ensure that the survey respondents were representative of the entire group of participants. Therefore, the quantitative survey results may be helpful in establishing the "thick description" of qualitative data, they are insufficient for quantitative analysis on their own. The examination of this data through qualitative analysis, however, may still result in trustworthy and reliable results (Creswell, 2013).

I sincerely hope that this research will lead toward more effective decision-making on all levels of educational systems for the benefit of people in marginalized societies. However, despite that transformational objective, the transformative research worldview presupposes that research should use "a program theory of beliefs about how a program works and why the problems of oppression, domination, and power relationships exist (Creswell, 2013, p. 10). This study does not presuppose a theory that explains the reasons for "oppression, domination, and power relationships." Moreover, presupposing such a theory may result in conclusions that are uncompelling to those who do not embrace the theory. Therefore, I approach the research questions from a social constructivist worldview, informed by postpositivist findings. For instance, I draw on findings about culture from Hofstede (Hofstede, 1980a, 1983b; Hofstede Insights, 2021b; WVS Database, 2021). However, I also assume that the Hofstede and WVS categories may not fully describe the participants because subjective meanings are negotiated socially and historically. They are not simply imprinted on individuals but are formed through interaction with others (hence social constructivism) and through historical and cultural norms that operate in individuals' lives (Creswell, 2013, p. 8).

The social constructivist approach does not require the formulation of completely new categories but recognizes that even categories established by research may require collaboration and negotiation to form meaning in a new context.

Nature of the Research Design

The data for this study began with a training program for 44 educators Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan who applied for a competitive one-year program in STEM Methods. They were selected for the training based on their English language proficiency, statement of interest, and statement from supervisors supporting their application of interactive methods. After COVID-19 pandemic restrictions in March 2020, 36 of the original participants remained, and in June 2020, 29 new participants joined the ODL training through a second application process. In July 2020, some participants launched their own iterations of the training after receiving permission from the facilitators and project owners to copy and lead the Moodle-based training. This brought the total participants to 139 people from 16 countries. These new participants joined with the same end-goal project in mind: an original module of a course based on constructivist methods. Phase 1 participants who stayed through Phase 2 contributed data from July 2019 through December 2020. Phase 2 participants contributed data from June or July 2020 through December 2020.

Their contributions to data were completed within the online training's Moodle and G Suite tools through the following activities: pre-and post-training surveys, online forum discussions of hindrances and successes to the diffusion of Web 2.0 technologies and related methodologies in their cultural contexts, and demonstrations of application of these technologies and methods in their classes. These activities were completed publicly and voluntarily by participants as part of the training, as described in the course design documents that were prepared in May 2019 (Appendix B) and May 2020 (Appendix C).

Pre- and post-training surveys (Appendix D) involving Likert-scale and open-ended questions help establish a baseline and endpoint for identifying change in attitudes or use of constructivist-related methods and Web 2.0 technologies. These were part of the course design (Appendices B and C), with prompts designed to measure changes in their use and intent to use STEM methods and educational technologies. These prompts were used as formative assessment for the course facilitators and to measure outcomes required by the funding agency for the program. The surveys also incorporate an authorized version of Hofstede's cultural dimensions survey (Hofstede, 2013). These prompts were included on the course surveys to enhance course discussions of learners' contexts and values when choosing appropriate pedagogical methods or technologies. Although the survey results were anonymous, summaries of the responses were shared with all participants for the purpose of course discussions. Within the context of this research, data from these surveys provides a baseline and end point for participants' self-evaluation of their Web 2.0 use and cultural values.

Discussions in two online forums within the Moodle environment allow the analysis of the participants' perceived hindrance to and successes in diffusing the technologies discussed in the program. Participants were able to see what others had posted in these forums, and they contributed to the forums voluntarily.

The participants' capstone projects include a reflective component and a demonstration, in writing or video, of the implementation of training concepts into actual classes. In many cases, this also included guest access to the Moodle or G Suite class so that researchers could virtually observe the course. The capstone projects were designed to be shared publicly online.

Of the 139 people who participated in this course, this study includes only the 59 from Central Asia who participated actively enough throughout the program to receive certificates of completion. Certificates were granted by the sponsoring organization based on participation, without regard to demonstrated adoption or diffusion of the technologies and methods taught in the course.

After the training program had finished, these assignments were downloaded from the G Suite and Moodle tools that had been used for the assignments. They were then coded using an a priori code derived from Hofstede's cultural dimensions, the TAM categories of PU and PEOU, specific Web 2.0 technologies identified in the literature review for this study, and an emergent code based on factors observed in the first coding cycle. Further description of the coding process is included in the Data Analysis and Procedures section of this study.

Assumptions of the Study

This study's research questions, methodology, and interpretation are drawn from the interplay between four key theories: Hofstede's Cultural Dimensions, Diffusion of Innovation (DoI), the Technology Acceptance Model (TAM), and General System

Theory (GST). Although these theories are rooted in sociology, information systems, anthropology, and mathematics, they each bring a necessary perspective for studies of cross-cultural educational systems reform. Each of these will be discussed in detail in Chapter Two of this study.

As discussed in the Definition of Terms section of this study, Hofstede's Cultural Dimensions have long been a standard for cultural research. Hofstede's Values Survey 2013 is available for internal use by organizations wanting to promote discussion of culture. It was included in the surveys of participants to promote such discussion in the training program. Since the training program was completed prior to the formation of this study, it was expedient to use Hofstede's findings as a cultural framework rather than the theories of culture discusses in this study's literature review.

The Diffusion of Innovations theory (DoI) emerged in the 1960s and 1970s to predict the way in which farmers would adopt new agricultural products and methods (Ken Schreiner, 2014), but it quickly spread as an effective tool for predicting the diffusion of innovations in many contexts. The model predicts the adoption of an innovation by a society beginning with a small group of innovators (2.5% of the population) and early adopters (13.5%) leading the diffusion process, which the burgeons into a standard bell curve, with 68% being in the early or late majority of adopting the innovation, and 16% forming the laggards (Robinson, 2009; Sahin, 2006). The model suggests that all innovations diffuse through these stages, but the speed of diffusion can be influenced by the nature of the innovation and communication about the innovation (Rogers & Ellsworth, 1997). The history of the DoI is further discussed in this study's literature review. This study applies the DoI theory especially in the analysis of how communication about and through the technologies influences the diffusion of the technologies.

For over 30 years, the Technology Acceptance Model (TAM) has explained that people tend to express positive attitudes toward technologies that they perceive as useful (PU) and perceive as easy to use (PEOU) (Davis, 1985, 1989; V. Venkatesh & Bala, 2008). International studies of the TAM's validity indicate the influence of factors other than PU and PEOU in some cultures (Hetrick, 2019; Lala, 2014; V. Venkatesh & Bala, 2008). The TAM is discussed in greater detail in this study's literature review. .

General Systems describes "wicked problems" as those involving complex relationships between variables that makes every possible solution "tentative, incomplete," because the problem changes "as the solution is approached" (Banathy & Jenlik, 1996, p. 46). In complex systems, such as introducing new technologies for communication and education during an online ecosystem, each variable's state is a function of previous states, so any changes may unpredictably influence future changes (Vancouver, 2013). Therefore, while this study does not seek to establish a causal relationship, it may help decision-makers accommodate and facilitate beneficial disruptive innovations (Bower & Christensen, 1995).

Summary: Introduction and Context

With the global popularity of Web 2.0 technologies (Alexander et al., 2019; Gyamfi, 2017) combined with the COVID-19 shift to emergency remote learning, the question of the relationship between culture and technology has immediate practical implications. Since March 2020, approximately 1.6 billion students in 190 countries, 90% of students worldwide, faced major disruptions in their education. This has moved ODL to the forefront of major educational influencers, from national governments to UNESCO and Microsoft (UNESCO, 2020). Although these technologies were being used around the world prior to the pandemic, the way in which they influence or are influenced by cultural values is now an area of growing relevance.

The purpose of this case study is to examine the way in which teachers' cultural values influence and are influenced by Web 2.0 technologies used in online professional development, as demonstrated by participant attitudes toward and use of these technologies in their courses. The study addresses this topic by examining the online interactions of 59 educators from four Central Asian countries who completed an ODL training on the use of collaborative, problem-based, learning methodologies as applied to courses in STEM, English-language for STEM, or asynchronous ODL. This study analyzes their interactions, course projects, and answers on surveys, to find the answer to one primary and research question and two sub-questions:

1. What is the relationship between cultural values and the diffusion of educational technologies? (RQ)
    a. How do participants' expressed attitudes toward and use of Web 2.0 technologies change during the training? (Rsq1)
    b. What cultural values, as described by Hofstede, are most relevant to participants' attitudes toward and use of Web 2.0 technologies? (Rsq2)

Data from the participants' coursework was coded according to Hofstede's cultural dimensions and TAM categories (Davis, 1989; Hofstede, 1980a; Minkov & Hofstede, 2012). It was also coded with an emergent code based on patterns that appear during the literature review and participants' final projects. This is further discussed in this study's Methodology section.

The findings from this research could apply directly to designing contextually-effective professional development programs for teachers (Perkins et al., 2003). It could also supplement research on the stability of Hofstede's categories over time (Beugelsdijk et al., 2015; Fernandez et al., 1997; Inglehart & Welzel, 2005), the cross-cultural relevance of the TAM (Hetrick, 2019; Lala, 2014), and the diffusion of innovations in general (Rogers & Ellsworth, 1997; Sahin, 2006). Moreover, while programs promising low-cost, durable computers for all children (Negroponte, 2006), or solar-powered village computers to replace teachers (Mitra et al., 2005) may be visionary, the visions often fail to notice the webs of cultural values blocking their implementation (Arora, 2010; Colombant, 2011). This study could help decision-makers at all levels of the educational sector invest more wisely in resources that are likely to be adopted and used effectively by their constituents. Finally, this study contributes to academic knowledge as one of the few studies of the educators' use of Web 2.0 ODL among the 75 million inhabitants of Central Asia (Worldometer, 2020).

Chapter 2 establishes the theoretical and contextual framework for this study. It first gives an overview of the foundational theories for the study: Hofstede's cultural dimensions, the DoI, the TAM, and GST. It then examines the use of Web 2.0 for ODL in the developing world through a realist literature review (Pawson et al., 2005) of 188 studies between 2009 and 2019. This clarifies the extent to which Web 2.0 ODL is diffusing in other parts of the developing world and identify factors that have tended to encourage or inhibit this diffusion. The findings from the literature review informs the research methodology and coding process. Chapter 3 gives a further explanation of the validity, reliability, research design, data collection, and ethical considerations with this methodology. Chapter 4 presents the findings according to the coding for each of the instruments used in data collection. Chapter 5 summarizes the findings and examines their possible relevance to the foundational theories of the study and possibilities for future research.

CHAPTER TWO: REVIEW OF THE LITERATURE

Appreciating this study's purpose, research questions, methods, and findings, requires some understanding of a specific historical and cultural setting of the Central Asian participants. This literature review, however, zooms out to help place those participants' responses to the data-collection instruments in the broader theoretical and global context of the discussion (Merriam, 2007). The purpose of this literature review is to explain the foundational theories for this study and their relevance to the research questions, and then to examine factors affecting the diffusion of ODL with Web 2.0 in the developing world in the last ten years. This involves answering the following research questions:

1. What are the foundational theories for this study, and how are they relevant?
2. What is the developing world?
3. What is the history of distance education in the developing world?
4. To what extent are Web 2.0 technologies diffusing in ODL programs in the developing world?
5. What factors have tended to encourage or inhibit this diffusion?

What are the Foundational Theories for this Study, and How are they Relevant?

As outlined in the Assumptions of the Study, in Chapter One, this study's research questions, methodology, and interpretation are drawn from an interplay between four key theories: Hofstede's Cultural Dimensions, the Diffusion of Innovation Theory

(DoI),), the Technology Acceptance Model (TAM), and General System Theory (GST). It also relies on the Human Development Index (HDI) as the measurement tool for development. This section of the literature review will review the key concepts and criticism of these theories and index, as well as their relevance for this study.

Hofstede's Cultural Dimensions

In the late 1960s and early 1970s, Hofstede conducted surveys of over 117,000 IBM employees in forty countries. Statistical analysis of responses identified patterns of attitudes and values that differentiated employees from each other on national levels even though they may have the same jobs as employees in different countries. This led Hofstede to define culture as "the collective mental programming of the people in an environment" (Hofstede, 1980a, p. 43). On a national level, cultures conditioned, or programmed their members to perceive stimuli in ways that benefited the society its specific historical and geographic context. Therefore, even though the IBM employees in his study may have had similar educational credentials, policy manuals, socio-economic status, daily tasks, they responded differently to prompts about four aspects of life. These first four cultural dimensions included Individualism vs. Collectivism (IDV), Power Distance (PDI), Uncertainty Avoidance (UAI), and Masculinity vs. Femininity (MAS) (Hofstede, 1980a,1980b). Further research in over 50 countries over the next twenty years resulted in identifying two additional dimensions: Long-Term Orientation (LTO) and Indulgence vs. Restraint (IND) (Fernandez et al., 1997; Hofstede & Bond, 1988; Hofstede & Minkov, 2010; Minkov & Hofstede, 2012). These dimensions are outlined in Table 2, along with examples of countries that scored the highest and lowest in each dimension. Table 3 shows examples of country comparisons across various dimensions.

Table 2 Hofstede's Cultural Dimensions (Hofstede Insights, 2020).

Cultural Dimension	High-Value Examples	Low-Value Examples
Individualism vs. Collectivism (IDV) *"the degree of interdependence a society maintains among its members"*	Privacy Freedom Individual Rewards United States Australia New Zealand Netherlands	Teamwork Group harmony "We" Guatemala Ecuador Panama Venezuela
Power Distance (PDI) "*the attitude of the culture toward these power inequalities amongst us*"	Hierarchical organizations High pay differences Malaysia Philippines Mexico Venezuela	Flat organizational structures Egalitarian workplaces Singapore Jamaica Denmark Sweden
Masculinity or Femininity (MAS) "*wanting to be the best (Masculine) or liking what you do (Feminine)"*	Titles Achievements Mexico China Japan Belarus	Relationships Quality of life Sweden Norway Netherlands Denmark
Uncertainty Avoidance (UAI) "*the way that a society deals with the fact that the future can never be known"*	Conservative Strong social norms Sense of urgency Finland Germany Greece Guatemala	Open to change Open-ended decisions Low sense of urgency Jamaica Denmark Singapore Sweden
Long Term Orientation (LTO)	Virtue and Character Education Modesty	Convictions Rights Confidence

"*[maintaining] some links with its own past while dealing with the challenges of the present and future*"	China Hong Kong Japan South Korea	Sierra Leone Nigeria Ghana Philippines
Indulgence or Restraint (IND) "*the extent to which people try to control their desires and impulses*"	Self-Expression Optimism Australia Canada United States Argentina	Self-Control Pessimism Belarus Russia Azerbaijan China

Table 3 Cultural Dimensions in Various Countries (Source: Hofstede Insights, 2021b)

	Canada	Colombia	China	Kazakhstan	Russia	Turkey	USA
PDI (Power Distance)	39	80	67	88	93	66	40
IDV (Individualism vs. Collectivism)	80	20	13	20	39	37	91
UAI (Uncertainty Avoidance)	48	30	80	88	95	85	46
MAS (Masculine vs. Feminine)	52	66	64	50	36	45	62
LTO (Long-Term vs. Short-Term Orientation)	36	87	13	85	81	46	26
IVR (Indulgence vs. Restraint)	68	24	83	22	20	49	68

Criticism and Alternatives to Hofstede.

Hofstede's research was primarily conducted when the Iron Curtain and geographic barriers blocked cultural interaction between many countries (Fernandez et al., 1997; Hofstede, 1980a, 1983a, 1983b, 1986). Therefore, it is reasonable to assume that these dimensions may change with increasing interaction of cultural groups.

Although Hofstede's dimensions appear generally stable thus far, there are indications that people in many countries are valuing Masculinity less than they did in 1980 (Beugelsdijk et al., 2015; Minkov & Hofstede, 2012). This finding is supported by other large-scale cultural studies (Inglehart, 2017; Trompenaars & Hampden-Turner, 1998; Welzel et al., 2001).

The World Values Survey (WVS) is the greatest competitor to Hofstede's research, having been given in 120 countries, representing 94.5% of the world's population, since 1981 (WVS Database). The initial WVS categories were derived from the European Value System Study Group (EVSSG), an organization that formed in the late 1970s to study changes in traditional Christian values in Western Europe, Canada, and the USA (European Values Study, 2020; WVS Database, 2021). The WVS was developed in 1981 based on Inglehart's research on aspects of culture that are specifically related to "cultural evolution," which was measured largely in terms increased secularism and economic development (Inglehart, 2017; Inglehart & Welzel, 2005; Welzel et al., 2001). According to this model, traditional societies value religion, familial ties, and respect for authority, and national pride, while secular societies de-emphasize these aspects of life, while emphasizing rationalism. Survival-focused societies value activities focus on meeting the basic needs of the group, where self-expression-focused societies express greater tolerance for diversity and openness because basic needs are felt to be met (Inglehart, 2017; Inglehart & Welzel, 2005, 2010; Welzel et al., 2001; WVS Database, 2021).

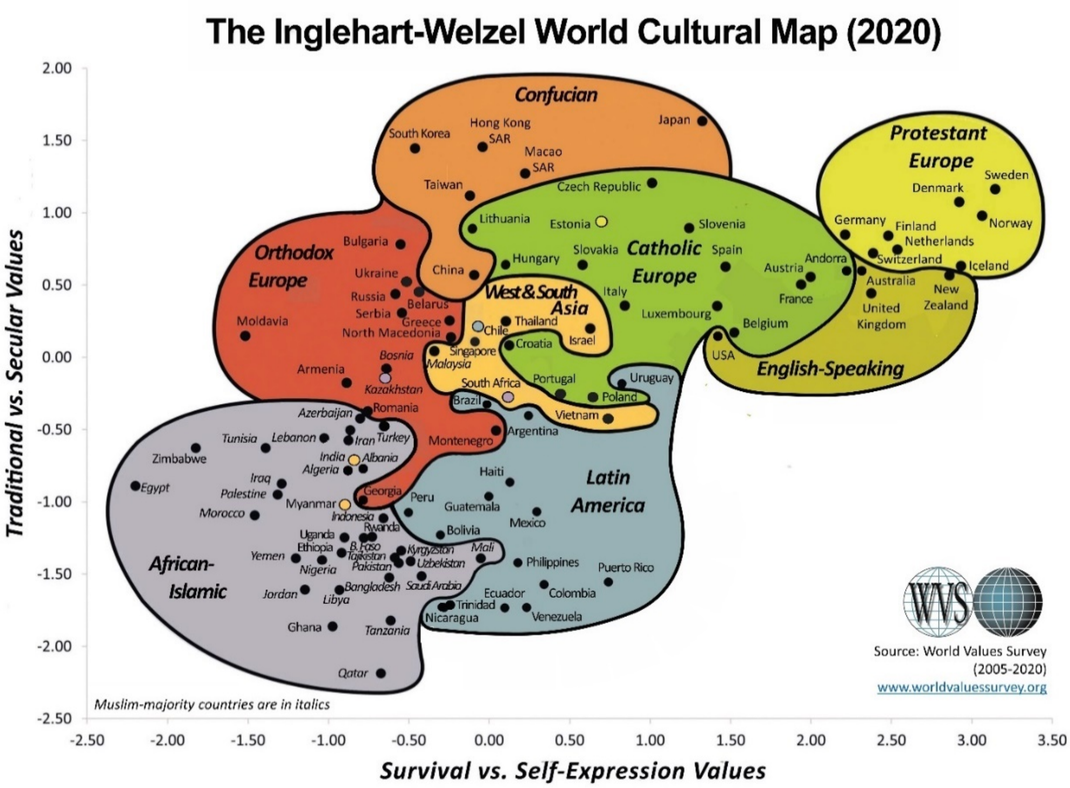


Figure 3 The Inglehart-Welzel World Cultural Map - World Values Survey 7 (2020)

[Provisional version]. Source: http://www.worldvaluessurvey.org/

The WVS has been conducted in Central Asia. As Figure 1 shows, the four countries in this study are all between -0.75 and -0.40 on the Survival vs. Self-Expression spectrum. Kyrgyzstan, Tajikistan, and Uzbekistan are very close to -1.50 on the Traditional vs. Secular spectrum, placing them solidly in the African-Islamic grouping. Kazakhstan, however, is one of the few Muslim-majority countries in the Orthodox Europe grouping, having a Traditional vs. Secular rating of -0.10 (*The Inglehart-Welzel World Cultural Map - World Values Survey 7,* 2020).

While the WVS is the greatest challenger to Hofstede's model in terms of data collection, Trompenaars and Hampden Turner are the greatest challengers in terms of vehemence. Trompenaars began examining culture from an economic point of view in the 1970s and published his first major work with Hampden-Turner in 1993 (Hampden-Turner & Trompenaars, 2020). They explained culture as multi-layered, with an "explicit culture" observable by behaviors and artifacts overlying norms and values, which surround a core of assumptions about existence. According to this model, a group's culture results from the group organizing itself to solve problems in ways that align with its underlying assumptions, norms, and values. Their statistical analysis of 15,000 workers in 50 countries resulted in identifying seven cultural dimensions that had some overlap with Hofstede's six (Figure 4). This was not taken well by Hofstede, who questioned his challengers' lack of transparency regarding survey prompts, lack of validity of specific survey prompts, operational definitions, methodology, statistical analysis, motivation, and character (Hofstede, 1996). Hofstede concluded that, rather than Trompenaars did not "ride the winds of commerce," but does,

ride messages to what he thinks the customer likes to hear…. in Trompenaars' questionnaire and book, controversial issues central to cultural conflicts, like power struggle, corruption, exploitation, aggression, anxiety, and differing concepts of masculinity and femininity, are rarely addressed. The result is a fast food approach to intercultural diversity and communication (Hofstede, 1996, p. 198).

Hampden-Turner and Trompenaars' response to Hofstede was not designed to lead to collegial collaboration: "If Hofstede 'knows' that we are in this business for the money and are ready to practice intellectual dishonesty to this end, then we leave him to this immaculate perception" (Hampden-Turner & Trompenaars, 1997, p. 159). However, in addition to being a model for academic trash-talking, their response outlined ten differences in their underlying assumptions about research and culture, which could be summarized as Hofstede's tendency toward positivism and Trompenaars' tendency toward post-positivism.

The Global Leadership and Organizational Effectiveness (GLOBE) Research Program began in the mid-1990s when 170 researchers in social science and management from 61 cultures formed a network to study the relationship between societal culture, organizational culture, and leadership. GLOBE defines culture as "shared motives, values, beliefs, identities, and interpretations or meanings of significant events that result from common experiences of members of collectives and are transmitted across age generations" (House et al., 1999, p. 13). The GLOBE approach built directly on Hofstede's work, but rearranged some conceptual categories to facilitate studies of culture related to leadership. It divided Hofstede's category of Masculinity into subcategories of Gender Egalitarianism and Assertiveness. This division allows a nuance not allowed by Hofstede's categories in that it addresses Femininity as something to be measured rather than assuming it as the absence of Masculinity (Shi & Wang, 2011). It then drew from research on national development and human motivation (McClelland, 1987; McClelland & Clelland, 1961) to form the conceptual categories Humanistic and Performance.

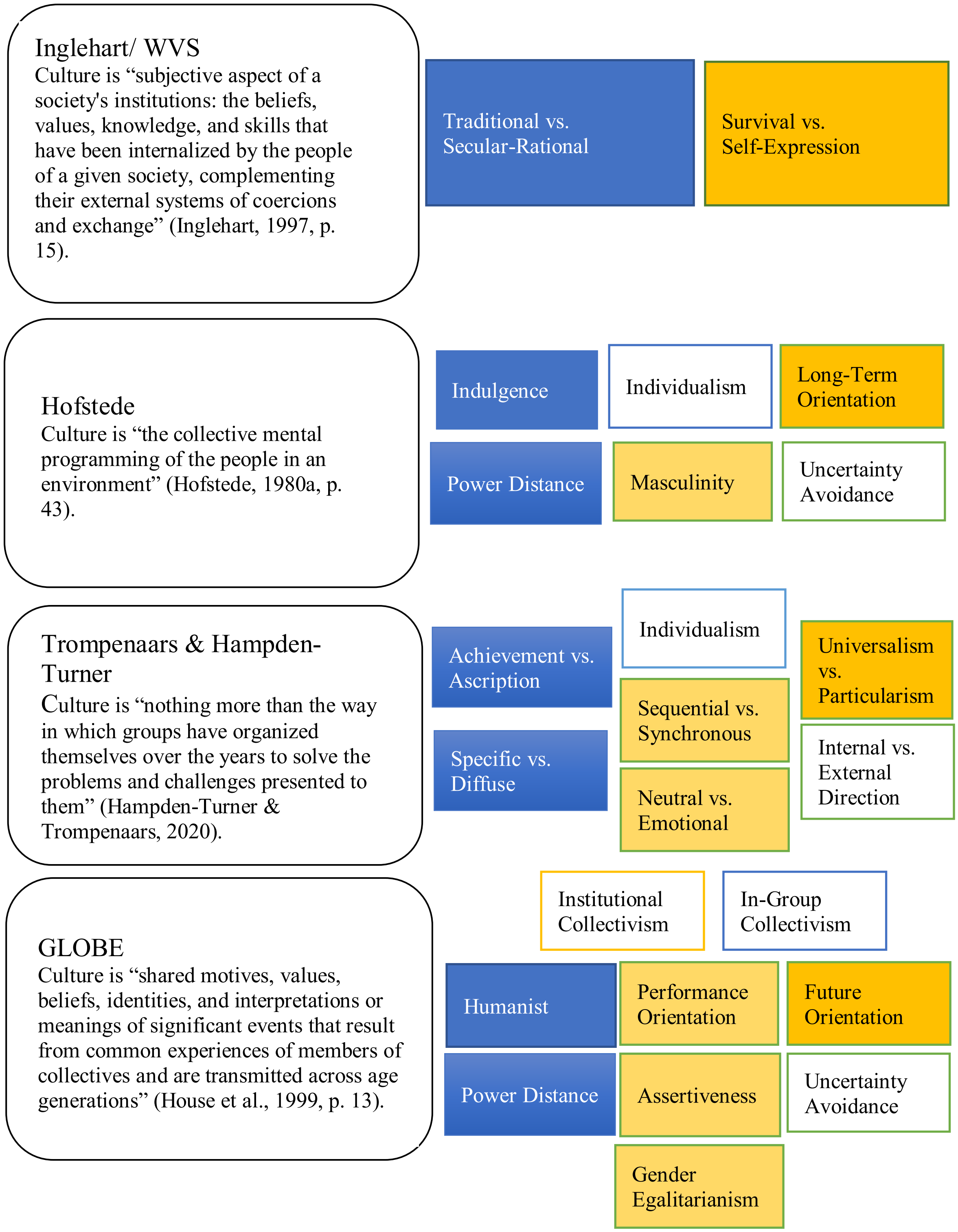


Figure 4 **Comparison of Inglehart, Hofstede, Trompenaars, and GLOBE**

Relevance of Hofstede's Cultural Dimensions to this Study.

As Figure 4 shows, there are multiple overlaps between the definitions and dimensions proposed by the Inglehart, Hofstede, Trompenaars, and GLOBE. Hofstede's studies have not been completed in the countries represented in this study, making it seem that the WVS may be more helpful for analysis. However, the WVS only allows measurement of two dimensions of culture. Moreover, it includes an implicit bias toward secularism and self-expression that would limit it as an effective tool for answering this study's research questions. Trompenaars' dimensions allow more nuance than Hofstede's, and its post-positivist assumptions align more closely with those of this paper than does Hofstede's claim of potential objectivity. However, due to Trompenaars' focus on culture in relation to organizational management, his model remains relatively untested in the developing world. The GLOBE categories closely follow Hofstede, and the nuance allowed by differentiating aspects of Masculinity would be helpful for this study. However, the GLOBE's focus on organizational leadership may yield misleading results if asked of educators whose workplace situations may have little in common with business models. In the end, though, Hofstede's model was chosen for this study for a very practical reason: Hofstede Insights has made a shortened of the values survey available for educational and research purposes. Those survey prompts were included in the pre- and post-training surveys for the training program that is the basis of this study to help promote discussion and reflection among the participants. The anonymous survey results had already been released and discussed with participants, and the data was available for analysis in this study.

The Diffusion of Innovations (DoI)

In 1962, Rogers developed the Diffusion of Innovations (DoI) theory based on research primarily with the diffusion of agricultural technology in the United States. DoI spread quickly, receiving cross-cultural support from over 1500 publication citing it by 1971 (Rogers & Shoemaker, 1971) and from more than 6,000 research studies and field tests in the next forty years (Robinson, 2009).

One reason for the quick spread of the theory is the breadth of change accounted for in Rogers' definitions. According to Rogers, "an innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2010, p. 11). This definition includes almost any noun and many verbs that provoke a sense of novelty in any number of decision makers, making it the type of universal theory that attracts challengers. Rogers said the diffusion of innovations is a process "by which an innovation is communicated through certain channels over time among the members of the social system" (Rogers, 1995, p. 250). This definition explains that DoI is a function of the innovation, communication, individuals, time, and social systems, making the theory applicable to many realms of society and academia.

Rogers proposed five attributes of innovations themselves that influence individuals' attitudes toward diffusion (Jebeile, 2003). The first is the perceived *relative advantage* of the innovation in the environment. The second is the *compatibility* of the innovation with other parts of the system. Third is the *complexity* of implementing the innovation. Fourth is the *trialability*, or the possibility of testing the innovation without making a long-term commitment or causing too much potential damage. Fifth is the *observability* of results from the innovation. A sixth attribute was added based on further cross-cultural research: the *image,* or status, that the innovation gave to its adopters (Moore & Benbasat, 1991, p. 195).

Rogers described the decision process regarding the adoption of an innovation, whether by individuals or groups, as involving five steps. First, the possible adopters needed sufficient knowledge about the innovation and its relevance to their situations to provoke interest. Second, the potential adopters needed persuasion verbally or through a demonstration to alleviate concerns about the potential costs and risks of implanting the innovation. After these two communication-focused steps, which rely heavily on the networks provided by various cultures (Rogers, 1979; Rogers & Shoemaker, 1971), the individuals or groups need to decide whether and how to implement the innovation. The process ends with confirmation from the individual or work as to the value of further implementing the innovation (Rogers, 2010).

According to the DoI , the diffusion process is predicted to usually follow a normal curve within a population, as shown in Figure 5. According to this model, the Innovators are statistical outliers in a society (2.5% of the population). About 13.5% of the population, the second standard deviation from the mean on the left, are the Early Adopters. Early Adopters are largely motivated by a desire to be "change agents" in their groups, but a "chasm" exists between their motivation and that of the Early Majority, who are more concerned with increasing productivity. If that chasm is crossed within a network, then widespread diffusion is highly likely (G. A. Moore, 2001, p. 15). The Early and Late Majority groups comprise the 68% that fall within one standard deviation of the mean. The last to adopt an innovation are the Laggards, which comprise approximately 16% of the group. The DoI predicts that all diffusion will pass through this process within a group, with the rate of change being affected primarily by the means of communication to promote knowledge and persuade as individuals make decisions, innovate, and confirm the innovation.

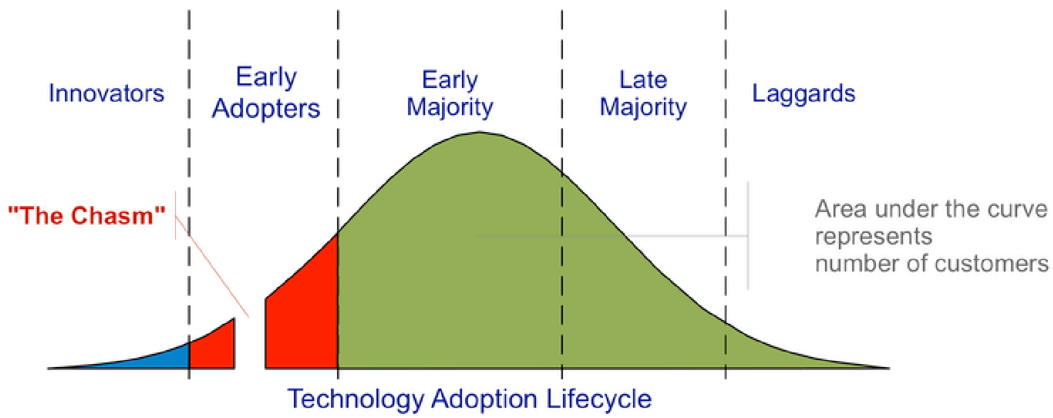


Figure 5 The Diffusion of Innovations Life Cycle (unchanged from Craig Chelius, February 10, 2009, Creative Commons Attribution 3.0 Unported License).

Criticism of the DoI

Some criticisms of the DoI particularly relevant to this study relate to its underlying assumptions of cross-cultural homogeneity. For instance, the DoI does not explicitly acknowledge that technological innovations require a level of development for infrastructure, economics, and, in cases of ICT, freedom of speech. The DoI also does not explicitly acknowledge factors of development such as standardized manufacturing and trade, investment rates, property rights protection, finances available for research and development, governmental oversight, or manufacturing capacity (Caselli & Coleman, 2001). Moreover, "the DOl tradition draws upon rational theories of organizational life adopted from economics, sociology and communication" (Lyytinen & Damsgaard, 2001, p. 174). Since the data collection for this study occurred with the onset of a pandemic, the "rational theories" normally accounting for behavior may not fully apply.

Other criticisms of the DoI are largely related to “conjectures” that are woven into the model. For instance, the DoI assumes that each innovation is a discrete item, which is not the case with an innovation such as Web 2.0. For instance, Web 2.0 includes group messaging and anonymous online forums, but there is no reason to assume that people who use one of those tools will use the other. The DoI also assumes that groups are a stable entity even though research shows that individual membership and identity are fluid (Jaber & Kennedy, 2017; Lowenthal & Dennen, 2017). The DoI assumes also that adopter’s decisions are based on information communicated about the innovation rather than more dubious motives such as the desire to gain power by currying favor or getting “gifts” (S. Venkatesh, 2009). The DoI assumes that diffusion evolves through distinct stages, ignoring the possibility of the stop-start-stop-start processes familiar to many who have been required to change LMS’s repeatedly based on institutional decisions. In short, the DoI, while eloquent, does not express the nuance of “the local complex, networked, and learning intensive features of technology” (Lyytinen & Damsgaard, 2001, p. 185).

Rogers has acknowledged many of these criticisms in his recent work by clarifying the communication model as a non-linear “special type of communication” involving messages that are “concerned with the new idea” (Rogers, 2010, p. 5-6):

> Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. This definition implies that communication is a process of convergence (or divergence) as two or more individuals exchange information in order to move toward each other (or apart) in the meanings that they give to certain events.

This leaves the summary of criticism of the theory resembling criticism of most theories in the social sciences. The DoI does not allow clear predictions or provide clear guidance on how to accelerate the process, it is not as accurate in some historical-cultural situations as in others, and increasing its accuracy could make it incomprehensibly complex, but it is probably better than competing theories (Minishi-Majanja & Kiplang'at, 2005).

Relevance of the DoI to this Study

The DoI is especially relevant for this study for several reasons. First, one of the explicit goals of the training program was that the participants would help to diffuse the pedagogical methods within their communities, so the training was designed with the DoI in mind. Second, the DoI acknowledges that the influence of cultural values on issues such as the perceived quality and usefulness of an innovation, and it acknowledges the influence of culture on communication about an innovation (Jebeile, 2003). Third, many studies and some meta-studies have been conducted on the relation of DoI to Hofstede's cultural dimensions. They have found a tendency toward faster diffusion once "the Chasm" has been crossed when cultures have low Individualism and low Uncertainty Avoidance (Chandrasekaran & Tellis, 2008; Dwyer et al., 2005; Flight et al., 2011; Hausman & Kalliny, 2007; Perez-Alvarez, 2009; Singelis et al., 1995; Steenkamp et al., 1999). Finally, since "diffusion is a kind of social change" that affects "the structure and function of a social system" (Rogers, 2010, p. 6), it is directly related to the issues of cultural values and educational systems addressed in this study.

The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) attempts to explain the formation of attitudes toward technological innovations in the communication and decision process of DoI. Davis developed the model as his doctoral dissertation in Management, based on a survey of 100 computer system users and an experiment involving 40 MBA students (Davis, 1985). His hope was that identifying the key factors in motivation to use technologies speed the process of diffusion by allowing “practitioners to gather information regarding the comparative acceptability of various alternative systems much earlier in the development process, without the disruptive process of test-bed implementation” (Davis, 1985, p. 12). Despite the relatively small data source for the original study, the model found widespread acceptance largely due to the simplicity and face validity of its basic principles: users’ attitudes toward and intent to use technologies are influenced by the extent to which they perceive the technologies as useful. These categories of Perceived Usefulness and Perceived Ease of Use are known by the unfortunate acronyms PU and PEOU. PU refers to "the degree to which an individual believes that using a particular system would enhance his or her job performance." PEOU refers to "the degree to which an individual believes that using a particular system would be free of physical and mental effort” (Davis, 1985, p. 26). Initial follow-up studies found that, while PEOU has strong correlation with user attitudes ($r = .45$ and $r = .51$), PU is a much stronger indicator ($r = .62$ and $r = .85$) (Davis, 1989, p. 319). With the development of standardized surveys to measure TAM categories (Lederer et al., 2000; G. C. Moore & Benbasat, 1991), research using the model expanded quickly, resulting in over 126,000 references on Google Scholar in May 2021.

The TAM has been expanded several times due to further research on the factors that influence user perceptions. Davis' original proposal depicted perceptions largely as the result of individual beliefs (V. Venkatesh, 1999, p. 245). Further research has identified the importance of personal experience and intrinsic motivation (V. Venkatesh, 1999), subjective norms, voluntariness of use, the image potential adopters feel the innovation will convey of themselves, job relevance, output quality, and result demonstrability (V. Venkatesh & Davis, 2000). This resulted in the TAM 2. Further researchers attempted to combine the TAM 2 with other models of technology acceptance, resulting in the Unified Theory of Acceptance and Use of Technology (UTAUT), which accounted for 70% of user variance on the basis of eight factors in initials studies (V. Venkatesh et al., 2003). The UTAUT, however, was not found to be as helpful as desired in providing direction on how to improve the PU and PEOU. The TAM 3 was developed to guide managers and others responsible for implementing the use of new technologies. In addition to the UTAUT categories, the TAM 3 indicated self-efficacy, perception of external control, anxiety, playfulness, perceived enjoyment, and objective usability as key factors influencing individuals' PU and PEOU toward specific technologies. The resulting web-like model includes 17 variables of varying influence, most of which influence at least two other variables.

Criticism of the TAM.

Despite the apparent common-sense appeal of the original TAM, there has been criticism of its value. First, the definitions of usefulness and ease of use are not necessarily discrete. For instance, it is possible that users may not see a technology as useful because understanding what it can do requires a high degree of mental effort (low

PEOU → low PU). This may lead to a conflation of the categories, especially in open-ended responses to questions. Second, the TAM assumes that people know their real reasons for attitudes toward technologies. The TAM 2, TAM 3, and UTAUT have attempted to identify underlying factors influencing attitudes, but they have not addressed issues related to possibly unarticulated or unacknowledged cultural values. For example, a quantitative study of TAM in perceptions of elearning in Kazakhstan led to the conclusion that researchers should use the TAM "cautiously" in cultures that value high Power Distance, Collectivism, and Masculinity (Hetrick, 2019, p. 129). This recommendation is echoed in research on TAM in other non-Western contexts (El-Masri & Tarhini, 2017; Faqih & Jaradat, 2015; Sunny et al., 2019; Tarhini et al., 2017).

Relevance of the TAM to this Study.

The TAM is relevant to this study despite concerns of its appropriateness in some cultures because this study involves a course that trained participants to accept and diffuse specific ODL technologies. Since this study involves only data collected during normal activities in the course, and those activities did not involve replying to TAM surveys, the analysis of PU and PEOU will consist only of coding participants' responses in discussion forums and final reports. While no contradictions of the TAM are expected, any such patterns would require explanation.

General System Theory (GST)

General System Theory (GST) is why this study does not attempt to establish a causal relation between Web 2.0 educational technologies and cultural values. GST aligns closely with the social-constructivist worldview for this study. In fact, some scholars describe GST as a *Weltanschauung,* a worldview or philosophy of life that is larger than a theory (Ruben & Kim, 1975). GST originated in the 1940s, as biologists von Bertalanffy and Ashby independently developed responses to the reductionist causal tendencies of logical positivism in science (Westbrook, 2006). Whereas the classical scientific method described a standardized process for observation, hypothesis formation, testing, and conclusion (Hempel & Hempel, 1966), von Bertalanffy and Ashby noticed that this process did not accurately describe the practice of scientific research, which often involved politically-nuanced collaboration and social barriers compounded with moments of insight and paradigm shifts (Kuhn, 1962). Moreover, based on work with human biology (Von Bertalanffy, 1968) and cybernetics (Ashby, 1961), they observed that complex systems involve constant communication and change between members to maintain homeostasis as well as the variability required for propagating the system (Ashby, 1991). Therefore, whereas the goal of classical physics was "eventually to resolve natural phenomena into a play of elementary units governed by 'blind' laws of nature (Von Bertalanffy, 1968, p. 30), there was a need for a General System Theory that would allow the study of complex "wholeness". Such a system would build on existing research on systems, integrate methods for natural and social sciences, unite scientific knowledge in various disciplines under specific principles, and advance integration in scientific education. GST defines systems as "sets of elements standing in interaction" (Von Bertalanffy,1968, p. 38), regardless of the complexity of the various elements. Von Bertalanffy admits that there is no general agreement on the definition of all that "systems theories" encompass, he asserts that this is "not an embarrassment or the result of confusion, but rather a healthy development" indicating "presumably necessary and complementary aspects of the problem" (Von Bertalanffy, 1972, p. 415). Research in

GST is characterized by an awareness of the dynamic interplay between individual elements and the whole, the need for interdisciplinary perspectives, constant feedback loops within the system, circular causality, and the potential of a change to any variable to have unanticipated consequences at other levels of the system (Boulding, 1956; Montuori, 2008).

Criticism of GST.

The main criticisms of GST has been admitted by GST proponents since its inception. A systemic focus can distract from the rigor required to study particulars, allow the investigation of particulars to be clouded by concerns of those with power in the system, and remove the sense of "objectiveness" of science (Montuori, 2008; Von Bertalanffy, 1950, 1951, 1972; Westbrook, 2006).

Relevance of GST to this Study.

GST is foundational to this study because the purpose of the study is to examine the relationship between the behavior of elements of a system (the participants) in relation to their expressed beliefs and communication within the closed system of the class and the open system of their wider societies. The central problem of this study is to help decision-makers at all levels of educational systems understand the possible systemic effects of attempting to diffuse Web 2.0 educational technologies. These issues align well with GST, which has been influential in many other studies on education and educational technologies (Burden & Gillham, 2018; Chen & Stroup, 1993; Lowe & Tinker, 1976; Mania-Singer, 2017; Taysum, 2017)

What is the History of Distance Education in the Developing World?

Many countries in the developing world adopted various forms of educational technology in ways that or to extents not found in highly developed countries with longstanding and powerful educational systems. This section summarizes some of the ways in which developing countries have implemented educational technology, highlighting the potentially unintended consequences of quickly implementing innovations endorsed by foreign sponsors.

What is the Developing World?

Economic development is, "the process whereby simple, low-income national economies are transformed into modern industrial economies" (Kreuger & Myint, 1998). National economies are usually measured in terms of gross domestic product (GDP) and its corollary, Gross National Income (GNI). These descriptors are relatively simple to compute and can be standardized to allow easy comparisons between countries, so they are often used as a short-hand by national development organizations ("Developed and Developing Countries," 2018; World Bank Data Team, 2019). However, even introductory economics and human geography textbooks acknowledge that these calculations are often unhelpful in determining a population's capacity for growth and development (Fouberg et al., 2012; McConnell et al., 2017). In fact, narrowing the definition of development to economic terms has resulted in dubious claims that plagues and wars caused development because GDP per capita increased, when the change resulted from a decrease in population, not an increase in production (Roskin, 2012).

Other macro-level indices of a population's development are available. For instance, the United Nations' Human Development Index (HDI) includes life expectancy, expected and mean years of education, and purchasing power parity in its ranking of countries (UNDP, 2019). The Multidimensional Poverty Index (MPI) goes into even more detail, adding nutrition, sanitation, electricity, housing, and assets to its index (Human Development Report Office, 2019). These indices are more difficult to measure than GDP because they attempt to assess what humans can *be* or *do* rather than what they produce (HDRO Outreach, 2015), but they are more useful from a development perspective because they indicate areas for potential improvement.

Despite the misguided notion of measuring educational opportunities only in terms of years of physical school, the HDI has been effective in moving education to the forefront of international development discussions. The United Nations' Millennium Development Goals list universal primary education as one of the top objectives and includes education as secondary components of goals such as gender equality and environmental sustainability (*United Nations Millennium Development Goals*, 2015). Likewise, the UN includes "quality education" as one of the seventeen Sustainable Development Goals and includes it as a subpoint of the other goals (*Sustainable Development Goals*, 2020). In these discussions of development plans, the UN usually refers to HDI (*2019 Human Development Index Ranking*, 2019), which ranks countries on a scale from 0 to 1.0. Although there are many ways to divide the countries on the list, each with its own political nuances, this study uses the term *developing countries* to refer to any of the 67 countries that, in 2020, had an HDI below 0.70 (United Nations, 2020).

This study assumes that the Human Development Index (HDI), while incomplete, indicates commonalities of scarcity that result in countries having similar obstacles to growth. This does not imply that unique aspects of geography, history, or culture are irrelevant to the adoption of technologies or methods. However, the ubiquitous adoption of information and communication technology (ICT) in nearly every country that does not ban the technology indicates that most cultures find the technology attractive (Kozma & Surya Vota, 2014; Latif et al., 2017; Lechman, 2014).

Some may argue that focusing on educational development, especially when related to technology, is misguided, noting that "it is hard to imagine that these technologies can have a positive influence on the education of children and adults who lack basic living resources and live with an underdeveloped educational infrastructure in an environment of political instability" (Gulati, 2008, p. 1). To some extent, this is true: starving children need food more than smartphones. Also, once basic needs for food and shelter are met, there is still a large infrastructure gap before meaningful discussion of Web 2.0 ODL can begin. Currently, less than 2% of the populations of Burundi, Ethiopia, Guinea, and Niger use the Internet, and, in 2014, broadband Internet cost more than $400 per month in 14 sub-Saharan countries (Sanchez-Gordon & Luján-Mora, 2014). That same year, only 887 of Tanzania's 4,367 schools had computers, over 10% of the computers did not work, and 45% were limited to administrative use (Ndibalema, 2014). Indeed, cost and Internet access are major barriers to ODL in many developing countries (DeYoung, 2010; Muhametjanova & Çağiltay, 2012; Ohanu & Chukwuone, 2018; Smyth, 2011). However, on a systemic level, education allows people access to the resources necessary to maintain their lives, livelihoods, and cultures in a changing world, making ongoing education essential for sustainability (Bukola, 2011), and new technologies open untested means of overcoming old barriers to education.

Pre-Web 2.0 Educational Technology in the Developing World

Developing countries and countries with large populations marginalized from traditional educational systems have a history of positive results from investment in technology for distance education (Crooks, 1983). For example, the USSR began state-sponsored correspondence schools in 1922 and expanded the program by 1929 to a formalized combination of individual study assessed through mail and periodic face-to-face meetings (Zawacki-Richter & Qayyum, 2019). By the 1930s, postal-service based correspondence schools had also spread around Africa (Perkins et al., 2003). Breakthroughs with radio technology in the 1930s lead to educational programs worldwide, followed by similar expansions and adoption of television, overhead-projector, and reel-to-reel recordings in the 1950s, cassette-recorded education in the 1960s and 1970s, VHS recordings in the 1980s, and CDs in the 1990s (Molenda, 2008). These were often directed and funded by the US and USSR to educate potential Cold War allies. However, some national governments also developed their own programs such as the University of South Africa's (UNISA) distance education in 1946, Mexico's "Telescundaria" educational television program in 1968, and the multi-national distance-learning University of the West Indies in 1973 (Gulati, 2008). These distance education programs were often seen as insufficient or, at most, "second best" in relation to traditional educational systems (Gulati, 2008), but, in the context of the scarcity in the developing world, "second best" may be good.

The delay between the development of educational technologies in developed countries and the implementation of these technologies in the developing world increased with the advent of complex and costly innovations like computers. Computers were widely implemented in many developed countries in the 1970s (Molenda, 2008), but the cost of purchasing them, providing infrastructure, maintaining them, training teachers, creating relevant content, and using English-based software all combined to slow their diffusion in developing countries (Kozma & Surya Vota, 2014; Perkins, 2008). However, this lack of ability to implement the technology did not stop leaders in the developing world from making plans to implement it. In fact, at the early stages of the Web 2.0 era, 48 of 53 African countries and most Middle Eastern countries already had long-term plans for developing ICT in education (Kozma & Surya Vota, 2014; Weber & Hamlaoui, 2018). Therefore, many developing countries were primed for action when Negroponte (2006) made the audacious, visionary call to provide "one laptop per child" (OLPC) as a means of opening new opportunities for ODL.

The OLPC project envisioned massive funding to design and distribute laptop computers that enclosed a wide variety of open-source, education-focused software in a hefty, climate-resistant shell. The laptops carried their own electrical infrastructure via batteries that could be recharged by solar power or a hand crank (Kraemer et al., 2009). However, the OLPC's call for 150 million $100 computers by 2007 resulted in only a few hundred thousand $200 computers by 2009 (Colombant, 2011; Cristia et al., 2012). OLPC progress over the next several years showed repeated shortcomings due to lack of infrastructure, lack of trained staff, lack of upper-level support, lack of relevance of the project, and the typical list of obstacles to development noted by nearly every diffusion of innovations in the developing world (Kraemer et al., 2009; B. L. Myers, 1999; Rogers & Ellsworth, 1997; Schein, 2011). Perhaps most surprising to the project's early supporters was the realization that children in the developing world "want the same laptop you [people in developed countries] get, not some gizmo that has a special power source and looks like a shoebox" (Colombant, 2011, p. 1). Likewise, donated library and school computers often took up valuable classroom space but sat unused due to lack of software, networking, technical support, or electricity and heat in the building (Bekbalaeva, 2017; Caselli & Coleman, 2001; Walton et al., 2012).

The Web 1.0 era provided people in the developing world with unprecedented access to information, but that information accessible only through technology that was expensive to maintain and access. Moreover, the content was often irrelevant to the lives of local populations (Perkins et al., 2003). On the rare occasion when large-scale studies examined student outcomes through the new media, countries across Latin America, Africa, and Asia again said there was no significant difference (Kozma & Surya Vota, 2014). All of this leads back to the conclusion that "diffusing a new innovation requires understanding the local environment" (Kraemer et al., 2009, p. 71).

How has ODL Spread in the Developing World since 2009?

Web 2.0, a term popularized by O'Reilly and Dougherty in 2004 (O'Reilly, 2010), brought fundamental changes occurring in the formation of online information. Whereas Web 1.0 focused largely on making digital versions of material that could be produced in other media, Web 2.0 technology allowed types of media and discourse that had no clear non-digital counterparts. Wikis, for instance, allow users to contribute to explanation of content and ideas in ways that have no direct analogy with dictionaries or encyclopedias. Twitter and blogs compete with traditional news sources by blurring the lines between journalism, conversation, therapy, and rallying (Dixon, 2012; Kamalipour & Friedrichsen, 2017). This type of interaction also blurs the line between expert and audience, allowing each webpage to be a "latent community" that gains influence through interaction (O'Reilly, 2010, p. 247).

Scholars worldwide quickly began to see the implications of Web 2.0 for education. From the triangulation necessary for academic publishing to the creation of elementary-school science content, the possibilities of online communication and collaboration in creating information allowed ODL to implement creative, collaborative methods. While, in theory, teachers could use email to assign a problem to remote learners, who could communicate through email to solve the problem, create a final document, and send it back for evaluation, technologies like Google Docs allow collaboration in real time. This nearly instant feedback led to the growth of social media sites, wikis, YouTube, and similar sites with user-created and moderated content (Gyamfi, 2017; O'Reilly, 2010). In 2008, the term MOOC was coined for the Massive Open Online Courses that had emerged as universities made their course syllabi and videos available online to students who could discuss the content with each other and tutors through Web 2.0 forums (Daniel, 2016). This was followed in 2013 with open educational resources (OER), which allowed teachers to create and share original content based on open-source material (Weller, 2018). 2009 also saw the first release of open badges, which allow validation of the digital artifacts that result from Web 2.0 ODL (Matkin, 2018).

The power of collaborative research and problem solving allowed by Web 2.0 ODL not only meant that students would learn more effectively, it blurred the line between learner and teacher (Davidson-Shivers et al., 2018; Pardo & Kloos, 2009). If learners construct knowledge in community, and if the learners and teachers have access to the same materials, then the role of the teacher becomes much more analogous of that of a coach or designer than to that of a library or computer server (Ertmer & Newby, 2008; Walker et al., 2015). In fact, the teacher's role in ODL may even come to resemble that of a party host educators help establish social presence for themselves and the students, assign participants to groups, and help learners communicate effectively (Trespalacios, 2017; Trespalacios & Perkins, 2016).

At this point, the implications for Web 2.0-based ODL become clearly apparent to those in the community development sphere. The work of Web 2.0 ODL teachers resembles that of community development workers: both facilitators establish groups, help the group choose goals, help with communication, and develop means for all voices to be heard (Foggin, 2005; Foggin & Torrance-Foggin, 2011). The reason for this similarity between community development focused on sustainable development and education has to do with principles underlying all aspects of personal or social change: changing the habitus. This habitus, a subjective sense of one's place and potential choices in the world, is shaped by forces as diverse as rural or urban location, geographical terrain, language, family income, and familial social position (Bourdieu & Nice, 1977). Educational development and social development both face the task of helping people recognize their habitus, analyze the factors that shaped it, and find ways to overcome the seemingly "predetermined and constrained" choices within the habitus (Hughes, 2018, p. 111). Collaborative interactions allow participants to form new solutions or knowledge within a habitus. When people in marginalized populations are allowed to collaboratively contribute toward the betterment of their community, this recognition of their knowledge and skills makes them more likely to take initiative again as agents of further personal and social transformation (Freire & Macedo, 2000; B. L. Myers, 1999). Transforming the beneficiaries of education into contributors to education allows greater self-determination, decreases marginalization, and increases the potential for personal and social improvement (Jugede, 2013; Ross et al., 2016). If collaborative problem solving is likely to increase the self-determination and initiative of people in developing countries, and if Web 2.0 tools promote collaborative problem solving, then the diffusion of Web 2.0 in ODL could benefit community-led changes in developing countries.

Methods

Systematic literature reviews are noted for their comprehensiveness, precision, and reproducibility (Okoli & Schabram, 2010; Sturm & Sunyaev, 2017). However, given the number of possible search terms included in the phrase *Web 2.0*, the number of languages spoken in the developing world, and the tendency for developing-world researchers to publish in less-frequently-cited journals, it is unlikely future researchers would be able to reproduce the exact findings of this study if it were attempted as a systematic review.

Scoping literature reviews explore “the extent, range, and nature of research activity for a topic that is complex or has not been comprehensively reviewed previously, mapping of key concepts for a research area, examination of the types of evidence available, or identification of gaps in the research literature” (Snelson & Hsu, 2019, paragraph 6). While this method certainly supports this literature review’s goals, it has some shortcomings for this study. For instance, it is common for scoping studies to have a small number of key terms that result in a large number of articles, many of which are rejected due to pre-determined, clearly-stated, and reproducible criteria (Paré & Kitsiou, 2017). However, the process can easily result in leaving too few studies for sampling a diverse population. For instance, one of the few scoping reviews of digital badge diffusion found only 41 of 1608 studies suitable for inclusion (Motheeram et al., 2018), and a systematic review of gamified learning in Asia excluded studies from all but four countries (So & Seo, 2018). Also, these methods and their results are valuable when the population being sample is assumed to be homogeneous, but these methods seem unlikely to lead to answering research questions about people living on the multilingual margins of formal educational systems.

Realist literature reviews provide an "explanatory analysis aimed at discerning what works for whom, in what circumstances, in what respects and how" (Pawson et al., 2005, p. 21). Rather than attempting to create a simple causal chain, in which an independent variable combines with a dependent variable to produce and outcome, realist reviews assume that the outcome results from interactions between variables that change based on the mechanism and context of interaction (Pawson et al., 2005; Wong et al., 2010, 2012). The literature review, therefore, becomes an iterative process of defining the purpose of the study, articulating key theories, and finding evidence. Knowing that the mechanisms and contexts of interaction between the key variables may produce different results from the same interactions, a realist review "learns from (rather than controls for) real-world phenomena such as diversity, change, idiosyncrasy, adaptation, cross-contamination and programme failure" (Pawson et al., 2005, p. 31). The result are findings that are "skewed" toward subjective and away from positivist approaches, but may nonetheless give readers the background necessary to evaluate new research and inform policy-making (Paré & Kitsiou, 2017). This approach is also consistent with the nature of research questions addressing education reform as a process in which "a number of interrelated parts, processes, policies, and personnel are attached to the effort" (Perkins, 2019, p. 32). Therefore, this literature review is more of an exploratory narrative of Web 2.0's diffusion into developing-world than a catalog of evidence of this diffusion.

This review limited the search to Google Scholar between the years 2009 and 2019. Searches included the following key terms and locations, alone and in combination: *Web 2.0, online distance learning, problem-based learning, assessment, developing world, Latin America, Africa, Asia, South Asia,* and *Central Asia.*

English was the primary search language, but searches also included Russian, French, and Spanish. The initial review of the articles focused on the key words used in the searches, but it quickly broke from a priori categories based on the prevalence of key themes emerging in the literature (Miles et al., 2019; Volkan, 2014). The research scope developed through successive iterations based on emerging themes from the research. Also, it quickly became clear that Google Scholar's algorithm did not highlight some of the most influential studies for these research questions. The research questions for this literature review focus on current practices in areas of the world that are unlikely to attract the interest of journals seeking maximum impact factor; instead, the studies included in this review tended to be written by scholars in developing world countries for their peers in the developing world. As G.K. Chesterton observed that, the phrase "experts in poverty" should not only "mean sociologists, but poor men" (Chesterton, 2020), this study took note that the experts on ODL in the developing world should not only "mean researchers, but educators in the developing world." Since educators in the developing world rarely have the resources of their developed-world colleagues in terms of access to libraries, Internet-enabled classes, or English language proficiency, it is likely that their research will not appear in highly ranked scientific journals. Therefore, this study grew by following citations from study to study. For example, Russian-language studies rarely appeared in Google Scholar. However, some English-language studies cited foreign-language studies and grey literature, and those articles cited others. This method was employed consistently and may give insight into aspects of the emerging developing-world system of Web 2.0 diffusion. It is hoped that, whereas a systematic or scoping review would yield an understanding of a region analogous to that resulting from a satellite photograph, this realistic approach yields an understanding analogous to that resulting from reading the journals and sketches of someone who traveled the land.

The results of this travel through the literature originally included 866 studies, which were the culled according to the following criteria. First, duplicates with different titles – a frequent problem with studies not originally published in English or published in different regional journals—were removed. Then, studies focusing on non-Internet-based ICT were excluded. Third, studies focusing on blended learning or technology-enhanced learning rather than ODL were removed. Fourth, studies were excluded for having faulty statistical analysis (e.g. a population too small for the statistical tests chosen), clear conflicts of interest, or English language use that caused communication breakdown. Fifth, many studies were removed because, although they referred to themselves as studies of developing countries, they actually focused on countries such as Singapore, South Korea, Russia, the United Arab Emirates, Saudi Arabia, and Turkey, all of which have an HDI over 0.70 (United Nations, 2020). Finally, one country with an HDI below 0.70 was excluded: South Africa. South Africa's HDI of 0.699 barely meets the numeric criteria for inclusion. However, the University of South Africa (UNISA) has had nearly one million graduates from ODL programs since 2010, with 350,000 currently enrolled (*Education Statistics*, 2020). UNISA is an influential ODL innovator on a global scale, so research primarily focusing on UNISA was excluded from this study because it is clearly not representative of the developing world. This selection process resulted in 188 studies focusing primarily on the geographic regions of sub-Saharan Africa, Southeast Asia, the West Indies, and Central Asia.

These studies were then coded to indicate the type of study. A priori study-type codes included *theoretical, comparative, report, history, literature review, qualitative, quantitative,* and *mixed-method.* During the coding process, the a priori codes were adjusted repeatedly to clarify the patterns emerging in the literature. The final codes for type of study include *quantitative, qualitative, mixed methods, experiment, literature review,* and *overview.* In addition to codes for type of study, a code emerged based on the type of Web 2.0 activity discussed. The list of emergent codes began with no a priori terms, it but grew and was re-formed through several iterations in examining the studies (O'Neill et al., 2018), resulting in the codes *apps and methods, MOOCs, ODL, OER, quality assurance,* and *systems and culture.*

Results

The study found that Web 2.0 technologies are being implemented or considered for implementation in many areas of the developing world. However, there is relatively little research, and most of the research focuses on describing educational systems or historical developments. The educational technologies of most interest fell into the following categories: *apps and methods, ODL, MOOCs, OER, quality assurance*, and *systemic or cultural issues*. While studies were generally positive about the potential of ODL, there is ample evidence of concern about the ways educational technology could negatively impact local societies.

Types of Studies.

Most of the studies in this review were based on analysis and theory, not on qualitative research, quantitative research, or experimentation (Table 4). 105 (59%) of the 188 studies were theoretical, historical, critical, or explanatory. An additional 15 (8%) were literature reviews, leaving less than one third contributing new evidence to the topic of ODL in the developing world.

Table 4 Topics and Types of Studies

Types of Studies								
Topics	Overview	Mixed Method	Quant.	Lit. Review	Qual.	Exper.	Total	%
ODL	27	7	9	7	3	3	56	30%
System/ Culture	33	1	4	2	2	0	42	22%
Quality	26	7	1	4	0	2	40	21%
Apps/ Methods	2	10	3	6	2	2	25	13%
OER	10	2	1	0	0	1	14	7%
MOOCs	7	3	1	0	0	0	11	6%
Total	105	30	19	15	8	5	188	100%
	59%	16%	10%	8%	4%	3%		100%

The studies were overwhelmingly positive regarding the potential of Web 2.0 or specific Web 2.0 technologies being adopted beneficially on systemic levels. For example, Web 2.0 education was promoted as a means for systemic reform in reaching UNESCO's Quality Education Goals (Tovar et al., 2019), expanding democracy and effective citizenship (Simsek & Simsek, 2013), attaining sustainable development (Kanwar, 2018), and even for making literacy no longer "a pre-condition of learning" (Kanwar, 2018, p. 46).

Despite the general optimism about Web 2.0 for education, many studies spoke cautiously about the infrastructure and systemic barriers to be faced. Some were openly skeptical, referring to Web 2.0 as "the latest hyped tool" (Gouseti, 2010) or possibly just a "fad" (Guilbaud et al., 2016). Even the more positive analyses tended to admit that "many of these providers in developing nations have yet to prove their quality, relevance, integrity, and value to employers" (Pfeffermann, 2013, p. 31).

The remaining 62 studies were divided between qualitative (4% of the total studies), quantitative (10%), mixed method (16%), and experimental or quasi-experimental (5%). All qualitative and mixed-methods studies were participant-observations or interviews.

Most of the quantitative studies and quantitative components of mixed-methods studies were surveys to establish access and usage of the Internet, computers, mobile devices, or specific technologies. Survey samples ranged from 30 to over 9,000 (Maity, 2014). In addition to establishing access and usage, many studies assessed the attitude of populations toward Web 2.0 technologies or educational methods, often using the TAM

(Akgül, 2019; Gyamfi, 2017; Maity, 2014; Mazman Akar, 2019; Ndibalema, 2014; Olesova et al., 2011; Ratna & Mehra, 2015; Tarhini et al., 2017).

Apps and Methods.

Twenty-five (13%) of the studies examined specific apps or methods. These studies tended to use participant-observer. mixed-method, case studies. The specific apps and methods that appeared in this review included the following:

1. Translation apps for language classes (Alexeevna, 2017; Osipov et al., 2015)
2. Webcams for distance tutoring and small-group work (Kozar, 2016);
3. Social media (Facebook, Instagram, and Twitter) for educational purposes (Aleem Ahmed, 2011; Muhametjanova & Ismailova, 2019; Pimmer et al., 2012; Shadiev et al., 2018; Sobaih et al., 2016, p. 2013);
4. Facebook as an LMS (Q. Wang et al., 2012);
5. Quizlet, a social digital flashcard app (K. Ismailova et al., 2017);
6. OER math sites (Cuesta Bueno & Moreira Cedeño, 2019; Kim et al., 2012);
7. One-to-one computing (Islam & Grönlund, 2016).

The apps in these studies received generally positive reviews and calls for more research. However, the Webcam and one-to-one computing studies reported a wide range of student and teacher satisfaction. A similar disparity appeared in the research on flipped classrooms, which reported varying success related to student attitudes and motivation (Martín R. & Tourón, 2017; Velasco, Feito-Ruiz, et al., 2017; Velasco, Ruiz, et al., 2017).

The gamification research (3% of the total studies) focused on increasing student motivation (Alsawaier, 2018; Hew et al., 2016; Purwandari et al., 2019). It also included two systematic literature reviews of gamification studies (Andreu, 2020) that indicated positive results about the effects of gamified learning but, unfortunately, were conducted "mainly in a small number of developed countries" (So & Seo, 2018, p. 406).

Online Distance Learning (ODL).

The largest category of interest and concern from educators in this review was related to the implementation of ODL. This included concerns about systemic change, teacher preparation, concerns about ODL, and large-scale plans to implement ODL.

Fifty-six (30%) of the studies included overviews of ODL, examinations of the systemic change possible because of ODL, and discussions of ways to prepare teachers for ODL environments. Studies from many areas of the world documented the massive growth in Internet access and e-learning. For example, as early as 2009, for-profit e-learning was making an impact on educational institutions and national economies in Asia (Jung, 2009), and mobile learning in Malaysia grew 57.5% per year from 2008-2013 (R. K. Ellis, 2013). This early growth was met with some hesitation by those who noted a lack of evidence that increased access to Web 2.0 learning resulted in "new learning," and technical and infrastructure problems were likely to stymie further progress (Valk et al., 2010). However, infrastructure globally increased faster than anticipated, and by 2019, nearly 84% of people in developed countries and 41% of people in developing countries were using the Internet (Qayyum & Zawacki-Richter, 2019). While this growth of global Internet use does not lead to the conclusion that all portions of a specific society have equal access to the Internet, it has caused educational leaders in some countries to see this a cause for systemic change (Naidu, 2014; Ramani, 2015). In fact, in 2014, educational leaders in Nigeria "forecast that by 2025, the typical student...will depend on his mobile phone or tablet PC for his/her lectures, reading materials and examinations (Botha et al., 2014, p. 9).

The literature also indicated a growing need to prepare teachers to use Web 2.0 effectively in ODL. Studies called for basic reminders of pedagogical principles, such as training in social presence (D'Agustino, 2016), applying Bloom's taxonomy in online contexts (Didenko et al., 2016), or classroom management with Wi-Fi or Bring-Your-Own-Device (BYOD) policies (Kong et al., 2014). Other studies reported practical examples of PBL applications in ODL contexts. These ranged from the "Pink Phone Revolution," in which Cambodian women used mobile phones to increase marketplace safety (Wagner et al., 2014), to projects for civics and medical education in remote areas of Pakistan (Akgül, 2019; Latif et al., 2017). Others chose to address the issue from a larger perspective, calling for a renewed emphasis on constructivist methodologies at all levels of teacher-education (Fields, 2015; Kerkhoff, 2017). This would facilitate the diffusion of Web 2.0 ODL because, as González Hernández observed, in Web 2.0 ODL,

> the teacher becomes a designer of new learning environments, a generator and evaluator of useful resources for self-learning and educational techniques, a transmitter of technical knowledge and a promoter of the development of professional skills, while continuing to be a counselor, tutor, motivator, and at the same time, a co-learner of their profession and a companion in the training process (2017, p. 13).

The literature also shows that some in the developing world approach ODL with caution. There are serious complaints about its apparently ad hoc implementation without a strong research base, struggles with computer and LMS technology, and, in some cases, over 40% of students saying that ODL assessment is inaccurate (Narakun Kyzy et al., 2017, 2018). In addition, there is concern that the foreign governments and non-government organizations funding innovative education could build "competing, multi-million dollar cultural empires around educational centres" (Amsler, 2009, p. 1193), exploiting marginalized populations through "a proliferation of institutions that can call themselves universities or institutes" (DeYoung, 2010, p. 426).

There are a rising number of large-scale attempts to implement ODL. Kenya has begun piloting ODL mobile courses with credentials verified by digital badges with a vision of a completely cloud-based mobile university (Jobe, 2013, 2014; Jobe & Hannson, 2013). Bangladesh's Open University now has over 300,000 students, and its mobile virtual classrooms have limited Internet access but are still beginning to implement "low-cost, large-scale interactive learning environment using video, mobile phones, [and] SMS-based tools" (Gronlund & Islam, 2010, p. 244). As of 2016, 79% of Kyrgyzstan's population had access to the Internet, with 30% identified as regular Internet users. Moreover, this country of 5.6 million people had 7.5 million mobile phone connections with almost six million wireless connections (*Kyrgyzstan: The 2016 ICT Sector Overview*, 2017). Also, in April 2019, UNICEF announced plans to use Blockchain technology to provide the Internet to 86% of Kyrgyzstan's schools by 2020 (Cook, 2019; Levina, 2019). Although the educational sector in many countries is still struggling to embrace this technology (Muhametjanova & Cagiltay, 2016;

Muhametjanova & Ismailova, 2019), it is clearly a disruptive innovation with the potential to effect systemic change (Botha et al., 2014, p. 201; Bower & Christensen, 1995; Jugede, 2013).

MOOCs

Massive Open Online Courses (MOOCs) had been developing for several years before the term was coined in 2008. By 2014, over 4,000 universities worldwide offered these online courses that use asynchronous online environments for content delivery, group discussions, research, and assessment for large groups of students (Daniel, 2016).

While the literature was generally positive regarding the long-term potential of MOOCs (Godwin-Jones, 2014; Jobe & Hansson, 2014; Moreno Izquierdo et al., 2016), there are concerns with adopting them in developing-world contexts. For example, there is a growing awareness of the high cost of creating and maintaining high-quality MOOCS, especially in countries where local labor is much cheaper than imported technology (Mulligan, 2016). In addition, since MOOCs are primarily a product of highly developed countries, their implementation could further marginalize the developing-country decision-makers by taking away their authority over the content and delivery of educational content (K. Zhang et al., 2019). Finally, there is a growing disillusionment at the diffusion of MOOCs in developing countries since 80% or more of MOOC students in many countries come from the wealthiest 5-10% of the population (Sanchez-Gordon & Luján-Mora, 2014).

Open Educational Resources (OER)

While this review shows a potentially growing disillusionment with MOOCs in the developing world, it also shows a growing fascination with all forms of Open

Education. The term *open educational resources* was adopted by UNESCO in 2002, during the days of Web 1.0 (Friesen, 2009). However, OER began rapid growth in 2007 following the "perfect storm". in which the world financial crisis forced higher education institutions (HEIs) to reduce costs while IT breakthroughs made it easier to distribute and store digital content (Burnett et al., 2009). Public and private institutions began developing, distributing, and adapting content while adjusting their financial models to attract a diverse multinational body of users and contributors (Farrow et al., 2016; Kanwar, 2018; Phelan, 2012).

However, although the studies were positive regarding OER in general, many were wary. For instance, OERs share the MOOC potential of contributing to latent imperialism. After all, "just as national or provincial ministries of education and institutional agencies might be prescribing what counts as valuable knowledge, appropriate skills and desirable dispositions, so, perhaps unwittingly, do creators of OER" (Hodgkinson-Williams & Trotter, 2018, p. 208). Also, even something as seemingly innocuous as the use of English for site content can unintentionally exacerbate the digital divide. After all, as of 2014, although only 4.8% of the world's population were native English speakers, 55.7% of websites were in English. 17% of the world's population are native Chinese speakers who could access only 2.9% of the websites in their native language. 3.7% of the world's population were native Hindi speakers who could only access 0.1% of the sites in their native language (Surman et al., 2014). The English-dominant Internet world is at least partially responsible for unequal contribution to OER. For instance, the entire multilingual continent of Africa produced only 1% of global OER in 2013, but English-dominant South Africa produced 60% of that (Umar, 2013). Finally, irony again appears in that one of the shortcomings OER, this great potential gift toward sustainability, is its own sustainability. Most OER development was funded by large grants, and dependence on grant funding is not sustainable (Friesen, 2009). Ultimately, OER's sustainability depends on its capacity to serve a global market for self-directed, informal, personalized learning recognized by institutions and employers.

The literature in this review provides ample evidence that OER is growing in many parts of the world, especially in relation to libraries or other forms of ODL (Baro et al., 2014; Bekbalaeva, 2017; Ebrahimzadeh Pirshahid et al., 2016; Nye, 2015; Xu et al., 2014; Yakovleva & Kudashov, 2019). However, it should be noted that the benefits of this potentially limitless resource are again influenced by the digital divide because, in many cases, "insufficient, unreliable, and costly bandwidth makes a mockery of the notion of browsing the Internet for content and research" (Ngugi, 2011, p. 208).

Quality Assurance

While the idea of unlimited, sustainable educational opportunities offered by OER is tantalizing, it leads to one of the largest areas of concern, discussion, and investigation in the literature sampled for this study: quality assurance. Forty (21%) of the studies in this review dealt with questions of how to accurately assess and validate ODL, especially in Web 2.0 contexts. The immediate reaction in many countries has been to place ODL under traditional governmental supervision. This has led to some governments actively seeking ways to discourage distance learning. For instance, in 2012, Kyrgyzstan "stopped enrollment into correspondence-type online and offline distance learning programs, where 43% of higher education students were enrolled at that time" (Asia Development

Bank, 2015, p. 5). Other governments around Asia, primarily in highly developed countries, established special oversight offices under the direction of national government or international partnerships (Jung et al., 2011). Worldwide, there are voices calling for national and international standards to be clarified and enforced (Lockee et al., 2011). However, it seems unlikely that national or international bodies will be able to respond quickly enough to the rapid changes of Web 2.0 to manage its influence in education.

This gap between innovation and official recognition is especially painful for many in developing countries, which may be prone to *diploma disease,* a phenomenon which "largely occurs in those societies where resources are scarce, and where large variances exist in incomes and status" and prompts individuals to seek continual additional credentials "in a socially legitimate way to improve one's life chances" (Jonbekova, 2019, p. 5). This phenomenon makes any educational enterprise resulting in an award, certificate, or diploma seem valuable, regardless of the quality of education associated with the credential. Likewise, it tends to prompt those most marginalized from official educational systems to avoid forms of education that may not result in a credential. This has led to a growing global attraction to alternate digital credentials (ADCs), which are especially attractive to young adults and are increasingly relevant to employment opportunities in many highly developed countries (Barnum et al., 2009; Gay, 2016; Rickes, 2009).

The ADC of most interest in the developing world, according to 29 (15%) of the studies in this review, were digital badges. Digital badges are digital images encoded with data that cannot be altered once the badge is issued. This encoded data may include the name of the issuer and recipient, a description of the purpose of the badge, date of issue, date of expiration, links to a third-party verifier, and a link to a digital artifact such as a .pdf file or YouTube video. Some digital badges are proprietary, meaning that they can only be issued or displayed within a specific online ecosystem, such as badges for many online games. Others are open, meaning that they use Mozilla's opensource code, JavaScript Open Notation (JSON), and can be displayed in any digital venue chosen by the recipient. Because they can be issued for any accomplishment, by anyone, and without constraints from institutional regulation, badges have the potential of being a truly disruptive innovation for global educational systems (Guilbaud et al., 2016; Jagendorf-Sobierajsk, 2018; Jovanovic & Devedzic, 2015; Lemoine & Richardson, 2015). As Figure 6 shows, badges have increasingly interested academia since Mozilla announced plans for their launch in 2011 and released the open-source code in 2012. Since 2015, the concept of badging in education has become so closely associated with open badges that articles increasingly omit the word "open" from the keywords.

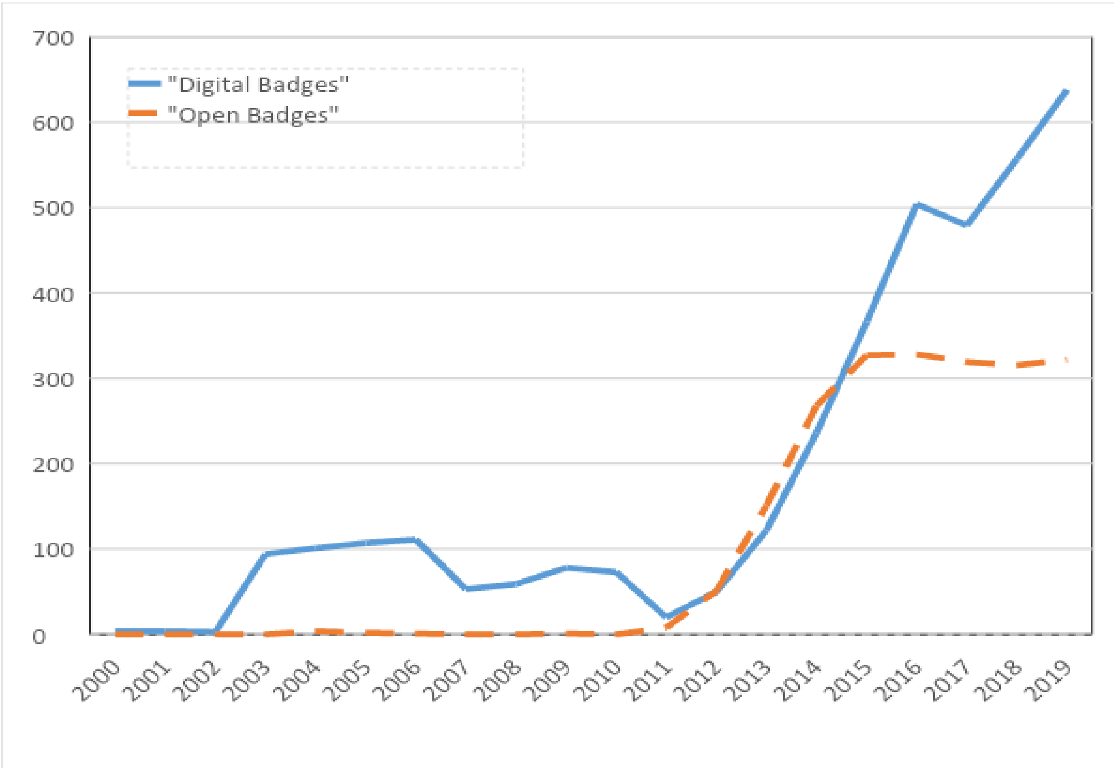


Figure 6 Google Scholar Studies on "Digital Badges" and "Open Badges."

The studies in this review indicate that developing-world academia's primary interest in badges so far has come from the desire to understand what badges are (Lemoine et al., 2018), the desire to know how to use badges (Motheeram et al., 2018), and the desire to anticipate how badges could impact educational systems. None of the studies examined in this review expressed the skepticism about the potential impact of badges that was voiced regarding MOOCs and OER. Instead, conclusions frequently called for educational institutions to view the potential of these emerging "online learning opportunities through a lens of reform and innovation and equally, as an opportunity to increase higher education participation" (Lemoine & Richardson, 2015, p. 36), because badges may be an ideal tool for resource-scare environments (Salerno et al., 2015).

The use of badges for education in the developing world is still limited. Araujo et al., (2017) observed that Badgetheworld.org listed only 84 projects actually implementing digital badging before 2016, and 75 of those were in the E.U. and U.S.A. While the literature in this review still exhibits few strong cases of effective distribution of this emerging technology, digital badges are being implemented in developing-world situations as diverse as remedial education (Martins et al., 2019), professional development (D. M. Anderson & Staub, 2015), and postgraduate work (J. Diamond & Gonzalez, 2014) in at least twenty countries across Europe, Latin America, and Africa (Ghasia et al., 2019; Martins et al., 2019). There is a general anticipation of their further implementation if they become recognized as a "currency of learning" (Bowen & Thomas, 2014) by established educational institutions (Liyanagunawardena et al., 2017).

Nine (5%) of the studies in this review took the idea of ADC's to the next logical step beyond badging: blockchain. Blockchain allows a string of verifiable and unalterable digital links stored on decentralized servers of all blockchain users. This can serve as a sort of open, decentralized, unalterable ledger for any type of transaction, from cryptocurrencies to educational records (Bdiwi et al., 2017; Beck, 2018; Choi et al., 2019; Jirgensons & Kapenieks, 2018). However, while the literature was completely positive about the technology's potential for democratizing sustainable ADCs, the technology appears several years out in implementation. Jirgensons & Kapenieks (2018b, p. 152) observed that, "the most serious problems with blockchain technology are the issues of scalability, privacy and increasing storage capacity." However, the amount of time given in each study to explaining how these chains of interconnected credentials work shows that the biggest barrier to implementation may be that decision-makers do not understand how it works (Alammary et al., 2019; Jeong & Choi, 2019; Nikolskaia et al., 2019).

Systems and Cultures

The final major theme of the literature reviewed on Web 2.0 for education in the developing world came from studies of systems and cultures. Some of these studies were surprisingly naïve, presenting reviews of national educational systems without mentioning words like *online, Web, blended, Internet,* or *technology* (Nessipbayeva & Dalayeva, 2013; Sabzalieva, 2015). Most, however, saw Web 2.0 combined with improved infrastructure as a catalyst for systemic educational changes in the developing world (Alehegn & Mentor, 2019; Marrinan et al., 2015; Morris et al., 2019).

These studies predicted a wide variety of responses to what they saw as potentially disruptive innovations. Some researchers focused on micro-level issues rather than the macro-level change. For example, they theorized about the difficulties of establishing fair compensation standards for online teachers (Karimov & Xikmatov, 2018), or bemoaned the loss of content instructional time due to teachers and students needing to learn to use Moodle (Narakun Kyzy et al., 2017). They were also divided on the probable effect of Web 2.0 for ODL on the ownership of educational systems. Some see these changes as opening the door for independence from European (Umar, 2013) and "Anglo-Saxon" (Anichkin & Kovalenko, 2018) educational systems. Others see it as an opportunity to move toward universal educational standards and practices (Jugede, 2013, p. 18).

The studies were almost unanimous in stating that the diffusion of Web 2.0 for ODL would meet with cultural barriers related to general opposition to constructivist pedagogies. For instance, a study from Kyrgyzstan reports a situation in which the school administrator banned the use of active-learning methods in his school. According to this school administrator, critical thinking strategies and problem-solving skills reduce students' respect for what teachers say and do. As a result, teachers and schools lose control over students' behavior (Price-rom & Sainazarov, 2010, p. 20).

In fact, it is difficult to envision effective Web 2.0 ODL in countries where an ideal learning situation is based on "the authoritative pupil-teacher relationship or the appropriate study of sacred texts (flawless memorizing, good diction, careful handling of books etc.)" (Stephan, 2010, p. 473). Other studies pointed out resistance due to longstanding rural-urban and gender divides, as shown in this quote from a woman in rural Kyrgyzstan, which found parallels with reports from women around the world (James, 2014; Maity, 2014; Sang et al., 2010; Zhou & Purushothaman, 2015):

Girls from a village, they don't really have access to a university, to college, to school because families are not really supportive of that….In our mentality, Uzbek-related mentality, girls should get married when they are like 20 or 21. (Hughes, 2018, p. 55)

This debate between about the value of collaborative critical thinking and problem solving in education "becomes especially pronounced in societies experiencing fast paced political, economic and social changes, because the question of what should be taught and how it should be taught becomes a matter for the very future survival of the society" (de la Sablonnière et al., 2009, p. 628). The literature in this review indicates that there are many in the developing world who realize that, regardless of the potential value of Web 2.0 ODL and its associated apps, methods, MOOCs, OER, and ADC's, teaching ODL through Web 2.0 will likely result in unintended conflicts with cultural values related to the nature of knowledge and education. Increasingly they are saying, in non-native but clear English, "The developing countries are borrowing foreign models which are also foreign to their environment therefore; the wanted results are emerging neither in volume nor in quality unlesss a contextual rethinking is accelerated [*sic*]" (Kundi & Nawaz, 2014, p. 150).

Discussion: ODL in the Developing World

The 2019 Educause Horizons Report lists the top mid-term trends in higher education as "developing cultures of innovation", measuring learning, "rethinking how institutions work", and "modularized and disaggregated degrees" (Alexander et al., 2019, p. 4). This review shows these issues at the top of the developing-world education list as well. Moreover, the discussions of ODL, OER, and quality assurance in this study mirror those in highly developed countries. Researchers in the developing-world seem generally open to trying the new technologies but question whether the tools will last long enough and perform well enough to be worth the investment of time and energy.

There seems to be a growing disillusionment with MOOCs' inability to deliver the low-cost, relevant, verifiable learning that had been desired. At the same time, the high percentage of theoretical and explanatory studies on the potential of digital badges and blockchain indicate that many in the developing world are poised to be early adopters of these emerging technologies.

Perhaps the biggest difference that came from asking the research questions about developing countries specifically instead of all countries in general, is that studies from the developing world often included extensive discussions of cultural and systemic issues impacting the diffusion of innovations. Many authors specifically discussed issues related to the latent imperialism that occurs when the means of content production and assessment of knowledge (e.g. low-cost Internet, computers, powerful institutions, and the English language) are the property of the global elite. Moreover, many scholars identified Web 2.0 implementation as promoting constructivism and acknowledged that constructivism clashes with some cultural values, especially by de-emphasizing traditional knowledge and assessment. Although the studies did not discuss cultural values in Hofstede's terms, it seems reasonable that the idea of socially constructed knowledge through innovative, collaborative critical thinking and problem solving would feel uncomfortable to people who value a high Power Distance, a low level of uncertainty, or a high desire to progress as a group instead of individually. While none of these studies argued to halt the use of Web 2.0, many see it as bringing complex and possibly unwelcomed changes.

Summary: Literature Review

The purpose of this literature review is to explain the foundational theories for this study and their relevance to the research questions, and then to examine factors affecting the diffusion of ODL with Web 2.0 in the developing world in the last ten years. This involves answering the following research questions:

1. What are the foundational theories for this study, and how are they relevant?
2. What is the developing world?
3. What is the history of distance education in the developing world?
4. To what extent are Web 2.0 technologies diffusing in ODL programs in the developing world?
5. What factors have tended to encourage or inhibit this diffusion?

The foundational theories for this study are Hosftede's cultural dimensions, the Diffusion of Innovation theory (DoI), the Technology Acceptance Model (TAM), and the General System Theory (GST). While there are competing models of culture that could also be used for this study, Hofstede's cultural dimensions are well-established, are not as politically biased as some other models, and have the convenience of having already been included in pre- and post-training surveys by the participants of this study as part of their training in the methodology courses. The DoI theory applies because the objectives for the training program being studied included helping participants to learn Web 2.0 educational technology and associated methods and diffuse them in their societies. Whereas the DoI looks at patterns of adoption of Web 2.0 educational technologies and models throughout the group, the TAM allows an examination of the way in which individual participants' attitudes toward the technologies changed during the program. Finally, GST relates the individual participants' attitudes and behaviors to their cultural or professional subgroups and to their larger cultural and national educational contexts.

The definition of the developing world is complex and highly nuanced politically. Although the Human Development Index (HDI) is overly reductionistic in its definition of development, it is the most standardized measurement worldwide. Therefore, for this study, the definition of the developing world includes the 67 countries with an HDI less than 0.70 according to the 2020 index.

This literature review shows that distance education is nothing new to the developing world. Historically, many technologies, from writing (Friesen, 2017) to offline mobile phones (Guevara, 2015) have been especially suited for cross-cultural diffusion and educational applications, and that seems to be the case with ODL. The Web

2.0 technologies currently being most explored and adopted in developing countries – social media apps, translation apps, ODL systems, MOOCs, OER, badges, and blockchain – are being explored in developed countries as well (Alexander et al., 2019). However, many people in the developing world are skeptical of the constructivist framework that undergirds effective implementation of these technologies in education (Borden, 2008; Huisman et al., 2018). Also, there is an awareness that systemic changes that use foreign tools could have unforeseen political and social consequences (B. Ismailova, 2004; Jansen, 1998).

This study indicates that ODL Web 2.0 is diffusing in the developing world very similarly to the way it is diffusing elsewhere when the environment includes ICT access. However, the developing-world answers regarding specific Web 2.0 technologies often include caution regarding the potential of technological innovations to clash with cultural values or promote foreign over local interests. The most common barriers cited to effective Web 2.0 use for ODL were unsurprising for anyone familiar with discussions of digital divides: lack of infrastructure, lack of repair specialists, lack of teacher education, lack of devices for students or teachers, preferential access to technology for certain groups, and resistance from interest groups within schools (Ching et al., 2005; Gil-Flores et al., 2017; Jackson, 2008). However, one should beware of too-quickly overlooking the significance of the digital divide due to the similarity of concerns voiced in highly developed countries. For instance, while computer students at universities in highly developed countries are prone to complain about lack of access to computers, developed-country students are unlikely to doubt whether the university has any computers (Gul, 2019). Likewise, while administrators in highly developed countries are likely to resist some types of pedagogical innovations, they are unlikely to ban active learning (Price-rom & Sainazarov, 2010).

It must be noted, though, that there is relatively little quantitative, qualitative, or experimental research on developing countries using Web 2.0-based education. 68% of the studies in this review were overviews, explanatory studies, or literature reviews, leaving less than one-third that presented new data. Of that third, most were small mixed-methods or quantitative studies comprised of a small sample and a short survey. There is obviously much that we do not know about people and systems in the developing world.

Ignorance about the educational practices of values of people in the developing word becomes increasingly dangerous as the Internet diminishes geographical barriers. Scholars across disciplines have pointed convincingly to the role of geography in historical events that the concept is standard in popular literature and introductory college textbooks (J. M. Diamond, 1997; Fouberg et al., 2012; Kaplan, 2012; Roskin, 2012; Waugh, 2009). However, despite the power of geography, climate, plate tectonics, microbes, and natural resources on historical events, we would do well, when dealing with systemic change, to “understand that we are dealing with people who know and understand their situation and who have creative ideas, knowledge, experience, skills and commitment” (Sachs, 2006). Although it may seem logical to adopt technologies with a high PU and PEOU, in actuality, the Tasmanians rejected the bow and arrow (J. M. Diamond, 1997), the Easter Islanders sacrificed their food supply for difficult constructions of dubious utility (J. M. Diamond, 2011), and some Central Asian countries chose television, WhatsApp, and Facebook over G Suite for emergency remote learning

(Levina, 2019; Sabzalieva, 2015; The World Bank, 2020). Cultural choices like that may indicate the influence of underlying, possibly unacknowledged values.

The central problem for this study is the relationship between technologies and cultural values, especially when the technologies, like Web 2.0, are conducive toward collaboration for critical thinking and innovative problem solving. Chapter 3 explains the research methodology to be applied in this case study. It begins with discussing concerns of validity and reliability. It then describes the participants and context, the process of data collection and management, the methods of analysis, ethical considerations, and the limitations of the study.

CHAPTER THREE: METHODOLOGY

The purpose of this case study is to examine the way in which teachers' cultural values influence and are influenced by Web 2.0 technologies used in online professional development, as demonstrated by participant attitudes toward and use of these technologies in their courses. The literature review showed a general openness toward ODL and Web 2.0 in most of the developing world, even though some are wary of ways the unanticipated changes that could result from a potential systemic change. The studies in the literature review indicated that educators in the developing world were especially interested in specific methods or technologies used in ODL, the theoretical concept and practice of ODL, validating learning that happens in ODL, OER, and implementations of ODL within specific cultural contexts. This study now zooms in to focus on the online interactions of 59 educators from four Central Asian countries who completed an online professional development training on the use of Web 2.0 to study methods for STEM education and asynchronous ODL. This chapter discusses the means of maintaining validity, reliability, and ethical standards while analyzing data that was collected from participants in an ODL professional development program.

Research Questions

This study's primary research question is, "What is the relationship between cultural values and the diffusion of educational technologies?" Answering this question requires establishing a baseline for the population in terms of cultural values and attitudes toward and use of Web 2.0 technologies at the beginning of the professional development. It then requires sampling during the professional development, and establishing an endpoint for cultural values and attitudes that allows change to be observed. This leads to answering two secondary research questions:

1. How do participants' expressed attitudes toward and use of Web 2.0 technologies change during the training? (Rsq1)
2. What cultural values, as described by Hofstede, are most relevant to participants' attitudes toward and use of Web 2.0 technologies? (Rsq2)

The primary research rephrases the main concept of the purpose statement. The first sub-question (Rsq1) requires establishing baseline and endpoints for the participants' attitudes and use of Web 2.0 technologies, as well as establishing means for participants to explain and demonstrate changes or lack of changes to their behavior. The second sub-question (Rsq2) requires identifying changes and references to cultural values as possible causes or effects from the changes expressed in Rsq1.

Research Methodology

The Research Methodology section explains the rationale for rejecting quantitative analysis or other qualitative methodologies and choosing the case study method. It then explains ways in which the study maximizes the trustworthiness of the case study.

Selecting the Case Study Method

Although the population is large enough for some types of quantitative analysis (Hatcher, 2013; Levin & Forde, 2016), the qualitative method, and a case study in particular, is preferable to quantitative for several reasons. First, as discussed in the "Rationale for Methodology" section of Chapter 1, the data was collected through instruments designed for teaching, so the processes necessary for ensuring representative sampling among the participants and on the surveys was not possible (Levin & Forde, 2016). Second, even if those statistical tools had been available, the research questions would be best answered by examining the experiences of the participants as things that are real, “vivid, concrete, situated, and irreplaceable character of experience, and the fact that it is ‘felt’ and ‘lived,’ rather than something made available for detached analysis” (Friesen & Francis-Poscente, 2008, p. 150). Third, this study’s research questions focus on the relationship between the use of educational technologies and pedagogical dispositions in a multi-cultural online environment. It is not intended to establish or reconstruct a theory; therefore, a grounded theory approach would be inappropriate. Although aspects of this study that could be presented with the standard literary devices of a narrative, narrative research derives its power from vivid details of the lived experiences of participants, as told through interviews (Friesen, 2008). That method is impractical with the number of participants in this study, and it is unlikely to result in answering the research questions. Likewise, phenomenological research aims at providing “a deep understanding” of “some common experience” of a small group of individuals to provide a deep understanding of their experience of the phenomenon (Creswell & Poth, 2016, Kindle Locations 3127-3128). However, this study’s research questions are not directly related to the experience of a phenomenon. Finally, the ethnographic method is not appropriate because the population for this study is not presumed to be a single cultural group (Creswell & Poth, 2016). The case study method using multiple data collection instruments was therefore chosen as the most appropriate for this situation.

Case study research is “defined not so much by the methods that you are using to do the study, but the edges you put around the case” (Thomas, 2015, p. 23). It involves identifying a specific set of subjects in a specific situation, collecting multiple types of qualitative data, and identifying themes in the data (Creswell, 2013; Creswell & Poth, 2016). In this study, the chronological boundaries of the case are the beginning and end of the ODL training: July 2019 to December 2020. The participant boundaries are the educators from Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan who received certificates of completion for the program. The multiple types of qualitative data are pre- and post-training surveys, self-introductions, online discussions of hindrances to and successes in diffusion, and capstone projects involving reflection and demonstration of concepts from the training.

Establishing Trustworthiness

Lincoln and Guba (1985, p. 290) describe trustworthiness in research as a function of truth value (internal validity), consistency (reliability), neutrality (objectivity), and applicability (external validity). Each of these factors applies to this case study as described below.

Internal Validity

Internal validity, also referred to as the truth value or credibility of a study, is the answer to the question, “How do you know that your findings are true and accurate?” (Statistics Solutions, 2016, para. 2). For this study, internal validity was first established through triangulation of multiple instruments with different types of data. While the use of surveys, self-introductions, forums, and capstone projects prohibits a direct comparison of one data type to another, it also increases the trustworthiness of findings when all instruments present the same trend (Creswell & Poth, 2016; Lincoln & Guba, 1985; Miles et al., 2019). In addition, an iterative coding process allowed a foundation in well-established theories and findings from the literature review, but also allow an emergent code as patterns emerged. Each item from each instrument was coded according to each a priori category, with notes made regarding potential additional categories. Each item from each instrument was again coded with each emergent code. This resulted in multiple coding cycles over a period of four months, reducing the chance of coding based on first impressions or the researcher's familiarity with specific participants (Miles et al., 2019; Saldana, 2015).

Consistency

Consistency, also referred to as reliability, reproducibility, or dependability is the extent to which it is likely that another qualitative study would find similar results (Lincoln & Guba, 1985; Statistics Solutions, 2016). Case studies assume that the exact case cannot be reproduced. However, this study maximizes reliability through a thorough description of the participant selection process, the participants, the Web 2.0 tools used to collect data, and the course design documents for the STEM and ODL courses used in data collection (Appendices B and C). This allows future researchers to replicate or adapt aspects of the data collection to various cases.

Neutrality

Neutrality, also referred to as objectivity or confirmability, "involves making sure that researcher bias does not skew the interpretation of what the research participants said to fit a certain narrative" (Statistics Solutions, 2016, para. 4). To enhance neutrality, I have been open about my biases having worked in Central Asia for 17 years prior to this study. I also created an audit trail to ensure referential adequacy and data accessibility. Referential adequacy emphasizes the storage of unanalyzed data to be used for checking findings. Data accessibility emphasizes the need to make data available for audit by other researchers. These are provided by saving all material from the training program—including data from participants in the training program that was not analyzed in this study—through G Suite or Moodle on the Boise State University Google Drive account, as per BSU policies. Each iteration of the professional development courses used for this study include dozens of assignments that are not analyzed in this study. Their backup files are stored on the BSU Google Drive account and could be imported into other Moodle servers for analysis.

Applicability

Applicability, also known as external validity or transferability, refers to the extent to which these findings may be applicable in other contexts. Case studies are, by definition, specific cases defined by participants, activities, space, and time (Creswell & Poth, 2016), so exact replication and generalization are both impossible. This leads to Lincoln and Guba's observation that "if there is to be transferability, the burden of proof lies less with the original investigator than with the person seeking to make an application elsewhere" (1985, p. 298). The person making the transfer, not the original researcher, is the one who knows the "case" into which the findings will be transferred. However, to aid with the potential transfer of these findings, this study incorporates "thick description" of the data. "Thick description" refers to not only describing behavior, but describing it in its full context and ascribing "present and future intentionality to the behavior" (Ponterotto, 2006, p. 539). To provide this "thick description", results in this study are reported with reference to the historical context of the participants' responses, and results are often reported in the participants' own words. This helps "to enable someone interested in making a transfer to reach a conclusion about whether transfer can be contemplated as a possibility" (Lincoln & Guba, 1985, p. 316).

Research Design

This study focuses on the 59 people from the four focus countries in Central Asia who received certificates of completion for the training. The complete curriculum, described in Appendices B and C, outlines most of the assignments. This study, however, examines only the assignments deemed most likely to directly contribute to answering the research questions, as outlined in Figure 7.

The course began with participants introducing themselves through 3-5 minute videos or through 350-word texts, following the examples provided by the course facilitators. The purpose of this assignment in the course was to help participants get used to using collaborative online tools, such as Google Sheets, and to help them begin to build social presence. The data from this activity contributes to this study by helping to establish a baseline for the participants' experience with and attitudes toward Web 2.0 educational technology and related methods. Coding of this data according to Hofstede's dimensions helps to establish a baseline for their cultural values.

The sponsors of the training program required a report documenting the effectiveness of the course in building positive attitudes toward STEM methods and research-based ODL methods. The course design, therefore, included pre- and post-training surveys including Likert-scale and open-ended prompts related to attitudes toward and use of Web 2.0 technologies. Since the course's objectives included differentiated learning, prompts related to Hofstede's cultural dimensions (Hofstede, 2013) were included to facilitate a discussion on differentiation related to cultural values. This data helps to establish the amount of change in participants' self-perceptions of attitudes toward and use of STEM Methods and Web 2.0 technologies, as well as change in their cultural values.

Since the goal of the training was diffusing best practices with STEM Methods and Web 2.0 ODL, it included two assignments asking participants to reflect on the appropriateness of these methods and technologies in their specific contexts. The first forum asked them to discuss potential hindrances to diffusion, and the second asked them to describe their successes in diffusing these methods. Data from these discussions will allow insight into the participants' attitudes toward and use of these methods and technologies. It also allows insight into participants' perceptions of cultural values that could hinder or facilitate the use of concepts in the course.

The final projects for the training required participants to give a 15-minute videos or 1500-word texts reflecting on and demonstrating ways in which they incorporated what they perceived as the most important aspects of the training. The demonstrations often included guest access to the LMS hosting their courses, allowing virtual classroom visits by other participants and training facilitators. These capstone projects were designed to showcase the participants' learning to the participants and the professional development course sponsors. Data from these projects allows insight into not only the participants' self-assessed attitudes toward and use of STEM Methods and Web 2.0 educational technology, but it also allows an assessment of their ability to apply these methods and tools. Comparing responses from the final project to responses to pretraining surveys and mid-training forums establishes changes in attitudes, behavior, and cultural values.

Each assignment included for analysis contributes directly to answering one of research sub-questions, as shown in Figure 1. When taken as a whole, they address the primary research question: What is the relationship between cultural values and the diffusion of educational technologies?

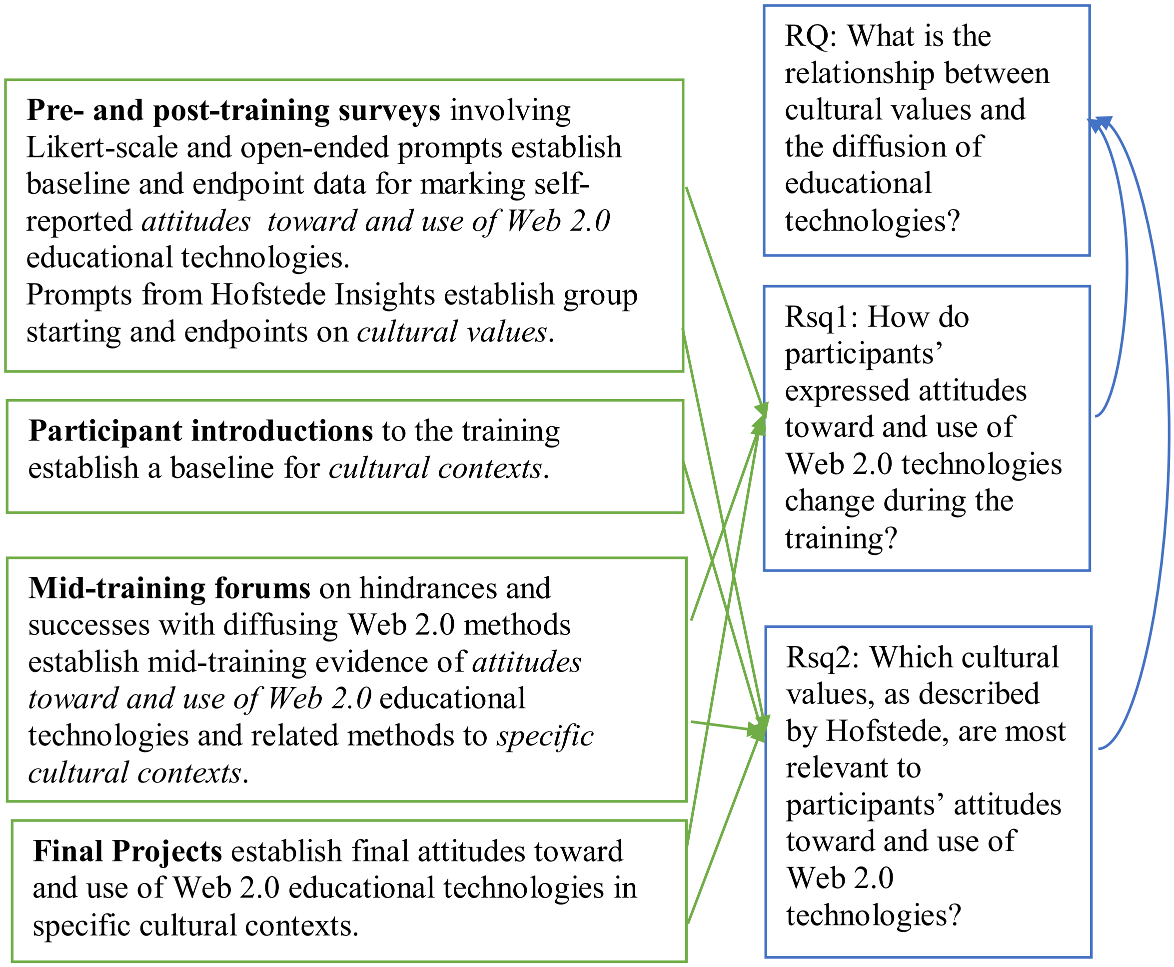


Figure 7 Research Questions and Data Sources

Data was coded through several steps of a priori codes followed by an emergent code (Table 7). First, coding was assigned based on the TAM categories of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). It was then coded according to Hofstede's cultural dimensions. Following that, it was coded based on types of ODL, and then types of Hindrances or Facilitators, based on categories drawn from this study's literature review.

I value allowing participants to be "involved in the study as co-researchers" (Creswell & Miller, 2000, p. 187). However, the large number of participants and the difficulties of establishing representative participation once the training ended made this impractical. Therefore, the data collection and analysis does not include contact between myself and the participants, and I did not discuss the training with the participants after the training ended.

Participants and Their Context

The original cohort for this training (Phase 1) were invited by a private educational center in Bishkek, Kyrgyzstan to apply for a competitive program in "STEM Methods." These methods were defined in promotional material as including interdisciplinary collaboration, critical thinking, creativity, and problem solving. These participants were provided with travel, room, and board for three face-to-face meetings for intensive training in Bishkek, Kyrgyzstan. Between these seminars, they would participate in about three hours each week of online instruction. They were selected by the director of the sponsoring private educational center in cooperation with the grant sponsor based on their statement of purpose, English language proficiency, availability for training, and endorsement from their supervisors to implement concepts from the training in their courses. A similar system was used for selecting participants for the training on methods for teaching asynchronous ODL. Additional iterations opened by the ODL participants brought in a total of 131 participants. The participants ranged in age from mid-twenties to early sixties. None spoke English as their primary language, but all demonstrated English proficiency in reading and writing before entering the program, as assessed by English language specialists from the sponsoring organization. Fifty-nine of the participants from Central Asa completed the training and are the subjects of this study.

Population and Sample

All participants had professional teaching credentials, several years of classroom experience, English proficiency, and a willingness to devote approximately three hours per week for six to eighteen months to this training. Tables 5 and 6 outline people (identified by pseudonyms) involved in this project, including administrators, facilitators, and participants.

Table 5 Assistants to the Researcher

	Role	Name and Background	Primary Responsibilities
Phase 1: STEM	Project Manager	Nazgul (Kyrgyz): the director of the English Language Center	• Administer grand • Direct program • Coordinate with chief stakeholders, especially at the US Embassy in Bishkek
	Student Liaison	Julia (American): U.S. State Department English-Language Fellow	• Select participants; • Counsel participants; • Liaise with participant employers and supervisors.
	STEM Methods Specialist	Bob (American): STEM Professional-Development outreach specialist for a Midwestern university	• Oversee quality assurance for online and face-to-face modules on STEM methods; • Lead face-to-face modules; • Lead one online cohort.
	Educational Technology and Curriculum Specialist	Randall (American): Primary researcher; multi-disciplinary teaching and curriculum development for K-12 and higher education	• Design ODL course; • Implement educational technology; • Train in diffusion of innovations • Lead face-to-face modules; • Lead one online cohort.
Phase 2: ODL	Educational Technology Specialists for Phase 2	Tom (STEM specialist) and Jim (Language Arts specialist); doctoral students in Educational Technology at BSU.	• Design asynchronous lessons relevant to their specialties in subjects and LMS's; • Create general training videos; • Maintain social presence and provide feedback to participants through the training's various media.

Table 6 Participants in the Program

	Role	Name and Background	Primary Responsibilities
Phase 1: STEM	4 Participants for the STEM training in July 2019	Teachers in universities or private high schools. Participants were selected through a process involving a statement of purpose, letters of recommendation, and a face-to-face interview.	• Complete the online orientation; • Participate effectively in all face-to-face and online learning modules; • Develop, demonstrate, and reflect on an original project demonstrating STEM principles for their context; • Provide at least one training for their colleagues in STEM principles.
Phase 2: ODL	7 additional Participants for ODL in June 2020 (71 total participants)	All original STEM participants were invited, but six withdrew. Additional participants were selected through a process involving a statement of purpose, letters of recommendation, and a face-to-face interview.	• Participate effectively in online learning modules; • Develop, demonstrate, and reflect on an original project demonstrating constructivist asynchronous ODL principles for their context; • Provide at least one training for their colleagues in constructivist asynchronous ODL methods.
Phase 3 ODL	60 additional Participants for ODL in July/August (131 total participants)	Several strong participants in the ODL training received permission from the facilitators and program director to open their own cohorts of the Moodle training.	• New participants came from multiple countries. • Selection was by invitation of the cohort leaders. • They had the same curricular goals, but with deadlines set by cohort leaders.
DATA	9 Study Participants	Judged to have completed sufficient work to receive a certificate of participation	• 51 submitted final projects • Quality of work was not evaluated in determining successful participation

Phase 1 (STEM methods) included thirty women and fourteen men from four Central Asian countries. Many of those continued into Phase 2 (ODL methods), which added 32 women and five men from the same countries. More joined in July and August as several members of the ODL training became facilitators of their own cohorts using copies of the Moodle course. This brought the total to 131 people from 16 countries. Of this total, only the 59 Central Asians who received certificates of completion were analyzed for this study. Their demographic details are shown in Figure 8.

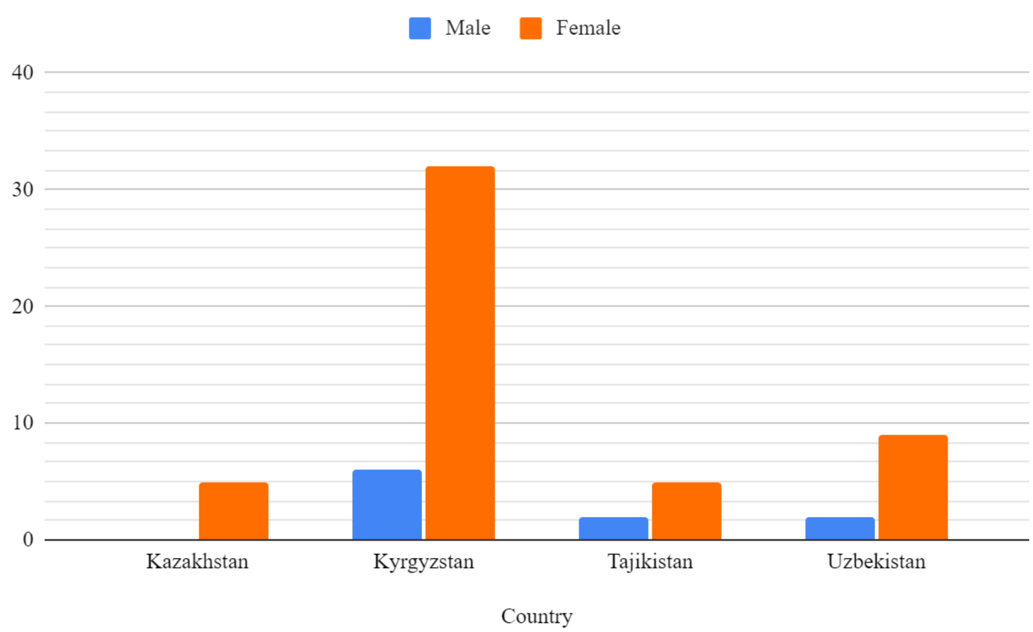


Figure 8 Research Participants by Country and Gender

Instrumentation or Sources of Data

The explicit purpose of the training was to increase the diffusion of interdisciplinary collaborative learning, critical thinking, and collaborative research for problem-solving throughout Central Asia (Bell, 2016; K. L. Smith et al., 2015; Stohlmann et al., 2012). In Phase 1, the content helped participants understand and apply these methods to STEM fields or teaching English to students who were entering STEM fields. Specific technologies modeled and required included makerspace, flipped classroom, social media for research, and mobile learning, with examples taken from other developing countries (Bharali, 2014; Hynes & Hynes, 2018; Jobe, 2014; Khirwadkar & Figg, 2019). The ODL portions of Phase 1 gave participants the opportunity to experience these methods through Web 2.0 activities in ODL, but almost all participants planned to apply what they had learned in face-to-face classrooms.

With the COVID-19-induced Phase 2, the ODL training continued to provide participants with these methods, but now aimed at producing courses in Web 2.0 ODL environments. Modules focused on subjects common to ODL training. These included building an online identity and social presence, instructional design, working within an LMS, inclusion and accommodation, and online assessment (Davidson-Shivers et al., 2018; Palloff & Pratt, 2009; Rice, 2009; Stavredes, 2011). It also included specific assignments in apps for video discussion, a virtual bulletin board, screen recorders for presentations, collaborative graphic design and video editing, G Suite for Education, Moodle, and hyperdocs (Appendices B and C).

The data for this study comes from online interaction between the participants within the LMSs used in the training. This includes written, visual, and video interactions in environments such as the course's Moodle site, G Suite tools, and other technologies outlined in the Research Design section of this proposal and Appendices B and C. All communication for the training was set to be visible to all participants and all capstone projects were designed to be shared publicly.

Data Management and Collection

All surveys and ODL interactions occurred between July 2019 and December 2020 within the training's Moodle and G Suite for Education tools. Moodle and G Suite automatically collect and backup all data contributed by any of the users. These tools were administered through my BSU student account. Data from the study was stored on the BSU cloud system as required by the institutional policies. At the end of the training, all information was downloaded from Moodle and uploaded to my Google Drive associated with my BSU email address.

My notes were stored in my personal computer, mobile device, and hard-copy notebook, each of which were stored on my person, or in my locked home office. They were uploaded to my BSU email account's Google Drive for archiving and analysis as per university policy. Once the training ended in December 2020, participants were no longer be able to contribute data to the Moodle or G Suite tools. They were encouraged to download their own material for their own records. After February 2020, only the researchers had access to the data on the Moodle and G Suite sites.

Data Analysis and Procedures

A priori coding included Hofstede's cultural dimensions (Hofstede, 1980b; Hofstede & Minkov, 2010), the TAM categories (Davis, 1985), and the ODL areas of interest identified in the literature for this study. Throughout the process, an emergent code was developed for data that did not fit within the a priori categories (Creswell, 2013). Although some researchers recommend dozens or hundreds of codes, this coding pattern follows Elliott's (2018) recommendation of five to seven major concepts with 15-20 nodes. Table 7 shows the complete system.

Table 7 Coding Categories and Purpose

Level of Coding	Basic Category	Codes	Purpose
A priori	Cultural Dimensions	1. Power Distance Index (PDI) 2. Individualism vs. Collectivism (IDV) 3. Uncertainty Avoidance Index (UAI) 4. Masculinity or Femininity (MAS) 5. Long-term orientation vs. Short-term orientation (LTO) 6. Indulgence vs. Restraint (IND)	Code items according to Hofstede's cultural dimensions.
A priori	TAM Concepts	7. Perceived Utility (PU) 8. Perceived Ease of Use (PEOU)	Highlight attitudes and decisions not explained by TAM.
A priori	ODL from the Literature Review	9. Specific Apps 10. Specific Methods 11. MOOCs 12. OER 13. Quality Assurance	Highlight specific types of Web 2.0 technologies to look for patterns in adaptation.
Emergent	ODL – Emergent Codes	14. LMS 15. Collaboration 16. Production	
Emergent	Barriers/ Facilitators	17. School Environment: curriculum, materials, standardized tests, supervisors 18. Cultural Environment: state mandates, systemic barriers, values, stakeholder expectations 19. Infrastructure: Internet, computers, space, mobility 20. Foreign Influence: curriculum, methods, outsiders	Allow comparison of this population with the global developing world patterns revealed in the literature review.
Emergent	Adoption	21. Little Evidence of Adoption 22. Solid Evidence of Adoption 23. Innovative Attempt to Encourage Adoption	Evaluate the extent to which participants applied concepts in their courses

Example of the Coding Process

For the coding process, data from the Moodle Forums and G Suite tools was first downloaded and converted into a Microsoft Excel Sheet. The first columns indicated the key categories of coding: ODL, Culture, TAM, and Barriers/ Facilitators. The next column, listed “Name” was actually the pseudonym. Then came the participants’ response in their own words. (Table 8).

Table 8 Coding Process Example

ODL	Culture	TAM	Barriers	Name	Response
methods, production, other, LMS, individual, collaborative	low UAI, low PDI, high IDV, low MAS	PU high	infras - facilitator	Nazima	Flipped classroom is a way good opportunity for teachers to explain some hard topics. For example, in Chemistry grade 11, there is a hard chapter(such as Thermodynamics) that students might struggle with just a classroom explanation. So, in such cases I am giving them some links of video-explanations of particular topics, so that the students can have at least a small idea about the new chapter. I tell them to take important notes and write questions on parts that they did not understand. And here we go! The next day, during the lesson, I can feel that the students are encouraged enough to discuss with the teacher a new chapter. https://www.youtube.com/user/bozeman, Bozeman is a great scientist, who helps not only students, but teachers as well;) https://www.youtube.com/user/khanacademy, Dr.Khan gives a great help to those students who are preparing for some external exams by solving real-exam questions. After the chapter ends, I am sharing my Power Point Presentation with my students on Google Classroom, so that they can turn back to that chapter whenever they are stuck.
LMS, OER, apps, collaborative, methods, production	low PDI, low UAI, high IDV	Mixed, PU-high	infrastructure - facilitator, school - facilitator	Mira	In my teaching experience I used AVN. It is a Corporate LAN of University. Every teacher and students have own page, where teachers download all materials according taught discipline! Mostly, we use AVN for students of distance education. So, offline and online teaching. With the situation of pandemic, I started to use WhatsApp with my students. Then, my students made presentations and use Kahoot Quizzes. Both for my students it was interesting and effective. I like Kahoot! All the best!

The coding process involved first reading through all responses for the data collection instrument and coding them for type of ODL used, which is related to

Research Sub-Question 1 and includes codes based on this study's literature review. In this case, Nazima and Mira indicated multiple types of ODL, each of which are recorded.

The data was then coded for Hofstede's cultural values. Values that were not directly expressed were not coded, but values that were expressed were coded as *low* or *high.* In the case shown in Table 8, Mira's casual tone indicated low Power Distance. Her willingness to try and encourage the use of new technologies indicated a low Uncertainty Avoidance. Her preference for tools that promoted individual communication (WhatsApp) and individual competition (Kahoot) indicated a high Individualism.

The data was then coded for the TAM categories of PU and PEOU. In the cases shown in Table 8, Nazima clearly indicated the high Perceived Usefulness of the Bozeman Science videos and Khan Academy. However, although these sites are easy to use, she did not specifically indicate that as a factor, so only PU-high was coded. Mira, however, was coded as mixed because, although she says that WhatsApp and Kahoot are "effective", indicating a high PU, she seems to use the university's AVN system because the university mandates it, which does not fit into either TAM category.

The coded was then coded once more for indicators of barriers or facilitators to the adoption of Web 2.0 technologies and methods. In both cases, the participants indicated that their schools facilitated the use of the technologies. Nazima indicated that infrastructure was a facilitator of some technologies by pointing out her early adoption of WhatsApp, which is very commonly used in Central Asia, in the early days of the pandemic restrictions.

<u>Quantifying the Data</u>

Applying arithmetic functions to quantify qualitative data is a valid way to enhance the visibility of patterns in the data (Hatcher, 2013; Levin & Forde, 2016). In fact, multiplying data by coefficients to allow comparison is recommended for analysis of survey results with Hofstede's Values Survey Module (Hofstede & Minkov, 2013). In the case of this study, since instruments involved different numbers of participants, and often participants gave no responses or no codable data, comparing raw numbers or percentages could be misleading. For example, if ten projects were coded as showing high Individualism and five were coded as showing low Individualism, but 20 gave no indication of their standing on the IDV dimension, it would be misleading to say that two-thirds of the population were highly individualistic. It would also be misleading to say that only 14% valued Collectivism. Therefore, the coded data for the study is presented as a function of the high to low ratio. For instance, coded responses regarding cultural dimensions were coded as 3 for "high" and 1 for "low." The "high" code became the numerator and the "low" code became the denominator. To prevent errors of divisibility by zero, as would happen if no items were coded as "low," the number five was added to the numerator and the denominator. The resulting quotient was then multiplied by 50 to make patterns in differences more noticeable. Finally, 10 was subtracted so that the lowest scores would be near zero. The result is that all results from coding of cultural dimensions may be expressed on a scale from zero to 250 (Figure 9).

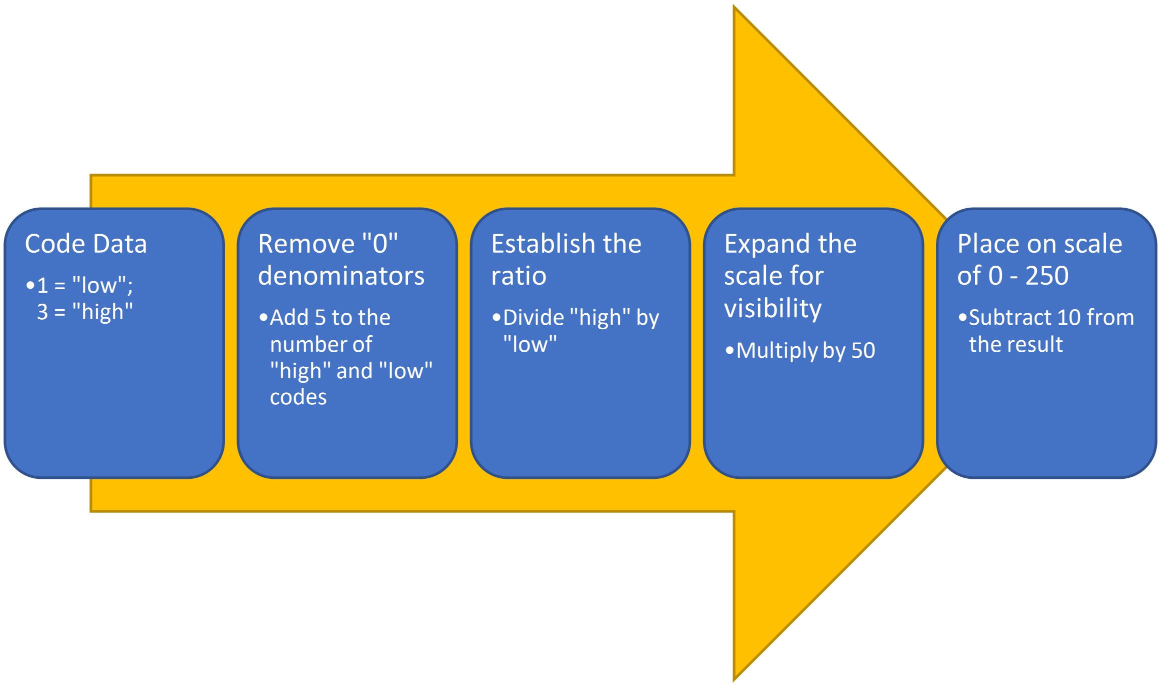


Figure 9 Establishing Ratios and Coefficients for Comparing Codes for Cultural Values

Ethical Considerations

I was not involved with recruiting participants to the course. Participants for the study were recruited to the training program through the course sponsor's and grant administrator's websites and social media pages, as well as through teachers' associations throughout Central Asia. The advertisements stated that the program was free and that the STEM Methods program include travel, room, and board during the three face-to-face sessions. The advertisements also gave a summary of the program contents and time commitment. The participants not only volunteered for the training but went through a competitive selection process involving an application and interview in English. They are professional educators between 24 and 65 years of age. The sponsoring organizations agreed before the project began that I could use the data for research purposes once the study was complete. Participants were informed in the orientation module that the data they shared publicly in the course might be used for research purposes, but they could opt out of having their data included by notifying me or any facilitators at any point during the training. The participants finished their training in December 2020, and data analysis did not begin until February 2021. All data was coded with pseudonyms for names and organizations prior to analysis.

I was a facilitator of the training, so I am familiar enough with the participants to sometimes identify them through their introductions, forums, and final projects even after pseudonyms were used. However, though I was able to identify some participants, the total number of participants in the training was large enough that each facilitator worked primarily with their own cohort. Since the participants in this study were drawn from all cohorts, there were many who I could not identify. The sample of participants is sufficiently large and diverse to prevent readers of this study from identifying individual participants or organizations, which are identified by pseudonyms.

This study has no significant ethical barriers because participants were not members of vulnerable populations, entered the training voluntarily with full disclosure of the training contents and methods, understood that all survey and forum results were not confidential, intentionally prepared capstone projects for public viewing, tacitly consented to data from the program being used in research, and participated only of their own volition. They were adult professionals who could work and study in English. The Office of Research Compliance at Boise State University provides a checklist to determine exemption from IRB review, and this study was determined to meet the criteria for exemption (Appendix A).

Conflicts of Interest

Although this study has no ethical concerns related to deception, confidentiality, or harm to participants, all participants in this program have conflicts of interest. The training's project manager has, for almost twenty years, directed an English-language program that relies heavily on the US for grant funding. Likewise, the program facilitators were all paid by the private language school with funds provided by a US Embassy grant. Two of the facilitators for the ODL training were in the BSU Educational Technology program with me. The participants were reimbursed for their program-related costs, including travel and housing during the training, by funds provided by the US Embassy in Bishkek. US Embassy officials played no role in developing training content and did not interact with participants or facilitators in the ODL environment. However, they were present at opening and closing ceremonies for the face-to-face sessions and they signed the certificates of completion. All interactions between the grant administrator, the US Embassy, and myself ended when final certificates of completion were distributed in January 2020. The grant administrators received a summary of the project (Appendix C) at the conclusion of the program but did not discuss potential findings of this study with me.

In the USSR, travel for professional development conferences was a source of prestige similar to a pay raise in capitalist countries (Joldoshalieva, 2007), and such travel is still a prestigious award in post-Soviet countries. As previously discussed, the participants came from cultures that value high Power Distance and the collective good, so selection for this program made participants implicitly responsible to represent their communities and this training well. This pressure for positive outcomes, combined with the previously mentioned cultural norms of portraying group endeavors in a way that brings honor to the group make it likely that initial reports of program success may be unobjectively positive (Georges & Baker, 2016). This study acknowledges those conflicts of interests but mitigates their influence on the results by completing all aspects of the training and delivering acknowledgements of completion before data analysis.

Limitations of the Method

Creswell (2013) argued that qualitative methods are the best ways to study new topics or phenomena or topics with many variables, which makes it well-suited for this study's research questions, population, and data collection instruments. However, there are three limitations that should be highlighted to the use of this method in this situation.

One limitation is that the participants were self-selected for the training program. They applied for the STEM and ODL training programs through a process that required receiving approval from their supervisors, completing a written application and interview in English, and committing to fulfilling the course requirements. They were not given any direct compensation for their training, and they were only promised a certificate of completion if they participated throughout the program. The fact that they fulfilled these requirements means that they were predisposed in favor of the adoption of the methods and technologies presented in the training when they entered the training.

This study's method is also limited by the relationships that developed between participants and between participants and facilitators during the training. It may be assumed that facilitators did not want any participants to fail to adopt the technologies or methods. However, it is reasonable that participants whose cultural values were aligned with those of the American program facilitators may have been likely to interact more with the facilitators, which may have resulted in higher levels of adoption of the technologies and methods from the course. To further complicate the influence of personal relationships on the findings, I was the lead program designer and facilitator prior to becoming the primary researcher on the project. Although participant names were replaced with pseudonyms prior to coding, I had interacted with many of the participants in forum discussions and coached them on their final projects prior to data analysis, and I was able to identify over two-thirds of the participants despite the pseudonyms.

The findings from the use of the case study method are further limited by the COVID-19 pandemic, which began just before the scheduled final projects of the STEM participants and just prior to the ODL course. This resulted in vast social changes for the participants as almost all were mandated to begin emergency online teaching while confined to their homes except for trips to pharmacies or grocery stores for over two months (The World Bank, 2020; UN Office of the Coordination of Humanitarian Affairs, 2020). The Central Asian countries removed many restrictions in June 2020, only to see spikes in cases of the virus. Social media interactions with the participants indicated that almost all of them had lost friends or family members to the virus by August 2020, when restrictions were again imposed mandating another semester of emergency online teaching. Teachers who were unable to teach online effectively or whose students stopped participating in courses were often laid off, resulting in severe economic hardship. Economic loss, the loss of identity as classroom teachers, and loss of social relationships may have strongly influenced participants' attitudes toward the Web 2.0 methods presented, and it may have influenced their cultural values.

Delimitations

The findings of this study are delimited by several factors that, though necessary, make it difficult to interpret some results. These include characteristics of the participants, characteristics of the data, the use of English among the participants, the lack of member checks and negative case study, and assumptions regarding coding.

The population is well-suited for this study in many ways due to having a common language and many aspects of history and culture in common. This facilitated communication and collaboration throughout the training. However, it also may have minimized the importance and expression of unique aspects of their local cultures, resulting in making them look more similar than they are. For instance, Uzbeks have a long history of city-based agriculture and education, while Kazakhs and Kyrgyz were pastoralists until forced into cities and farming by the Soviet Union. The Uzbeks, Kazakhs, and Kyrgyz have similar Turkic languages, while Tajiks speak a language in the Persian family. Uzbekistan and Kazakhstan have had stable governments since independence, but Tajikistan had a devastating civil war, and Kyrgyzstan had three revolutions or coups. However, they all have nearly a century of education strongly influenced by the Soviet Union and the Russian language (Hiro, 2011; Hopkirk, 1992; K. Meyer, 2004; K. E. Meyer & Brysac, 2006). The participants, therefore, had similar educational systems accompanied by an unusually high diversity in cultures and languages. This mitigates the role of educational systems as a confounding variable in this study of the introduction of new pedagogical tools in multicultural settings.

This study is based on data collected through instruments designed for teaching, not instruments designed for gathering data. The self-introductions, surveys, forums, and final projects collect different genres of data, so a direct comparison between the data is not possible. For instance, it is possible that participants would give different indications of their cultural values on statistically normed surveys like Hofstede's Values Survey Module than they would on self-introductions or final projects in which they were attempting to portray themselves in the best light. To accommodate this delimitation, this study will take care to present the findings in a way that does not attempt to present direct relationships between data collected through the different instruments. In addition, findings presented in figures will be designed to highlight the fact that the surveys are a different genre from the other instruments.

The study is also delimited by the choice of English for all communication within the materials. The participants included STEM teachers who knew English as well as English teachers with STEM students. The English teachers had all received previous pedagogical instruction and many had met prior to this program at professional conferences. Most of the STEM teachers, however, had little or no pedagogical training. Moreover, they did not see themselves as sharing educational methods or objectives with teachers in different STEM fields. The differences between these groups of teachers was not included in this analysis due to a desire to focus on larger cultural patterns.

This study does not include member checks or negative case study. This study's data is limited to that provided by participants as part of their activities in an ODL environment. Following up with the participants regarding their assessment of the interpretation of these results could provide additional insight, but the time required for that process is beyond the scope of this study. The purpose of negative case study is "to refine a hypothesis until it *accounts for all known cases without exception*" (Lincoln &

Guba, 1985, p. 309). This is also beyond the scope of this study as many of the 131 participants in aspects of the training left and did not responds to follow-up emails or electronic messages during the COVID-19 pandemic.

As discussed in the Assumptions section, Hofstede's cultural dimensions and the TAM have proven robust in many situations. Because of that, this study assumes that these models prove sufficient for practical and consistent initial coding. However, this delimitation may result in overlooking patterns that would have become apparent had other models been used.

Summary: Methodology

The purpose of this case study is to examine the way in which teachers' cultural values influence and are influenced by Web 2.0 technologies in online professional development, as demonstrated by participant attitudes toward and use of these technologies in their courses. Examining this issue leads to an answer to the question, "What is the relationship between cultural values and the diffusion of educational technologies?" and two sub-questions:

1. How do participants' expressed attitudes toward and use of Web 2.0 technologies change during the training? (Rsq1)
2. What cultural values, as described by Hofstede, are most relevant to participants' attitudes toward and use of Web 2.0 technologies? (Rsq2)

A case study method was chosen as the best means of answering these questions for several reasons. First, an unusual collection of data was available from a six to eighteen-month training program using and training educators to use and diffuse Web 2.0 technologies. Since the true evidence of adoption of technologies is the effective demonstration of their use, a qualitative method describing the practices is better suited for the questions than is a statistical analysis. Of the qualitative methods available, a case study is most appropriate because the participants are defined by a start and end point of participation in a specific project.

Data for the study consists of the participant work in the training, including pre- and post-training surveys, ODL forum discussions, and final reflective and demonstrative presentations. The data was coded using a priori coding for key concepts, and emergent coding based on observations during iterative coding process. The relationship of the problem, purpose, research questions and methods is shown in Figure 10.

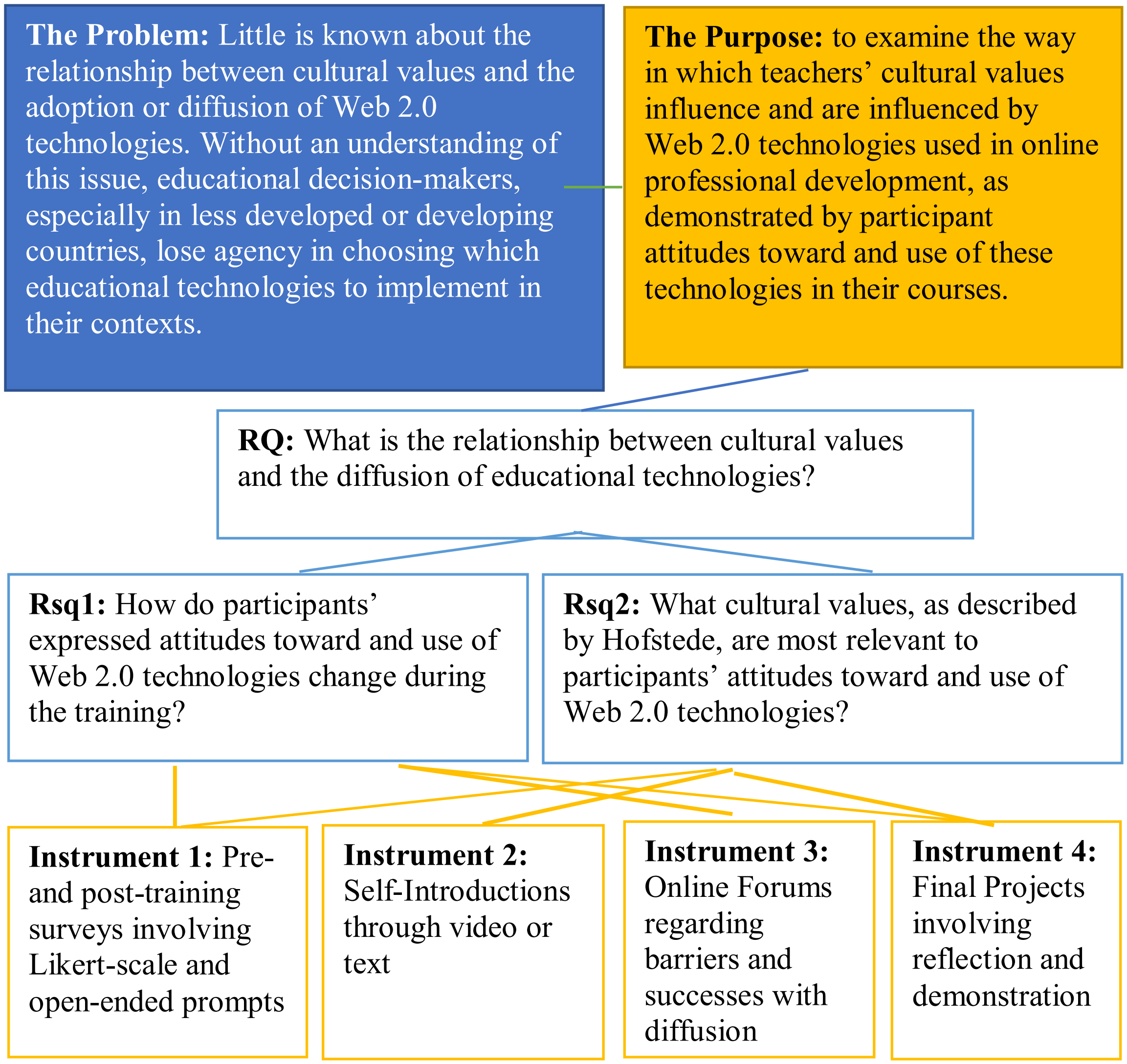


Figure 10 The Problem, Purpose, Research Questions, and Methods for this Study

CHAPTER FOUR: DATA AND ANALYSIS

This research attempts to answer the primary question, "What is the relationship between cultural values and the diffusion of educational technologies?" As outlined in Figure 10, answering this question requires answering two sub-questions, each of which is addressed by the data from different activities in the training.

Chronology of the Data Collection

As described in the Population and Sample section of Chapter Three, the course activities in which data was collected occurred at different times for the three groups of people who went through the training. Phase 1 STEM began in July 2019, Phase 2 ODL began in June 2020, and Phase 3 ODL began in August 2020. All groups ended in December 2020 (Figure 11).

The training began with emails to participants indicating that their applications had been approved and they could log into the course's Moodle site. Upon logging in, they viewed an outline of the program, with the first assignments ready for completion. Since applicants did not need to demonstrate online competencies in order to be selected for the program, the first assignments required them to use the basic Web 2.0 tools that they would later use as teachers (Trespalacios & Uribe-Florez, 2020, p.; Wiss et al., 2018). Their first assignment was to work collaboratively to develop an online catalog through which they could meet their colleagues and begin developing social presence (for a list of specific activities that this included, see the training Design Documents in Appendices B and C).

Participants then completed the anonymous introductory survey, after which they could see a summary of the other participants' responses (Appendix D). The online self-introductions requested that participants submit a selfie-style profile picture and a brief video or written biographical statement highlighting their professional work.

Following the self-introductions and initial surveys, participants engaged in approximately three hours of week of asynchronous online learning. Because many had already indicated that they used videoconferencing and direct messaging for ODL, the training activities involved exclusively asynchronous methods. This included online discussion forums, pair and group research projects and video presentations, collaborative graphic design, and assignments in which participants could choose from multiple research topics and means of demonstrating their knowledge (see Appendices B and C). The first units of the course explicitly presented constructivism and observational learning as theoretical foundations for asynchronous ODL. These early units also broadened the definition of technology for most participants, from computer-based tools to any tools or methods designed to promote learning. The opening units specifically dealt with issues of social presence, access, and inclusion in online environments, focusing especially on accommodations for students with limited Internet access.

From mid-March through May 2020, most Central Asian countries implemented states of emergency involving severe limits on movement, frequent checkpoints, shutdowns of non-essential facilities, and curfews (UN Office of the Coordination of Humanitarian Affairs, 2020). The restrictions were lifted at the end of May and early June, but this led to massive outbreaks of COVID-19. By mid-August, almost every remaining participant in the training reported having had the virus or caring for loved ones who had it. In late August 2020, governments across Central Asia reversed earlier plans to open schools. Of the 96 Central Asians enrolled in the ODL training in early August, 24 stopped logging into the website or replying to emails but did not officially withdraw from the program, 21 officially withdrew due to work or family responsibilities. 59 continued to actively participate, and 51 submitted final projects. This resulted in the following changes to the training:

- The instructional content on ODL assessment, planned for September, was omitted;
- The weekly online forum interactions were reduced to about one hour per week;
- The planned online conference for presenting participant work was postponed indefinitely;
- Capstone projects were redesigned to allow participants to present their actual ODL courses;
- The deadline for final projects was extended from November 7 to December 18;
- Fifty-.one participants completed a total of 40 projects (several participants worked in groups).

Figure 11 Timeline of Data Collection Instruments and Major Historical Events

Coding the Data

As outlined in Table 8, the data was coded through a combination of a priori and emergent codes. This included the following steps:

1. Coding for Hofstede's cultural dimensions;
2. Coding for TAM;
3. Coding for the categories of ODL that appeared in the literature review for this study;
4. Coding for the categories of ODL that emerged during the a priori coding process;
5. Coding for Barriers and Hindrances that appeared in the literature review for this study.

The a priori categories of ODL that appeared in the literature review include 1) specific apps, 2) specific methods, 3) MOOCs, 4) OER, and 5) Quality Assurance. The emergent coding process added the categories of 6) LMS, 7) Individual Use, 7) Collaboration, and 8) Creation. The a priori categories of Barriers/ Facilitators, based on the literature review, include 1) school environment, 2) cultural environment, 3) infrastructure, and 4) foreign influence. Each of these categories were coded to indicate whether participants mentioned them and whether participants identified them as barriers or facilitators. No emergent codes were added to the Barriers/ Facilitators category.

An additional category of codes became necessary for coding the final projects: evidence of adoption. This category included the codes “little evidence of adoption”, “solid evidence of adoption”, and “innovative attempt to encourage adoption.” All final projects used Web 2.0 technology, but projects with “little evidence of adoption” presented teacher-centered or textbook-centered lessons with little teacher-student or student-student interaction and few opportunities for students to create, present, or solve novel problems. Those with “solid evidence of adoption” used Web 2.0 educational technologies in ways that had been demonstrated, discussed, or tested in the training. The projects categorized as “innovative attempt to encourage adoption” applied principles from the training appropriately but with technologies, educational contexts, or scopes that went beyond the training.

The open-ended survey responses, self-introductions, forum discussions, and final projects were, in effect, different genres. Also, the participants had varying degrees of English proficiency. These factors made it impossible to create a list of key terms indicative of certain codes. Instead, each response and each code had to be considered in its specific context. Table 8 shows examples of the types of participant responses that would elicit various codes. Many of these codes were further divided into “high” vs. “low” (Table 9).

Table 9 Codes and Examples

Purpose	Code Meaning	Examples: High	Examples: Low
Cultural Dimensions	1. IDV: Individualism vs. Collectivism	• "I" / "My" • Leaving the village or family	• "We" / "Our" • Care for parents in the village
	2. PDI: Hierarchical vs. Egalitarian	• Titles • Formal tone	• First names • Personal, Humorous tone
	3. UAI: Positive about The New vs. Negative about The New	• "Let's try it!" • "So many opportunities!"	• "Be careful." • "So many risks."
	4. MAS: Masculine vs. Feminine	• References to prestigious accomplishments • Achievements	• References to home, family, feelings • Relationships
	5. LTO: Compromise vs. Conviction	• "What does research show might work?" • "We can always go back."	• "This is the right way." • "It will never be the same again."
	6. IND: Indulgence vs. Restraint	• "Time to celebrate!" • Optimism	• "Don't fall behind!" • Pessimism
AM	7. PU: Perceived Usefulness	• "You can do so much with Moodle!"	• "I don't need all the tools

	8. PEOU: Perceived Ease of Use	• "Classroom is so easy for teachers!"	Moodle offers." • "Classroom is a pain for administrators."
Web 2.0 ODL	9. Apps: Apps, software, or websites	• WhatsApp, Quizlet, Padlet, Diigo	
	10. Methods: Pedagogical methods	• Flipped Classroom, PBL, SLR	
	11. MOOCs: Massive Open Online Courses	• EdX, Coursera	
	12. OER: Open Educational Resources	• Online libraries, OER sites, Creative Commons	
	13. Quality Assurance: Ensuring that learners mastered objectives or skills	• Tests, quizzes, badges, certificates	
	14. LMS: Learning Management Systems for multiple courses	• Moodle, G Suite, Edmodo	
	15. Individual: Apps or methods to facilitate individual production	• Microsoft Office; individually-utilized apps; individual competitions	
	16. Collaborative: Apps or methods to facilitate collaborative production	• YouTube Studio, Canva, collaborative Docs, group presentations	
Barriers/ Facilitators to Diffusion	17. School Environment	• Curriculum, Schedules, Administrators, Classrooms, Standardized Tests	
	18. Cultural Environment	• Beliefs about learning, Quality of Education, Specific values	
	19. Infrastructure	• Electricity, WiFi, Computers, Tech Support, Mobile Devices	
	20. Foreign Influence	• Imperialism, Foreign Aid, Grants, NGO's	

Diffusion	21. Little Evidence of Adoption: Little collaboration, creation, or creative problem solving	• Using Google Docs only to submit assignments to the teacher
	22. Solid Evidence of Adoption: Appropriately follows models from the training program	• A lesson in a HyperDoc trains students to collaboratively create HyperDocs
	23. Innovative attempt to encourage adoption: Applies concepts from the training with new technologies, concepts, or scopes	• Classrooms used to train teachers to develop Classroom-based public health courses to reduce the spread of COVID-19 in their communities

To focus on the participants' identity as professional teachers rather than their identity as English-language learners, direct quotations are presented in standard English. Simple errors such as capitalization, punctuation, spelling, subject-verb agreement, and article choice, are standardized, and the editorial "*sic*" is avoided (Selinker & Rutherford, 1992; Tarone, 1983).

Rsq1: Changes in Attitudes Toward and Use of Web 2.0 Technologies

The first research sub-question asks, "How do participants' expressed attitudes toward and use of Web 2.0 technologies change during the training?" Evidence to answer this question was collected from initial and final surveys, mid-training forums on hindrances and successes to their attempts to encourage adoption of concepts from the training, and final projects demonstrating their use of concepts from the training.

Rsq1: Evidence from the Surveys

The participants were asked to complete surveys at the beginning and end of the training (Appendix D). These surveys were designed for three purposes. First, they helped the program facilitators design the training to fit the participants' expressed needs. Second, since Google Forms allowed participants to see anonymous summaries of the results, they helped the participants to know each other and facilitated discussion. Third, they provided some evidence of effectiveness of the training for the program sponsors. They involved Likert-scale and open-ended prompts regarding attitudes toward and use of educational technologies and methods, and they included prompts related to cultural values from Hofstede Insights VSM 2013. Only 31 of the participants completed Survey 1, and only 21 participants completed Survey 2. Moreover, since the surveys were anonymous, there is no way to tell whether the same people completed both surveys. Therefore, while the results may indicate general patterns among the population, they do not indicate changes of behavior for specific participants.

Table 10 shows the results of 5-point Likert-scale scores on prompts related to attitudes toward innovation and existing infrastructure at the beginning (Survey 1, $N = 31$ of 96) and end (Survey 2, $N = 21$ of 51) of the program. One respondent selected "Strongly Disagree" for each item on the first survey, and one selected "Strongly Agree" for each item on the second survey. In both cases, these participants' qualitative answers did not align with their quantitative responses, indicating a possible comprehension problem with the quantitative answers. These two respondents were regarded as outliers and their responses on Likert-scale items were not included in the analysis (Hatcher, 2013; Levin & Forde, 2016).

This survey indicates little change in most areas. Prompts 1 and 2 indicate a generally increased positivity toward online courses and interactions with others in the program, but the changes are slight changes from “Agree” toward “Strongly Agree.” There is an increase in perceived negativity communities toward change (Prompt 4) and the use of new technology for education (Prompt 6). There also may have been a decrease in Internet access by the end of the program (Prompts 8 and 9). This change is reasonable, however, given the circumstances of the COVID-19 pandemic. Communities overwhelmed by the changes required for emergency online learning could feel resistant to change in general, and Internet infrastructures were taxed beyond their normal burdens. In general, however, the surveys do not show strong changes in use of technology, attitudes toward technology, or attitudes toward teaching methods.

Table 10 Participant Attitudes and Infrastructure: Pre- and Post-Course Mean Scores

Prompts	Survey 1 $N = 31$	Survey 2 $N = 21$
1. I feel very comfortable taking online courses.	4.19	4.56
2. I will enjoy/ have enjoyed interacting with my instructors in the online part of this program.	4.55	4.80
3. I will enjoy/ have enjoyed interacting with my colleagues in the online part of this program.	4.48	4.68
4. My learning community is very open to change.	3.91	3.72
5. My learning community believes the best teachers are the ones whose students have the highest scores on standardized tests.	3.63	3.80
6. My learning community is very supportive of using new technology for education.	4.13	3.76
7. My learning community is very supportive of innovative teaching methods.	4.34	4.32
8. I have reliable Internet at home.	4.52	4.23
9. I usually have access to an Internet-enabled mobile device.	4.45	4.32
10. I use the Internet a lot in the courses I teach.	3.74	4.48
11. I can use the Internet reliably for classes in my school.	4.25	4.20
12. Being effective in a STEM profession requires... (1 = memorizing a lot of facts and mastering technology. 5 = finding new information and applying it to solve problems in new ways.)	4.72	4.60
13. Students almost always learn most effectively when... (1 = they have an instructor who is an expert in the field and who explains everything well. 5 = they work together to solve problems creatively.)	4.06	4.32
14. What percent of time in a STEM course should usually be spent in lecture? (1 = < 20%; 5 = > 80%.)	2.50	2.52

The surveys indicated some differences between ODL use among this population and those of the developing world, as indicated by the literature review (Figure 12). All participants indicated that they felt support from their communities to implement new technologies or methods, but this is unsurprising as community support was a requirement to enter the program. In addition, almost all agreed or strongly agreed that they had sufficient access to the Internet and computers at school and home, although almost a third indicated that Internet access could be problematic for their students. Although the literature review for this study found a high level of interest in MOOCs, OER, and quality assurance through digital badges or blockchain, these surveys showed no interest in these topics by participants in the training. This, however, is not surprising, as all but 4 participants indicated that they had little or no experience with teaching online prior to March 2020.

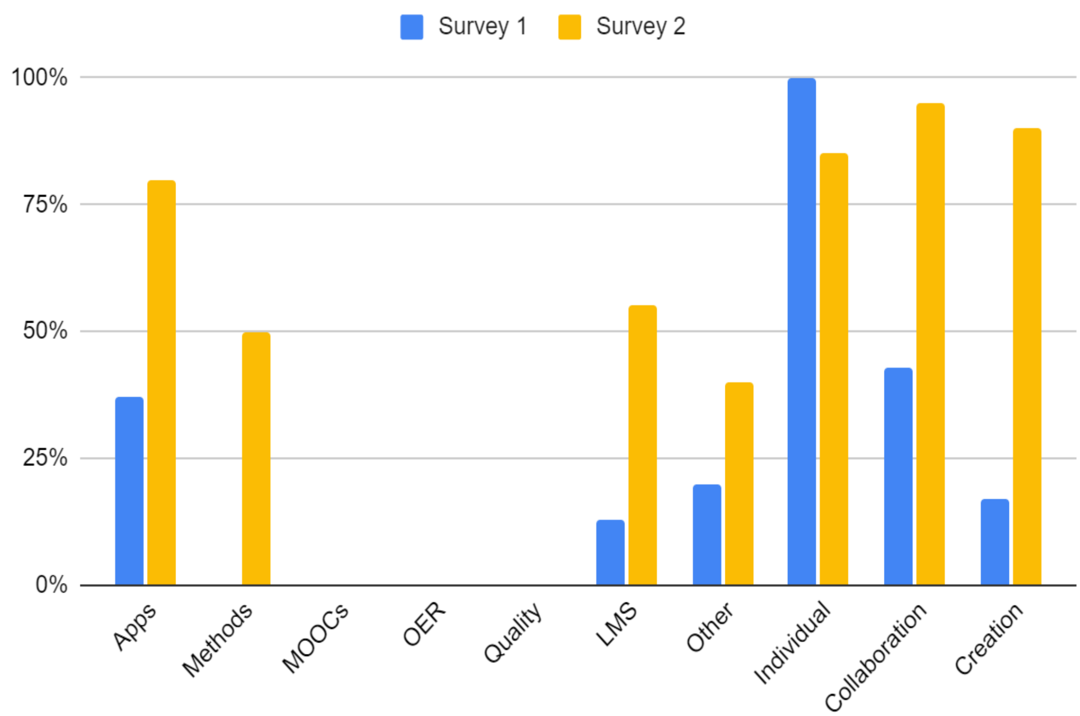


Figure 12 Changes in Web 2.0 ODL Use: Survey 1 and Survey 2

The training did not include explicit instruction regarding MOOCs, OER, or quality assurance, and Figure 11 shows that there was no evidence of change in participants' attitudes toward these ODL tools from the surveys. However, there was a marked increase in participant responses indicating the use of specific apps, methods, LMS', and other educational technologies such as the use of augmented or virtual reality, makerspace, or gamification. The increases in use of asynchronous methods and LMS's are especially notable given the skepticism some showed about these topics on the initial survey. For instance, Aliya bemoaned that, although adopting an LMS may be eventually beneficial, "no one actually knows how to do it right." Irina "refused this idea [of asynchronous learning] immediately because a live atmosphere and interaction are very important for me in class." However, the surveys indicate that the use of these technologies increased substantially during the program.

The largest category of change was Content Creation. Items were coded as creation only if they involved students or teachers producing new content through video, wikis, websites, or collaborative research that made new information available to the class or wider world. This category grew from 17% on Survey 1 to 90% on Survey 2.

The only category that showed a decrease during the training was the use of apps that primarily promoted individual or synchronous work. On Survey 1, 100% of respondents said their educational technology use consisted mostly of apps for individual communication (e.g. WhatsApp) or individual production (e.g. Microsoft Word, Excel, PowerPoint). On Survey 2, only 85% mentioned these technologies. This decline in individual-focused apps was mirrored by more than doubling (43% to 95%) of reports indicating the use of collaboration-focused Web 2.0 apps such as Canva and G Suite.

Rsq1: Evidence from the Forums

Two to three months into the training, depending on the iteration, an assignment asked students to address the possibilities of diffusing the methods and technologies from their training into their communities. This forum on hindrances began with an assignment that explained the principles of a SWOT Analysis (Strengths, Weaknesses, Opportunities, and Threats) (Amando et al., 2018; Cabanis-Brewin, 2014). It then asked participants to prepare a table or infographic outlining these issues for Web 2.0 educational technology and related methods (Schooley, 2019). The forum on successful diffusion simply asked participants to report a successful experience introducing the concepts or technologies from the course into their communities.

Coding forum responses for the types of ODL that had been indicated by this study's literature review indicated general alignment of the forum responses with the survey results regarding attitudes toward and use of Web 2.0 educational technology. However, the open nature of the forums indicated some interest in OER (18%) and quality through digital badges (6%) that had not appeared on the surveys. The forums, like Survey 2, indicated a growth of interest in specific apps, methods, LMS use, collaboration, and online content creation. On Survey 1, no one mentioned specific methods for ODL, but 71% mentioned specific methods in the forums. On Survey 1, 43% mentioned collaborative tools, but 100% mentioning them in the forums. The most notable decrease is, again, the decline in mentioning individual-oriented apps or tasks, which dropped from 100% on Survey 1 to 12% in the forums.

Participants overwhelmingly saw the biggest hindrances to diffusing Web 2.0 ODL and related methods to be teachers in their own countries. For instance, Aigerim, a young teacher from a mountain village said, "[my country] has many old-fashioned teachers, who like the traditional way of teaching." Guljamal, one of the older participants, commiserated, "Older teachers are always skeptical of new technologies." One of the few computer programming teachers, Aisha, however, was more specific in her criticism, saying that IT teachers could easy adapt methods of collaborative research and problem solving because their goal was to help students meet customer expectations, but,

> for math teachers, it is important that students master, for example, the solution of differential equations. That's all. Math teachers no longer care if students will be able to apply their knowledge or not…. Math teachers are not interested in improving something. As a rule, they are not innovative; they are inert.

None of the participants specifically named constructivism or methods such as collaborative learning as especially aligning or conflicting with their cultural values. Several cited specific governmental or institutional proclamations indicating the need for better methods for STEM education. However, Nadia pointed out that “IT professionals do not go into teaching, so there has been a drop in the relevance of university education in the IT field.” She went on to blame inadequate primary and secondary educational programs, claiming that “applicants are at a low level, so they have a fear of studying natural science disciplines at the university.” Mahabat, a young teacher in a prairie town, agreed that “entrance exams are mostly based on memorizing information,” and concluded forebodingly that “not everyone will be pleased by new standards for education.” Many participants expressed their own hesitancy with the concept of collaborative problem-based learning. Olga, one of the senior mathematics teachers at an elite urban private school, was one of the first to report her attempt to use problem-based learning combined with Web 2.0 collaborative research:

> The result was sad. Students said they were not used to this approach. What is more understandable for them is following the logic of a presentation of the material: "theory → slides on the screen → sending the material told by the teacher by e-mail → passing the test."

In other words, her students, who were among the wealthiest and most educated in her country, expected ODL to consist of video presentations of facts that they would memorize during class time and recite for standardized tests. Olga went on to question the appropriateness of SLR for PBL in her cultural context, explaining that, “the need for independent work at home to study the material, for them, was unattractive." Olga admitted disappointment "with the result of my experiment," but a willingness to "study this approach in more detail and try to apply it again."

Many teachers expressed a dilemma because they were simultaneously attracted by the possibilities of new means of learning and skeptical the practicality of attempting these methods. Over 80% of responses in discussions of hindrances to the diffusion of course content mentioned the difficulty of changing teachers' practices, changing parental expectations, changing student expectations, or changing systems. Some participants, such as Anya, a math teacher who has lived through several revolutions and coups, seem to have despaired of systemic reforms due to the way confounding socio-historical variables left "no way to make a statistical analysis based on previous experience in our country." Aijamal, a young English teacher, expressed the frustration of many early adopters in cultures that value avoiding uncertainty, observing that "all people believe in a better future, but most of them just sit and wait for the miracle to come."

Many of the participants noted success diffusing the methods and technologies in a wide variety of classroom contexts. Mahabat, for example, used the flipped classroom method (watching content-filled videos as homework and coming together to apply new knowledge) to initiate SLR for PBL with 5th-graders learning to design eco-friendly homes. Nazima reported surprise at the effectiveness of flipped classrooms in her online 11th-grade chemistry class:

> I tell them to take important notes and write questions on parts that they did not understand. And here we go! The next day, during the

> lesson, I can feel that the students are encouraged enough to discuss with the new chapter with me!

Aijamal also reported that guiding student groups through online collaboration and research in problem solving resulted in students discovering mathematical concepts that "they do not need to learn until next year." Ruslan observed that student performance in collaborative PBL for mathematics and geography, using Internet maps and online graphing calculators, was more conceptually advanced than in face-to-face lessons. Suita developed a series of collaborative-research lessons that lead high-school students to develop augmented reality (AR) tools. Talaibek worked with his department to create do-it-yourself chemistry and biology laboratory activities for high-school students to complete at home during the COVID-19 lockdown.

Many teachers also reported successful work to spread adoption of innovations on department- or school-wide levels. Aidai, for example, reported enthusiastically that,

> A year ago, I couldn't even imagine how to use different online tools. But as it turned out, I'm the most skilled at my working place, so I taught my colleagues and about 25 methodologists [i.e. teacher trainers] to create courses in Google Classroom, make videos by Inshot, do evaluation by Mentimeter and Google Forms, and organize discussions by using Jamboard and Padlet. Now if any group invites me to organize trainings, I refuse to use flipcharts. Instead of wasting paper, I offer all materials online.

She went on to explain that she found the methods she had learned for teaching STEM applicable to many other subject areas, so she used the methods with teams of curriculum developers in her region “to enrich the learning materials on sustainable development for 5-6 Grade students…. [developing] lessons on social justice, gender equality, people with special needs, religion, etc.”

Over ten percent of the participants received professional recognition for diffusing the training they received in the program. Begimai and Maria generated so much interest in PBL that their students successfully petitioned for space and materials for makerspace clubs in their respective schools. Gulmira and Mirza were offered leadership roles in their regional English teachers’ associations following a presentation of their work with problem-based learning in their respective countries. Janara’s professional development presentations on problem-based learning for architecture resulted in her winning a competition to attend a seminar on digital architecture in St. Petersburg. Jalil presented the results of his online mathematics investigative research groups to the Ministry of Education in his country and given a position designing and coordinating ODL preparatory groups for a national mathematics competition. Azamat led a series of professional development discussions based on his applications of course concepts and was promoted to the chair of pedagogy for his university. The case study of his experience with Web 2.0 for collaborative learning is in the peer-review process for a regional academic journal.

Reports of successfully spreading course concepts and technologies were met by cheerful congratulations by others in the training program, and the reports of success frequently were shared via the course’s WhatsApp group so that the celebratory responses could come more quickly and personally. This study does not include data from the WhatsApp group. However, Aliya's comment on the forum is an example of the joy participants often showed while reporting successes:

> At first, I thought I would die bravely in the battle with online teaching. Then, when I somehow could handle the technology, planning, and conducting process, I saw that my efforts are not in vain. It worked! Children were really learning, the lessons were going smoothly, and I could finally enjoy my teaching. I was happy as a baby and even danced a victory dance!

Rsq1: Evidence from Final Projects

The final projects for the training instructed participants to provide evidence of applying concepts from the training to their classes. Some of these projects included a written description of a course or courses with links to key websites or pages. Other participants made screen-capture videos to show their course websites, accompanied by voice-over narration. All provided a summary of the lesson, unit, or course, with a reflection on how they had applied principles from the course. Participants were told that their projects should demonstrate core principles and apply them to the design of a complete module of a course.

The capstone projects were not graded in the training, but they were coded for this study according to three categories: *little evidence of adoption, solid evidence of adoption*, and *innovative attempt to encourage adoption.* Those with little evidence of adoption of the course concepts were characterized by little student-student interaction, little collaboration, little research, little creative problem solving, little learner presentation, few lessons, and little creativity. Seventeen percent of the final projects were rated as showing little evidence of adoption. Solid evidence of adoption involved demonstrations of many of the course concepts, development of multiple lessons or units, and applications of concepts that clearly demonstrated principles from the training. Fifty-three percent of the final projects were rated as showing solid evidence of adoption. Innovative attempts to encourage adoption involved demonstrating most of the course concepts on a scale or in contexts that went beyond any examples presented in the course. Thirty percent of the final projects were classified as innovative attempts to encourage adoption. The complete rubric for coding the final projects is presented in Table 11.

Table 11 Rubric for Final Projects

Criteria	Innovative attempt to encourage adoption	Solid evidence of adoption	Little evidence of adoption
Application of Web 2.0 EdTech	>3 of the following: o Student-Student Communication; o Collaboration; o Research; o Creative Problem Solving; o Presentation by Learners.	2-3 of the following: o Student-Student Communication; o Collaboration; o Research; o Creative Problem Solving; o Presentation by Learners.	<2 of the following: o Student-Student Communication; o Collaboration o Research; o Creative Problem Solving; o Presentation by Learners.
Project Scope	Any of the following: o A complete course; o A series of courses, even if not all are complete;	o A complete 2-4 week unit of a standard course.	o A partial unit, incomplete course, or a few lessons.
Project Creativity	o Applies Web 2.0 technologies for purposes or scales far beyond those presented in the training. o An application outside of traditional structures for learning.	o Applies Web 2.0 technologies as promoted in the training.	o Limited use of Web 2.0 technologies for collaboration; o Relies on apps or methods that do not foster collaboration (e.g. Presenting a lecture or textbook page online.).
	12 (30%)	21 (53%)	7 (17%)

Number of Projects

As Figure 13 shows, non-collaborative technology was only recorded in the final projects of the Low Adoption group, 86% of which either relied extensively on apps designed for individual use or used Web 2.0 tools in ways that did not allow peer-to-peer communication. The Low Adoption group was also characterized by low levels of student interaction, SLR, collaboration, PBL, student presentations, and LMS use. In contrast the Solid Adoption group was characterized by high levels of student interaction, presentation, and LMS use, but mid-range levels of SLR, collaboration, and PBL. The participants coded as "Innovative attempt to encourage adoption" exemplified 75-100% application of Student-Student Interaction, SLR, Collaboration, PBL, Presentation, and LMS Use. None of these students mentioned regular use of apps designed primarily for individual purposes.

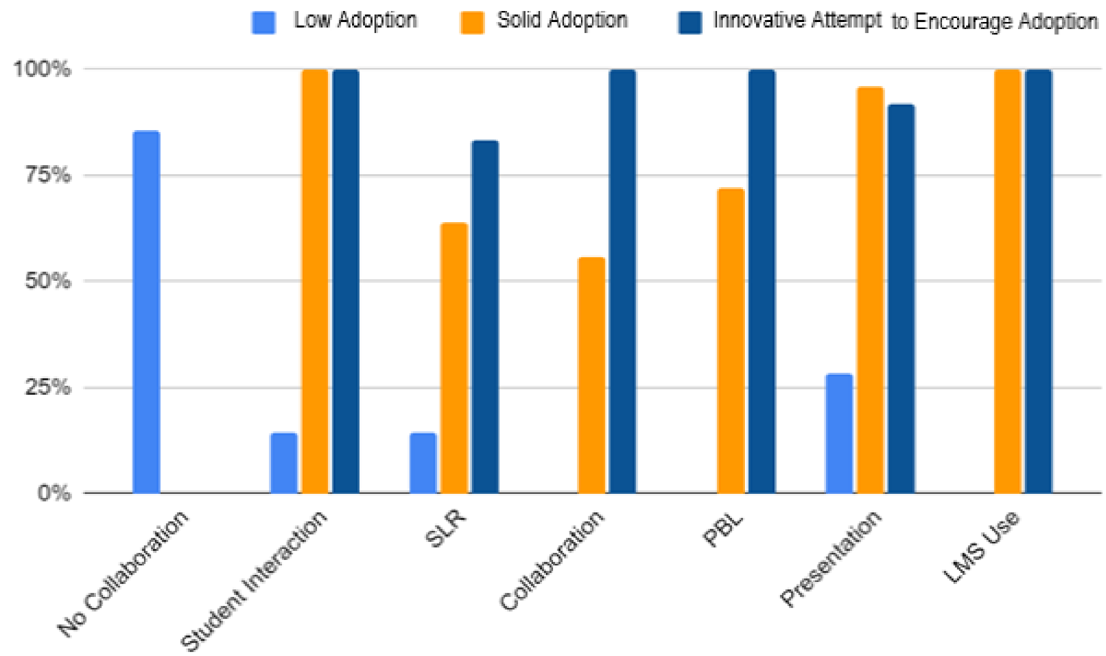


Figure 13 Which ODL Technologies were Adopted?

<u>Little Evidence of Adoption.</u>

Seven (17%) of the 41 final projects showed little or no evidence of the participants adopting the Web 2.0 tools or methods from the training in ways that promoted discussion for collaborative research, problem solving, or application. Gulbuhar, for instance, submitted a Microsoft Word document explaining that she would use the WhatsApp messaging app to send YouTube videos to students and collect their answers to multiple-choice quizzes. Chynara presented a 45-minute video of a Zoom call in which none of her 15 middle-school students turned on their cameras or talked to each other. Mirgul, Nazima, Eliana, and Aijamal used Google Classroom, but only to present content from the teacher, collect individual assignments, and assign grades.

It may be suspected that the participants who did not adopt Web 2.0 ODL methods shared some commonalities. These non-adopters were women, but many women emerged as innovators. These participants came from Kyrgyzstan and Uzbekistan, but so did most participants in the study. There were no common factors in terms of or subject of instruction. Some taught lower-elementary courses and some taught adult education. One taught art, three taught math, and four taught English. However, these non-adopters tended to have two traits in common. First, they had similar projects to those of their colleagues at the same schools. In fact, five of these seven projects came from two schools. Second, as will be discussed regarding the second research sub-question, they tended to value high Power Distance and high Masculinity more than their colleagues.

Solid Evidence of Adoption.

Twenty-five (61%) of the 41 final projects clearly demonstrated the principles of using Web 2.0 for collaborative, creative, project-based, student-centered lessons. These projects used LMS's, with the favorite being Classroom, followed by Moodle, Moodle-Classroom combinations, and other programs. Twenty-four (96%) of these 25 solid-adopters included student-created video presentations. Eighteen (72%) of these projects included PBL. Sixteen (64%) involved SLR. Fourteen (56%) included interdisciplinary collaboration between teachers. Perhaps most striking, considering the initial participant reliance on messaging tools such as WhatsApp, only three of the final projects included messaging, and these projects limited its use to helping the parents of elementary students understand assignments. Likewise, while nearly all participants reported using Zoom at the beginning, only 43% used synchronous meetings for their capstone projects, and they used these meetings primarily as tools for motivation and engagement, not as the primary means of content delivery. The classes ranged from English-language for kindergarten to university-level physics and professional development on teaching methodology.

The final projects showed the attempt to encourage adoption of a wide range of Web 2.0 ODL technologies. For example, Indira, an elementary English teacher in a small city, developed PBL activities focusing on STEM content for her students. Then she shared the idea with teachers of other foreign languages so that all foreign language students in her school presented STEM concepts through their foreign language courses. Salta focused her Grade 5 English class on the theme of learning effectively in ODL. This resulted in students collaboratively researching and creating educational videos that taught their peers, in English, how to use each G Suite for Education app. Djamila's Grade 3 students researched each weekly theme to present in Google Slides or Flipgrid in synchronous "film festivals," that allowed students to discuss their work. Ulugbek created a YouTube channel with video tutorials on cooking, using Moodle forums as a venue for high-school students to display and discuss their own cooking videos. Aliya created a course in teaching methodology through Microsoft Teams, requiring student teachers to conduct their own research projects on theories and methods and present their findings in the media of their choice. Many of her students reported that they found the Web 2.0 tools for ODL more effective than face-to-face interaction for some learning objectives. Perhaps the most complimentary project adaptation was developed by five colleagues at a university in a small city. They developed a seven-week ODL professional development course to help teachers become "STEM Ambassadors." The course was developed in Moodle, as their own training course had been, and the syllabus, training videos, readings, and assignments were heavily plagiarized from the training described in Appendices B and C, with translations and annotations in local languages. In December 2020, they were halfway through their first iteration and planning to run the course again in the spring. These types of applications were directly in line with models of course projects presented in the training, but with adaptations for new courses or ages of students.

As the “STEM Ambassadors” program shows, community practice appeared influential in the participants’ final projects. People from a specific school almost always chose the same LMS and Web 2.0 tools, and they almost always chose similar means of employing the tools. For instance, Ulugbek, Mirza, Jyldyz, and Mirgul were the only participants to use Google Sites to communicate weekly objectives and assignments with parents, and they all worked at the same private school. Umida and Nataliya worked in the same region and found similar ways to use Web 2.0 despite principals requiring them to record daily student progress on regional-standard worksheets and prohibiting them from using texts and videos that had not been officially approved. Local-community expectations seemed as influential with the solid adopters as with the non-adopters.

Innovative Attempts to Encourage Adoption.

Twelve of the 41 final projects (30%) showed innovation and the attempt to encourage adoption of concepts in ways that surpassed expectations of the training. DoI theory would lead to anticipating 2.5% of a population as innovators and 13.5% as early adopters (Rogers & Ellsworth, 1997). This would lead to expecting one innovator and seven early adopters in a standard group of 51 people, with higher numbers in a group that self-selected to study innovations. In view of this distribution, the following projects indicate an exceptionally high number among the participants, and a lack of cultural barriers toward the adoption of Web 2.0 educational technology in the participants’ communities.

Three of the participants developed courses using Web 2.0 technologies that were never discussed in the training. For example, Jalil was unimpressed with the virtual reality and mathematics modeling allowed by Moodle, so he developed university-level Physics 1 and 2 courses using the LMS MyOpenMath. Within this environment, cohorts of students conducted collaborative SLR within virtual-reality labs and presented their findings to their peers in synchronous video conferences. Anya, a programming instructor, found Moodle and Classroom too constraining, so she developed her own website to guide students through multiple semesters of PBL training in programming and design. Student teams learned to research coding solutions, produce original apps, and share their work though an Instagram site integrated with the course. Janara integrated her ODL high-school leadership class with Facebook so that her students could learn to apply social media messaging, crowdsourcing, and crowdfunding to social problems caused by COVID-19 in their communities.

Two of the participants led school-wide implementation of Web 2.0. Nadia had been teaching online for over a decade but had been unable to interest her university in the potential of ODL. Her final project, however, involved creating over fifteen courses on ICT and a course on “Online Teaching Methodology” for colleagues in other departments. Her course on pedagogy emphasized ways to improve student collaboration, SLR, and PBL, and required participants to demonstrate those methods in their ODL coursework. Orfey was the only participant to see the possibility of Web 2.0 for developing cMOOCs. By August 2020, he had developed a state-sponsored Moodle site and had over 300 students in foreign language courses. He then accepted a position as director of ODL for a university that, under his guidance, has implemented Moodle for all courses and required collaborative SLR and PBL throughout the curriculum.

Finally, three participants saw the potential of Web 2.0-based ODL to provide opportunities outside traditional educational systems. Aijamal, the head of the foreign language department at her university, recruited a foreign biology scholar to collaborate in creating an “English through STEM” competition for university students around her country. The competition was designed to encourage “learners to explore English and IT …beyond the scope of the university curriculum” through collaborative ODL research and PBL. Participants in her program demonstrated their learning through ODL presentations that showed they had learned to “take responsibility for their own learning; be empowered in the rigors of academic writing; think critically and creatively; develop computational thinking; develop collaboration, work in teams; and so on.” Makhamad saw a similar potential in mathematics and used Moodle to create an online program that prepared 52 students from six village schools for national and international mathematics competitions. He is currently hoping to publish a study on this program, as he found “strong statistically significant correlations” between frequency of using the course site and upper-percentile scores in the competitions. Ruslan created a Moodle debate club that allowed students from many villages in his mountainous region to train for and participate in competitive online written and video debates during the COVID-19 lockdown. Dina decided to use Google Classroom for public health education:

More and more people are using alcohol having heard that it helps to combat the virus. Especially reliable information is not accessible in [my native] language, and the majority of village people do not read newspapers or watch TV. They do what their nearby people say, but those people can give misinformation…. In this situation, the teachers will be a bridge between people and medicine. All the knowledge on preventing and combating the virus will be spread by the teachers through online platforms. We are making the teachers' job easy and effective, having prepared five levels with three lessons each on preventing Covid.

Dina received a grant from an international donor to fund this training, which provides teachers with information on COVID-19 and contains instruction on how they can replicate this course or create their own G Suite courses. Alisher's final project, a collection of ICT courses, led him to a new job as the director of ICT and ODL at an elite private school. However, his final project ended with an open letter to other participants inviting them to help start a multinational Web 2.0 ODL school for Central Asian students who are unable to access traditional education.

As with the non-adopters and solid adopters, local community expectations seemed to influence the behavior or these innovators. Anya and Nadia, both of whom showed innovation in programming and IT course development, shared an office at their university. Dina entered a community of international scholars and donors to complete her work. Makhamed, Aijamal, and Ruslan were from different countries, but they worked together in PBL and research groups together several times in the training, and all produced final projects related to multi-school extracurricular gamified learning. Orfey and Alisher also worked together often on PBL in the training and produced final projects exploring systemic change. As with the non-adopters and strong adopters, the innovators seemed to be influenced by the expectations of a community.

Rsq1: Summary of Findings

The first sub-question for this study asks how participants' expressed attitudes toward and use of Web 2.0 technologies change during the training. The summary answer is that participants' expressed attitudes toward and use of Web 2.0 technologies increased during the training, particularly regarding the use of specific methods (e.g. PBL, SLR), collaboration, the use of LMS's, and content creation.

Figure 14 shows a slight rise in mentions of specific apps used for teaching STEM or ODL. However, it shows an increase in references to specific methods discussed in the training, such as flipped classroom, PBL, and SLR. It should be noted, however, that the null response for methods on Survey 1 may simply indicate that the participants had not considered the importance of methods in their answers to open-ended questions. Therefore, the increase in reference to methods does not necessarily represent an increase in use of these methods; it may only indicate that the participants increased their awareness of the need to mention these methods when discussing teaching.

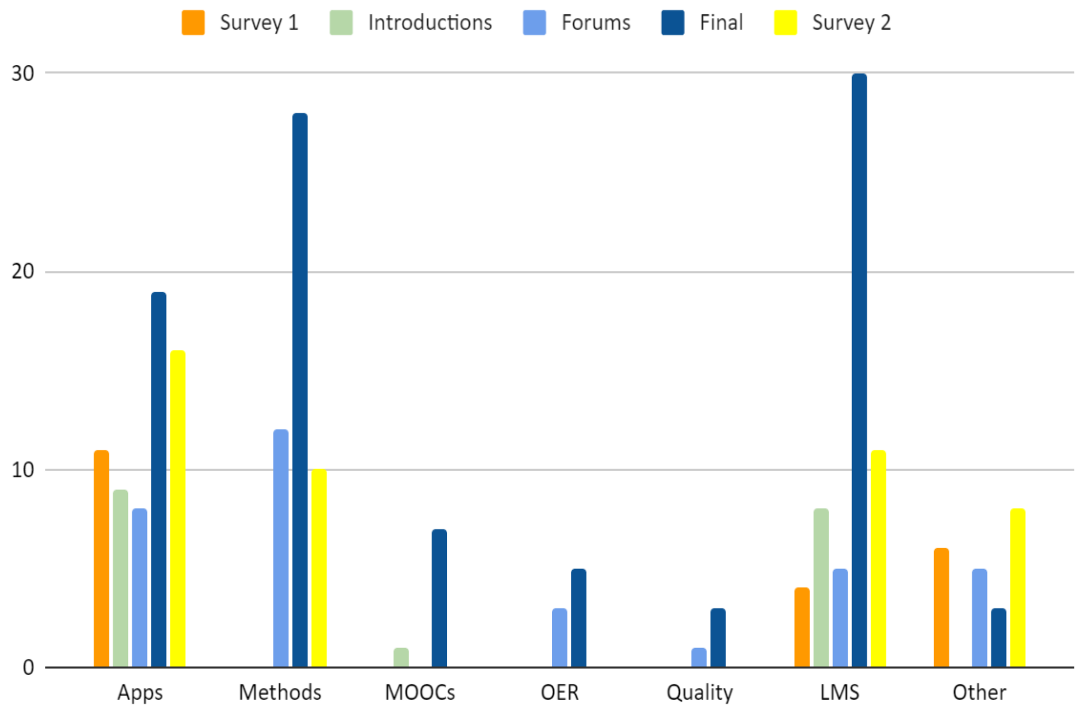
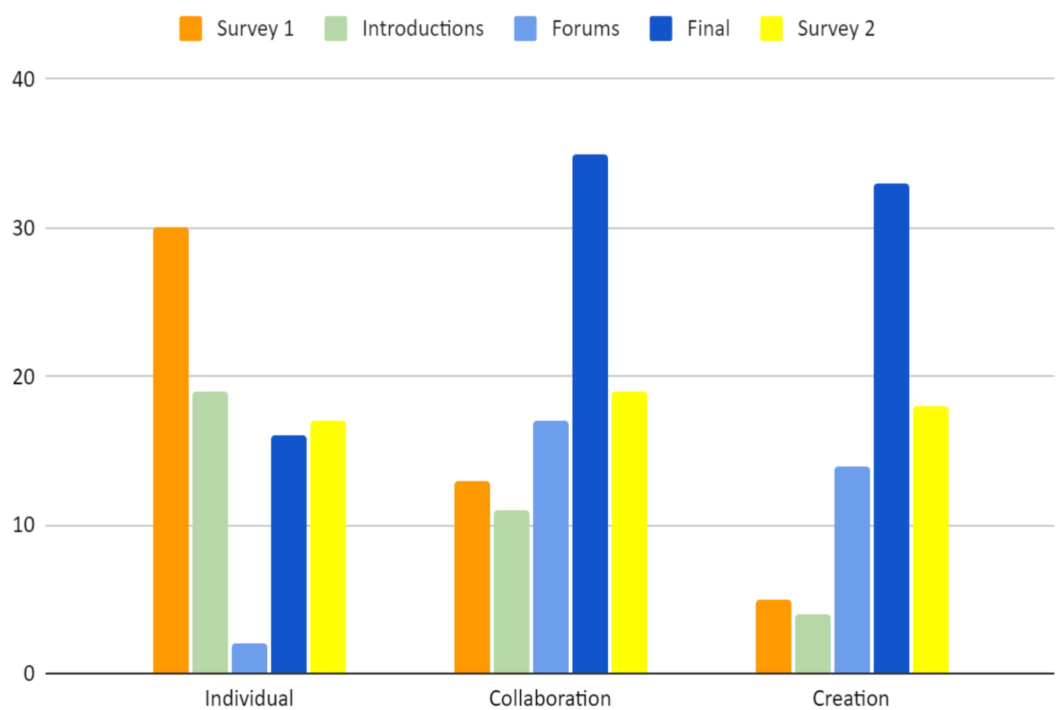


Figure 14 Changes in ODL Categories from the Literature Review During the Training

Although the literature review for this study gave reason to believe that the population would be interested in MOOCs and OER, these participants had relatively little interest in subject. No one mentioned MOOCs or OER on the surveys, less than 20% of the participants mentioned OER in the forums or final projects, and only 18% made any reference to MOOCs in their final projects. Interest in methods not directly taught in the program, such as the use of AR/VR and gamification, attracted the interest of 15-40% of the participants at various times in the training. However, interest in LMS's grew from interesting 13% to interesting 77% of the participants during the program.

The use of apps for collaboration and creation increased from well below 50% to over 80% for participants in this study. This increase in collective learning and production was again mirrored by a decrease in reported use of individual-focused educational technology. Individual-focused apps were mentioned by 100% of the respondents to Survey 1, but only 12% of the forum participants. 82% of the respondents to Survey 2 indicated still using individual-focused apps regularly, but 59% of the participants did not use individual-focused apps in their final projects (Figure 15).



Figue 15 Changes in Individual, Collaboration, and Creation App Use through the Program

To answer the question of attitudes toward Web 2.0 educational technology, the surveys, forums, and final projects were coded with the TAM categories of High Perceived Utility (High PU), Low Perceived Utility (Low PU), High Perceived Ease of Use (High PEOU), and Low Perceived Ease of Use (Low PEOU). This coding shows (Figure 19) that there was a generally high PU towards Web 2.0 educational technology throughout the program, with nearly all respondents viewing it as highly useful on Survey 2. PEOU, however, tended to be much lower. This would seem to indicate that PU may be a more affective factor than PEOU in decisions to adopt or diffuse Web 2.0 educational technologies. However, this conclusion is suspect since 33-75% of participants gave no codable TAM response on any of the instruments used. Moreover, 33-54% of respondents indicated responses related to PU or PEOU but did so in ways that conflated the categories or noted that, regardless of personal preferences, they were required to use specific technologies by their schools, districts, or countries (Figure 16). While this finding in no way disproves the TAM, it aligns with the findings of others that the TAM may not be a useful predictor in some cultures (Faqih & Jaradat, 2015; Hetrick, 2019; Jaradat & Al-Mashaqba, 2014; Lala, 2014).

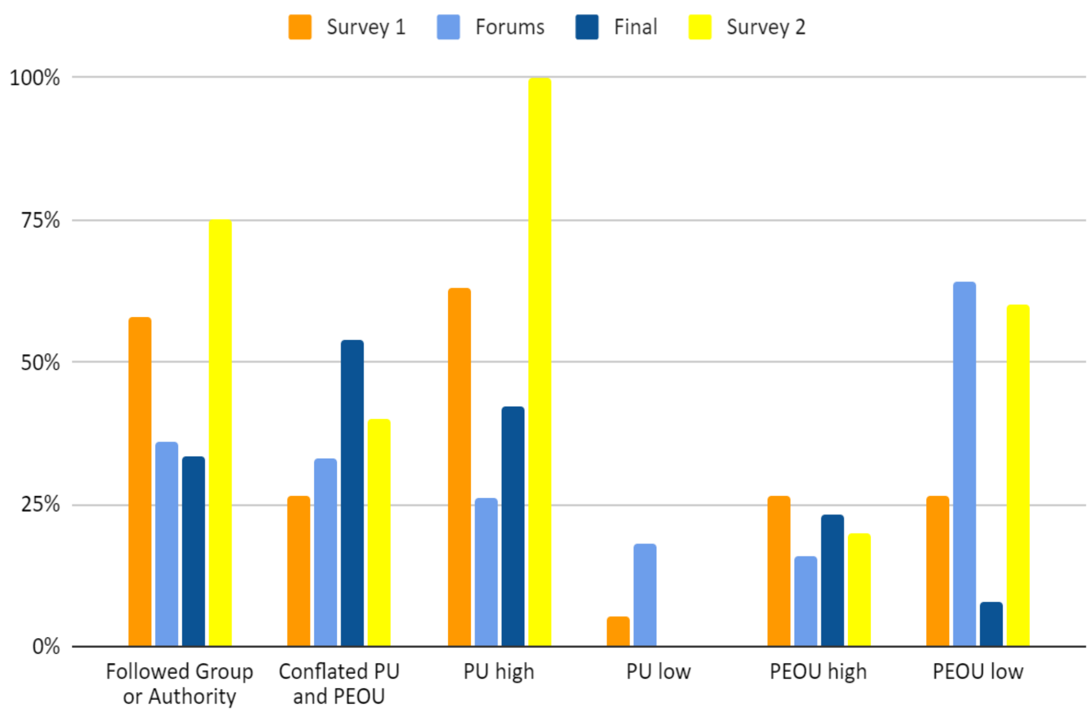


Figure 16 TAM Categories throughout the Training

Finally, the surveys, forums, and final projects were coded to indicate barriers or facilitators to the adoption or diffusion of Web 2.0 educational technologies. The focus categories for barriers and facilitators were based on the categories that appeared during the literature review for this study: *school, culture, infrastructure, foreign,* and *other.* As Figure 20 shows, school and culture appeared as the biggest barriers. This should not be surprising, though, as the participants were selected, in part, based on their claim to having sufficient infrastructure to participate in the training. The literature review indicated that foreign influence, school requirements, and cultural values could be major causes for concern in diffusing Web 2.0 educational technology. However, up to 40% of respondents in this study listed school as a facilitator for spreading the technologies and concepts. Approximately equal numbers named culture and infrastructure and barriers and facilitators. No one listed foreign influence as a barrier, and almost 10% listed it as a facilitator. However, it should be noted again that the participants were responding from within the context of a program that was endorsed by their school supervisors and sponsored by a foreign host, so their responses may be influenced by multiple factors (Figure 17).

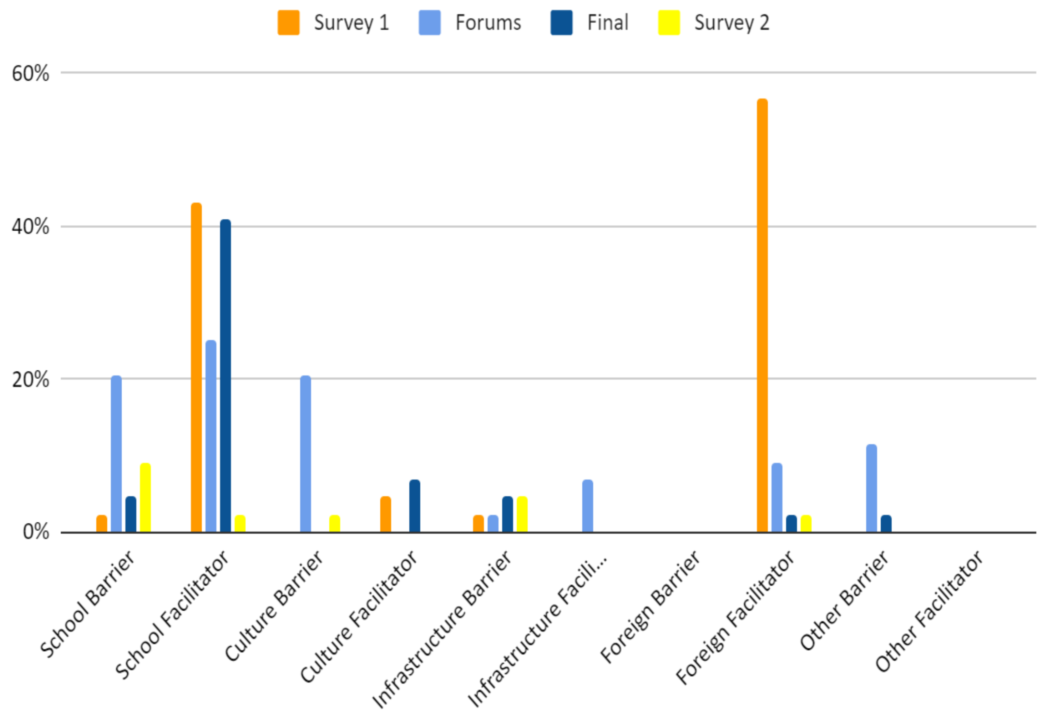


Figure 17 Perceived Barriers or Facilitators of Diffusion

Rsq2: Cultural Values in Relation to Attitudes Toward and Use of Web 2.0 Technologies

The second sub-question for this study's research is, "What cultural values, as described by Hofstede, are most relevant to participants' attitudes toward and use of Web 2.0 technologies?" Answering this question involved comparing quantitative results from the initial and final survey items that included Hofstede's Values Survey Module 2013. It also involved coding the participants' self-introductions, survey responses, forum discussions, and final projects according to Hofstede's cultural dimensions, which are discussed in the literature review for this study.

Rsq2: Evidence from the Self-Introductions

The self-introduction assignment at the beginning of each iteration of the training required participants to submit a short biographical statement and portrait to a collaborative Google Sheet. The examples provided by the three American facilitators were designed to promote social presence (Bozkurt & Tu, 2016; Lowenthal & Dunlap, 2018; Song et al., 2019). They set a tone of informal collegiality, including selfie-style photographs and third-person biographical statements that included references to family members, hobbies, and self-deprecating humorous references to needs for greater sleep or exercise. The facilitators also recorded short, conversational introductory videos in which they added details about their personal life and personality. The American models set an example of informality (low Power Distance), vulnerability (low Masculinity), and cooperation (low Individualism).

Coding the responses to the self-introduction process was unexpectedly simple because the participants' responses were unexpectedly uniform. Even though the assignment instructed participants to use informal photographs and "help us get to know you," 94% of the participants submitted unsmiling institutional or passport photos. The remaining six shared photographs of themselves receiving professional awards. This, combined with long lists of professional accomplishments, indicates a high value on Masculinity (MAS). This high-MAS value also appeared in their references to family relationships. Although family relationships are highly valued in Central Asia, only twelve (20%) of the participants mentioned family members.

The instructions and models for the assignment indicated that participants should tell about their personal lives. However, only seven (12%) mentioned hobbies. These were coded as low-Power Distance (PDI). Also, although participants were instructed to make informal videos, only two submitted videos, and they appeared to read or recite their biographical texts. Over 70% of the participants emphasized their lengthy experience in education. These types of responses were coded as high-PDI.

Responses indicating frequent new ventures or changes of location were coded as low for Uncertainty Avoidance (UAI). Responses indicating leaving family to pursue personal or professional goals were coded high for Individualism (IDV), while those indicating staying in their hometown or living with family were coded as low-IDV. High Long-Term Orientation (LTO) was indicated by references to working with organizations that may have competing values, such as the Peace Corps and the national military. Responses were coded for low-LTO, on the other hand, if they clearly stated beliefs or principles that could differentiate them from the group, such as two participants naming aspects of their education that openly marked them as belonging to a minority religion in the region.

None of the participants gave responses that could be coded for Indulgence or Restraint (IVR). This is not surprising since it would generally be unusual for someone introducing themselves in a professional setting to tell of their love for big parties or their admiration of frugality. In fact, none of the qualitative instruments in this study showed codable data for the IVR category. Full coding of cultural dimensions in the self-introductions (Table 12) indicates that the group began the training with high values of Power Distance (PDI = 140) and Long Term Orientation (LTO = 147). They had mid-range values for Individualism (IDV = 80), Masculinity (IDV = 90). They had a very low value of avoiding uncertainty (UAI = 10). There was no indication in their responses of valuing Indulgence or Restraint.

Table 12 Coding Self-Introductions for Cultural Dimensions

Cultural Dimension	Number	Percent
IDV high	22	49%
IDV low	10	22%
IDV Ratio ((IDV high + 5)/(IDV low + 5))*50)-10)	80	
PDI high	31	69%
PDI low	7	16%
PDI Ratio ((PDI high + 5)/(PDI low + 5))*50)-10)	140	
UAI high	8	18%
UAI low	27	60%
UAI Ratio ((UAI high + 5)/(UAI low + 5))*50)-10)	10	
MAS high	27	60%
MAS low	11	24%
MAS Ratio ((MAS high + 5)/(MAS low + 5))*50)-10)	90	
LTO high	17	38%
LTO low	2	4%
LTO Ratio ((LTO high + 5)/(LTO low + 5))*50)-10)	147	
IVR – No data	0	

Rsq2: Evidence from the Surveys

The first week of the course gave participants both self-introduction assignment and the first survey. Final surveys were given to all participants in December 2020. The surveys (Appendix D) included Likert-scale and open-ended prompts regarding pedagogical methods and educational technology use. These surveys also included the Likert-scale prompts from Hofstede's Values Survey Module, which is designed to aid with discussions of cultural values within organizations (Hofstede, 2013).

Quantitative Results from the Surveys.

The Likert-scale survey results from the Values Survey Module 2013 were tabulated as instructed in the Values Survey Module, not coded. These scores are not normed for comparison with official surveys on the national level, but they may be used to show relative values within an organization (Hofstede & Minkov, 2013). As previously mentioned, the number of respondents for the surveys is small, and the surveys were given anonymously. There is no way to determine if the same people took Survey 1 and Survey 2, so statistical analysis of these results would be suspect (Hatcher, 2013). These quantitative scores (Table 13) indicate an increase in the value of Power Distance (Survey 1 PDI = 19.00; Survey 2 PDI = 31.43). They also show decreases in Long-Term Orientation (Survey 1 LTO = 24.00, Survey 2 LTO = 12.14) and Indulgence (Survey 1 IVR = 25.00; Survey 2 IVR = 13.81). There is little evidence of change in Individualism (Survey 1 IDV = 31.33; Survey 2 IDV = 33.33), Masculinity (Survey 1 MAS = 9.33; Survey 2 MAS = 10.00) or Uncertainty Avoidance (Survey 1 UAI = 62.67; Survey 2 UAI = 61.67).

Table 13 Changes in Cultural Values based on Survey 1 and Survey 2

Cultural Dimension	Survey 1 *N* = 31 of 96.	Survey 2 *N* = 21 of 51.
PDI (Power Distance)	19.00	31.43
IDV (Individualism vs Collectivism)	31.33	33.33
MAS (Masculine vs. Feminine)	9.33	10.00
UAI (Uncertainty Avoidance)	62.67	61.67
LTO (Long-Term Orientation)	24.00	12.14
IVR (Indulgence vs. Restraint)	25.00	13.81

The data from Hofstede's Values Survey Module 2013 does not support the original projections of this study or findings from coding the course introductions and forums on hindrances and diffusion. For example, the decrease in LTO was unanticipated. Cultures with a high LTO scores, like China (87), Kazakhstan (85), and Russian (81) tend to "encourage thrift and efforts in modern education as a way to prepare for the future," whereas countries with low LTO's, like Nigeria (13), "prefer to maintain time-honoured traditions and norms while viewing societal change with suspicion" (Hofstede Insights, 2021, para. 15-16). Why would using new educational technologies make people move from encouraging "modern education as a way to prepare for the future" to preferring "to maintain time-honoured traditions and norms"? In the same way, why would participants report an increased value in high Power Distance after Web 2.0 ODL interactions?

The lived experience of participants during the COVID-19 pandemic may be partly responsible for these changes. For instance, a decreased value for Indulgence (IVR) shows an increased value of restraint, which would be reasonable for people who were suffering economically due to a pandemic that led to extreme economic hardship. Moreover, as already discussed, many participants changed jobs during the training, almost all had forced changes to emergency remote teaching, and many were dealing losses to health and relationships due to COVID-19. These kinds of unexpected stresses could reasonably result in a heightened perceived need for stability, which could be exemplified by a heightened desire for trusted principles (lower LTO), a heightened desire for someone who knows what to do is in charge (higher PDI), and a greater willingness to delay gratification (lower IVR).

Examining specific prompts may further clarify survey results not aligning with coding results. For instance, it seems reasonable that the participants' growing expertise in ODL would lead them to be value being consulted more often by superioris (Prompt 22), while also being challenged more often by students in new ODL environments (Prompt 23). While these experiences may diminish with the normalization of ODL courses, the responses after several months of teaching could result in a temporary preference for higher PDI. Likewise, Kyrgyzstan went through a coup in October 2020, resulting in a general election being overturned and a convicted kidnapper being established being established as the head of government (Abdurasulov, 2020). This crisis was unresolved in December 2020 and could have influenced some participants' pride in their citizenship (Prompt 39), as could lack of satisfaction with the governments' handling of the pandemic. This could lead to answering Prompt 39 in ways that would appear as a decrease in LTO. Table 14 shows the specific prompt results. The numbering of items in the table is intentional to allow consistency with the numbering of survey items in Table 9.

Table 14 Changes in Specific Prompts on Hofstede's Values Survey Module 2013: Survey 1 and Survey 2

Cultural Dimension	Prompt	Survey 1	Survey 2
PDI (Power Distance Index)	15. In an ideal job, how important is it to have a supervisor you can respect?	4.45	4.43
	16. In an ideal job, how important is it to be consulted by your supervisor in decisions about your work?	4.17	4.24
	17. How often, in your experience, are students afraid to contradict their teacher?	3.03	3.29
	18. An organizational structure in which certain subordinates have two bosses should be avoided at all cost.	3.90	3.76
IDV (Individualism vs. Collectivism)	19. In an ideal job, how important is it to have enough time for your personal or home life?	4.43	4.52
	20. In an ideal job, how important is it to have job security? (Know that you will not lose your job?)	4.33	4.57
	21. In an ideal job, how important is it to do work that is interesting?	4.73	5.00
	22. In an ideal job, how important is it to have a job that is respected by your family and friends?	4.30	4.48
MAS (Masculinity vs. Femininity)	23. In an ideal job, how important is it to live in a desirable area?	4.30	4.10
	24. In an ideal job, how important is it to get recognition for good performance?	4.47	4.52
	25. In an ideal job, how important is it to have pleasant people to work with?	4.38	4.67
	26. In an ideal job, how important is it to have chances for promotion to higher levels in the organization?	4.40	3.95

UAI (Uncertainty Avoidance Index)	27. How often do you feel nervous or tense?	2.77	2.95
	28. All in all, how would you describe your state of health these days?	4.33	4.05
	29. One can be a good teacher without having a precise answer to every question a student may raise about his or her work.	3.33	4.00
	30. An organization's rules should not be broken - not even when the employee thinks breaking the rules would be in the organization's best interest.	3.33	3.29
LTO (Long-Term Orientation vs. Short-Term Orientation)	31. In your private life, how important is it to serve your friends?	4.27	4.19
	32. In your private life, how important is it to avoid spending more money than required?	3.83	3.86
	33. How proud are you to be a citizen of your country?	4.57	4.33
	34. Persistent efforts are the surest way to results.	4.30	4.38
IVR (Indulgence vs. Restraint)	35. Are you a happy person?	4.47	4.43
	36. In your private life, how important is it to keep time free for fun?	3.80	4.24
	37. In your private life, how important is it to have a life of contentment and moderation; have few desires?	4.00	4.05
	38. Do other people or circumstances ever prevent you from doing what you really want to do?	3.17	3.19

In summary, the quantitative responses regarding cultural values on the VSM could be unreliable in this situation due to the statistically unreliable means of sampling and to the trauma that participants underwent due to COVID-19 during the months prior to Survey 2. It should also be noted that while the changes in PDI (+12.43), LTO (-11.86), and IVR (-11.19) are noticeable, they are not radical changes in terms of Hofstede's cultural dimensions. For example, Canada, Iceland, Ireland, and the United States score within 12 points of each other for PDI, LTO, and IVR (Hofstede Insights, 2021a).

Coded Results from the Surveys.

The course-initial and course-final surveys included open-ended prompts that allowed coding for cultural values (Figure 21). High values of Individualism (IDV) were indicated by references to personalized or differentiated learning. Consistently formal tone, references to "expert" knowledge, and teacher-centered methodology were coded as indicating a high Power Distance (PDI). References to competition and achievement were coded as high Masculinity (MAS), while references to collaboration and expressions of vulnerability were coded as low-MAS. Expressions of a desire to try new things was coded as a low Uncertainty Avoidance (UAI), while expressions of skepticism or doubt about "the New" were coded as high-UAI. Finally, wanting to learn "the best methods" based on current research was coded as a high Long-Term Orientation (LTO), while arguing based on philosophical, religious, or cultural tradition was coded as low-LTO.

For several areas, there was no discernable pattern of change from the self-introductions and initial surveys, which were given in the first week of the training, and the final surveys. For instance, the category of Individualism appears relatively low throughout the program even though the numbers don't align exactly between the instruments. Likewise, these instruments all showed a relatively high Long-Term Orientation (LTO). The only categories in which there appears to have been a change were Power Distance (PDI) and Masculinity (MAS), which had noticeable and consistent decreases between the training-initial survey and introductions, and the training-final survey, as will be shown later in this study.

Rsq2: Evidence from the Forums

The early modules explicitly dealt with establishing the social presence of participants to help them be perceived as immediate and “real” during asynchronous learning (Lowenthal & Snelson, 2017). The facilitators modeled social presence by dividing participants into cohorts of 10-20 people and interacting with cohort members multiple times each week through comments and messages in training forums and social media groups that participants had created in the early weeks of the program.

The training on social presence was adopted quickly by most participants in ways that indicated a decrease in Power Distance (PDI). For example, forum posts and comments were initially limited to course content, but quickly expanded to include family news, discussions of current events, well-wishing on birthdays and holidays, and random videos and GIFs. In the early weeks of each iteration, forum posts usually demonstrated high PDI by beginning with formal greetings such as, “My Dear Colleagues,” or famous quotations, as is common in Russian-language essays. However, after the first month, PDI appeared to decrease as it became common to see posts begin with, “Hellooo, Everyone!” or “I can’t wait to see what you have to say about this!” Even phrases of questionable professionalism such as, “My dears”, “Well, ladies”, “Hey girls”, or “What do the boys think? Share!” began to appear as participants attempted to express colloquial affection and inclusion. Seven participants (14%) even returned to the introductory assignment to change their pictures to selfies or add conversational self-introduction videos.

This decrease in PDI also appeared in the names participants used for themselves and others. Calling a colleague by name in Russian typically involves using the first name and patronymic, a variation of the person's father's name. For example, colleagues of Vladimir Putin, the son of Vladimir, would call him by his patronymic, Vladimir Vladimirovich, while more distant relations would call him Vladimir Putin. In this training, early forum discussions often included patronymic phrases such as "Maria Alexandrovna said," or, "What is Alexander Ivanovich's opinion?" However, within the second month, participants of all age groups tended to refer to themselves and others by the shortened familiar names normally reserved for close friends and family. Mariya Alexandrova became Masha and Alexander Ivanovich became Sasha. Since I am a foreigner, they originally addressed me as Mr.Gwin, Mr. Randall, or, mistakenly, as Professor Randall. After a month or two of Web 2.0 ODL, though, many addressed me as Randall *baike* [older brother, uncle], or simply, Randall. Decreases in power distance are common in all cultures as relationships grow, but it often takes months or years to change the formality of names, pronouns, and verb forms in Central Asian contexts (I recently had a younger friend of over 12 years ask me if she could address me with the familiar rather than the formal pronoun). In the Web 2.0 ODL environment, however, the changes were noticeable for many participants within a month that included eight to twelve hours of Web 2.0 ODL interaction.

The forum interactions also showed a decrease in expressions associated with high Masculinity (MAS). The self-introductions and initial surveys included numerous lists of accomplishments, references to awards received, and claims to expertise, all of which are coded as high-MAS. In fact, peer feedback in the early forums was often unexpectedly direct and competitive by Western standards, including comments such as, “You clearly did not understand the text,” or “You did not apply the concept correctly.” By the time of the forums on hindrances and successes with diffusion of Web 2.0 ODL and associated methods, however, comments frequently appealed to group identity and collaboration, such as, “Thanks for the comments! We have such a great team!” or, “Our wonderful teachers and colleagues have helped me so much.” These types of responses were coded as low-MAS.

There appeared to be little change in other cultural dimensions. Individuality (IND) was coded as decreasing slightly, while Uncertainty Avoidance (UAI) and Long-Term Orientation (LTO) remained low (Table 15).

Table 15 Cultural Dimensions as Coded for All Instruments

	Introductions		Survey 1		Forums		Final		Survey 2	
IDV high	22	49%	3	10%	11	50%	5	13%	11	52%
IDV low	10	22%	12	44%	8	38%	8	21%	4	19%
IDV RATIO	80		14		52		28		79	
PDI high	31	9%	17	3%	1	5%	17	44%	5	24%
PDI low	7	6%	5	19%	20	92%	15	38%	7	33%
PDI RATIO	140		100		2		45		32	
UAI high	8	18%	13	48%	2	8%	9	23%	5	24%
UAI low	27	60%	12	44%	21	96%	28	72%	12	57%
UAI RATIO	10		43		3		11		19	
MAS high	27	60%	16	59%	4	19%	6	15%	4	19%
MAS low	11	24%	7	26%	11	52%	11	28%	10	48%
MAS RATIO	90		78		18		24		20	
LTO high	17	38%	20	74%	14	61%	19	49%	13	62%
LTO low	2	4%	0	0%	0	0%	0	0%	0	0%
LTO RATIO	147		240		180		230		170	

Rsq2: Evidence from Final Projects

The final projects for all participants were completed in December 2020. These required participants to give a written and/or video demonstration of a unit of their ODL course using Web 2.0 educational technologies and methods from the program. As discussed in the section on Research Sub-Question 1, their projects demonstrated different levels of adoption and attempts to encourage the adoption of the pedagogies and methods. Research Sub-Question 2 addresses the cultural values associated with attempts to adopt and encourage the adoption of Web 2.0 educational technologies. The trend in decreasing Power Distance (PDI) and Masculinity (MAS) carried over into the final projects, as did the relatively little change in Individualism (IDV), Uncertainty Avoidance (UAI) and Long-Term Orientation (LTO) (Figure 18).

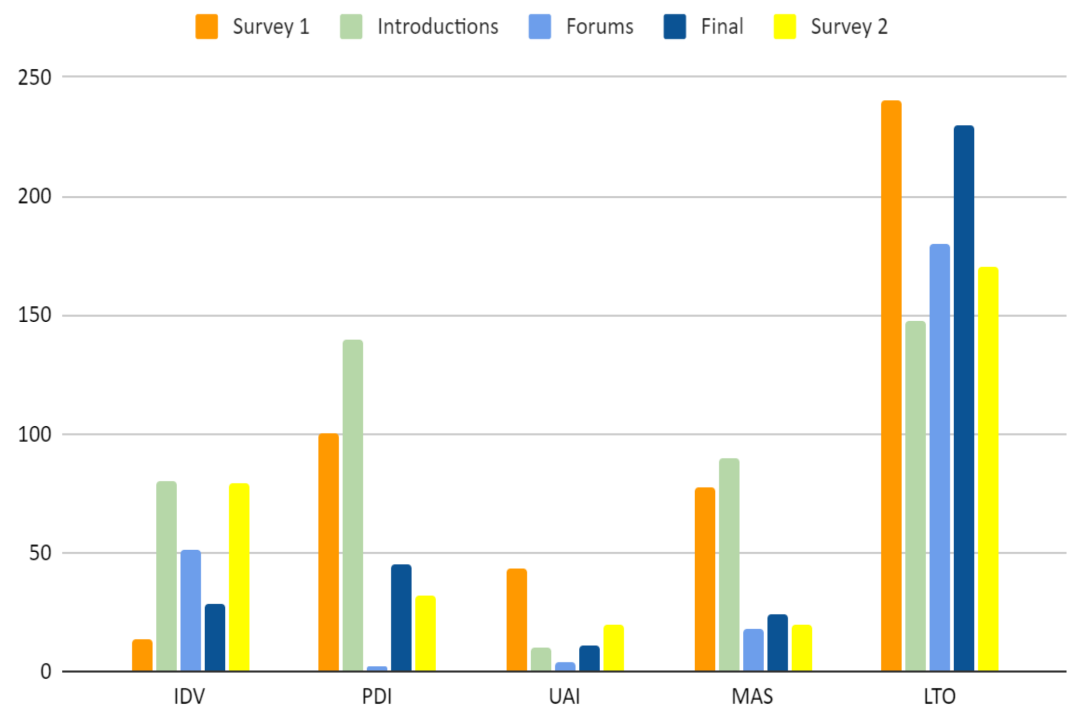


Figure 18 Changes in Cultural Values through the Program

The participants overwhelmingly demonstrated increasing vulnerability and warmth of feelings toward each other, which were coded as low-MAS. They also increasingly addressed each other informally and collegially, which was coded as low-PDI. As anyone who has worked in Central Asia for very long knows, the local cultures value toasts of appreciation or public blessings at the culmination of large gatherings or projects (Low, 2008; Mack & Surina, 2005). This tradition of closing with a blessing transferred to many final projects in the training. For instance, Chynara introduced her final project with thanks to "our Super Trainers, for their valuable feedbacks and engaging tutorials" and Saida said, "I feel very honored to share with you my video and get feedback." Surprisingly, though, all of those who were coded as "little evidence of adoption" according to the criteria for Research Sub-Question 1 were coded as high-PDI in the forum discussions and final projects. They posted their final projects without comment or with a variation of, "Here it is." Gulbahar even went so far as to break high-PDI and collectivist norms by criticizing G Suite and the training on using rubrics for Google Classroom that had been promoted during the training. This indicates that these participants' lack of demonstrated desire for Web 2.0 interaction may be connected to their lack of production of interactive Web 2.0 lessons.

Rsq2: Summary of Findings

The coding of cultural values for the self-introductions, surveys, forums, and final projects showed that participants' cultural values for several areas were unchanged throughout the study (Figure 23). The dimension of Indulgence vs. Restraint (IVR) was never coded because there was no evidence of that value in participant responses. Individualism (IDV) was relatively unchanged and varied around the mid-range on the scale. Uncertainty Avoidance (UAI) was low, and Long-Term Orientation (LTO) was high overall throughout the training (Figure 23). There were noticeable declines in Power Distance (PDI) and Masculinity (MAS) between the training-initial instruments and the mid-term instruments.

Quantitative results from Hofstede's Values Survey Module (2013) were not consistent with the coded results. They indicated an increase in PDI, no change in MAS, and a decrease in LTO. However, it is reasonable to question the reliability of this survey in this situation because many responses could have been influenced by participants completing Survey 2 in a pandemic.

Summary: Data and Analysis

The purpose of this case study is to examine the way in which teachers' cultural values influence and are influenced by Web 2.0 technologies used in online professional development, as demonstrated by participant attitudes toward and use of these technologies in their courses. This requires describing the relationship between cultural values and the diffusion of educational technologies, which in turn requires answering the questions, "How do participants' expressed attitudes toward and use of Web 2.0 technologies change during the training?" and, "To what extent are the above answers related to the participants' cultural values, as defined by Hofstede?"

The study examines data collected over 18 months from 59 participants from four countries in overlapping iterations of ODL professional development courses (Appendices B and C). Both courses explicitly promoted the use of student interaction, collaboration, research, problem-solving, and application as means of learning, and both required participants to use Web 2.0 technologies for these pedagogical purposes. The data analysis established a baseline for participants' cultural values and attitudes toward and use of Web 2.0 technology by examining the participants' self-introductions at the beginning of their course and their answers to Likert-scale and open-ended questions on a course-initial survey (Appendix D). It then established change in participants' values and

Web 2.0 attitudes and practices by examining online forums in which participants discussed hindrances and successes in diffusing the technologies and methods in their communities. It further established self-perceptions of changes in attitudes or values through a course-final survey replicating the questions of the initial survey (Appendix D). Finally, it examined the participants' actual use of Web 2.0 technology and associated methods through their final projects, in which they demonstrated and explained their course designs, assignments, and assessment. Participants' responses for each of the instruments listed above were also coded according to Hofstede's cultural dimensions. This process leads to the following tentative findings.

Rsq1: How do Participants' Expressed Attitudes toward and Use of Web 2.0 Technologies Change during the Training?

The participants' expressed attitudes toward and use of Web 2.0 educational technologies improved during the training, but not as anticipated. There were no discernable patterns among the non-adopters, solid adopters, and innovators related to gender, nationality, or other common demographics. However, patterns of adoption appeared related to social interaction between the participants, as those with "little evidence of adoption", "solid evidence of adoption", or "innovative attempt to encourage adoption" often grouped with others from the same institutions or had collaborated within the online training. Web 2.0 technologies and methods that promoted collaboration, research, problem solving, creation, and systematization (such as LMS's) tended to diffuse broadly through the training, while interest in and use of single-user apps and teacher-centered methods decreased.

When responding to prompts related to the Technology Acceptance Model (TAM), participants may have expressed a higher confidence in Perceived Usefulness (PU) of the technologies than their Perceived Ease of Use (PEOU). However, the TAM categories of PU and PEOU were not useful predictors of behavior because participants gave responses conflating the categories or chose the technologies endorsed by their authorities or groups (Table 12).

There were few items (134 from all instruments combined) coded as barriers to or facilitators to spreading these technologies or methods. Again, the categories of barriers and facilitators did not align with those of other areas in the developing world identified in the literature review of this study. For instance, the literature review indicated that issues like the school environment, curriculum, and expectations would be a major barrier. From these participants, though, only 18 items were coded as “School-Barrier,” and 54 were coded as “School-Facilitator”. Also, the literature review indicated a concern about foreign influence as a barrier to spreading many forms of ODL, but none of the data in this study was coded as “Foreign-Barrier,” and 31 were coded as “Foreign-Facilitator” (Table 16).

Table 16 Complete Data on Web 2.0 Educational Technology Use through the Program

		Introductions	Survey 1	Forums	Final Projects	Survey 2
TAM Categories	Followed Group	26 (58%)	24 (53%)	14 (36%)	13 (33%)	15 (75%)
	Conflated PU and PEOU	5 (11%)	0	6 (33%)	14 (36%)	2 (10%)
	PU high	12 (28%)	0	8 (26%)	11 (28%)	5 (25%)
	PU low	1 (2%)	0	1 (18%)	0	0
	PEOU high	5 (11%)	0	4 (16%)	6 (15%)	1 (5%)
	PEOU low	5 (11%)	0	7 (64%)	2 (5%)	3 (15%)
ODL	Apps	9 (43%)	11 (37%)	8 (47%)	19 (49%)	16 (80%)
	Methods	0	0	12 (71%)	28 (72%)	10 (50%)
	MOOCs	1 (5%)	0	0	7 (18%)	0
	OER	0	0	3 (18%)	5 (13%)	0
	Quality	0	0	1 (6%)	3 (8%)	0
	LMS	8 (38%)	4 (13%)	5 (29%)	30 (77%)	11 (55%)
	Other	0	6 (20%)	5 (29%)	3 (8%)	8 (40%)
	Individual	19 (90%)	30 (100%)	2 (12%)	16 (41%)	17 (85%)
	Collaboration	11 (52%)	13 (43%)	17 (100%)	35 (90%)	19 (95%)
	Content Creation	4 (19%)	5 (17%)	14 (82%)	33 (85%)	18 (90%)
Barriers	School	1 (2%)	2 (5%)	9 (20%)	2 (5%)	4 (9%)
	Culture	0	2 (5%)	9 (20%)	0	1 (2%)
	Infrastructure	1 (2%)	1 (2%)	1 (2%)	2 (5%)	2 (5%)
	Foreign	0	0	0	0	0
	Other	0	0	5 (11%)	1 (2%)	0
Facilitators	School	19 (43%)	3 (7%)	11 (25%)	18 (41%)	1 (2%)
	Culture	2 (5%)	0	0	3 (7%)	0
	Infrastructure	0	0	3 (7%)	0	0
	Foreign	25 (57%)	0	4 (9%)	1 (2%)	1 (2%)

Other	0	0	0	0	0

Rsq2: What Cultural Values, as Described by Hofstede, are Most Relevant to Participants' Attitudes toward and Use of Web 2.0 Technologies?

The relationship between cultural values, as described by Hofstede, and pedagogical dispositions toward Web 2.0 educational technology remains unclear due to varying evidence from the coded qualitative data and the calculated quantitative data. The participants in this study overwhelmingly indicated a low Uncertainty Avoidance (UAI) and high Long-Term Orientation (LTO) in coded responses in this study. These values would reasonably be associated with participants being willing to risk learning about and applying new technologies for long-term benefits (Table 17). The participants generally had a low- to mid-range level of Individualism (IDV), but this study did not find evidence that this value was clearly connected to pedagogical dispositions toward the technologies or methods in the training. Power Distance (PDI) and Masculinity (MAS) both showed marked decreases in coded responses as participants collaborated on creative problem-solving using Web 2.0 tools through the study. However, the calculated quantitative data from Hofstede's Values Survey Module 2013 indicates that the participants were characterized by a very high UAI and a very low MAS throughout the program. It also indicates that the participants' LTO decreased and PDI increased during the training. These results are counterintuitive for those familiar with Central Asian populations, Hofstede's study has never been normed on these populations, and the increasing effects of the COVID-19 pandemic cast doubt on the validity of some survey prompts. However, the Hofstede Values Survey Module 2013 results cast doubt on findings from the coded data.

Table 17 Complete Coded Data on Cultural Dimensions

Cultural Dimen.	Intro.		Survey 1 VS2013	Survey 1 Qual.		Forums		Final Projects		Survey 2 VS2013	Survey 2 Qual.	
IDV high	22	(49%)		3	(10%)	11	(52%)	11	(50%)		5	(13%)
IDV low	10	(22%)		12	(44%)	4	(19%)	8	(38%)		8	(21%)
IDV Ratio (Score)	**80**		**(31.33)**	**14**		**79**		**52**		**(33.33)**	**28**	
PDI high	31	(69%)		17	(63%)	5	(24%)	1	(5%)		17	(44%)
PDI low	7	(16%)		5	(19%)	7	(33%)	20	(92%)		15	(38%)
PDI Ratio (Score)	**140**		**(19.00)**	**100**		**32**		**2**		**(31.43)**	**45**	
UAI high	8	(18%)		13	(48%)	5	(24%)	2	(8%)		9	(23%)
UAI low	27	(60%)		12	(44%)	12	(57%)	21	(96%)		28	(72%)
UAI Ratio (Score)	**10**		**(62.67)**	**43**		**19**		**3**		**(61.67)**	**11**	
MAS high	27	(60%)		16	(59%)	4	(19%)	4	(19%)		6	(15%)
MAS low	11	(24%)		7	(26%)	10	(48%)	11	(52%)		11	(28%)
MAS Ratio (Score)	**90**		**(9.33)**	**78**		**20**		**18**		**(10.00)**	**24**	
LTO high	17	(38%)		20	(74%)	13	(62%)	14	(61%)		19	(49%)
LTO low (Score)	2	(4%)		0		0		0			0	
LTO Ratio	**147**		**(24.00)**	**240**		**170**		**180**		**(12.14)**	**230**	**45**

RQ: What is the Relationship between Cultural Values and the Diffusion of Educational Technologies?

This online professional development resulted in Web 2.0 technologies being adopted effectively by most participants regardless of their cultural contexts. Of the 96 Central Asians enrolled in August 2020, only 59 completed enough of the training to receive certificates of completion. Of those, only 51 submitted final projects, and seven of the final projects did not demonstrate the use of Web 2.0 technologies for student collaboration, research, problem-solving, or presentations. The participants' qualitative responses on the final surveys indicated a growth Web 2.0 tools than they had used at the beginning of the training. These open-ended responses showed a clear perceived change in favor of collaborative ODL technologies and methods that promoted collaboration, research, problem solving, and content creation. This was evidenced by an increase from about 50% to 90% in the use of Web 2.0 collaborative tools, an increase from about 20% to 90% in the use of content-creation, and an increase from 0 to 70% in the use of specific methods for using Web 2.0 to enhance learning. Fifty-three percent of the final projects applied Web 2.0 technologies for methods or activities presented in the training and an additional 30% of the final projects demonstrated innovative applications of Web 2.0 ODL beyond the scope of the training.

The participants' interactions throughout the course became noticeably informal, and almost familial, much more quickly than would be expected in face-to-face settings in their cultures. Their quick change from formal writing to the use of informal names, pronouns, and emojis, as well as their increased reference to personal situations through forums or social media indicates a possible decrease in PDI. This change was accompanied by a noticeable increase in openness regarding personal, family, and community issues not directly associated with the training. These types of expressions were uncommon during the first month of each iteration of the training. It is reasonable that this decrease in MAS was facilitated by the onset of the COVID-19 pandemic and the way in which personal stress related to the pandemic affected professional expectations. However, the training began with explicit instruction and activities to promote the development of social presence through informal personal interaction (low PDI) and building collaborative relationships (low MAS) among the participants. Moreover, the assignments for the training required Web 2.0 collaborative problem solving. The Web 2.0 environment minimized normal social status markers such as gender and age (low PDI), and the collaborative activities rewarded participation over competition (low MAS).

CHAPTER FIVE: DISCUSSION AND CONCLUSION

Introduction

The purpose of this case study is to examine the way in which teachers' cultural values influence and are influenced by Web 2.0 technologies used in online professional development, as demonstrated by participant attitudes toward and use of these technologies in their courses. Understanding this issue requires answering the question, "What is the relationship between cultural values and the diffusion of educational technologies? This question, in turn, requires identifying the change in participants' expressed attitudes toward and use of Web 2.0 technologies during the training and identifying the extent to which these issues are related to the participants' cultural values.

This chapter begins with a summary of the findings related to the research sub-questions and the research question. It then turns to a discussion of future research questions related to this study's unexpected findings in relation to its literature review, the importance of social presence, and the foundational theories for the study. It concludes by clarifying the limitations of the study and possible implications for further research.

Summary of Findings Related to the Research Questions

A full answer to the research questions, including analysis of the evidence is presented in Chapter 4. This chapter includes a summary of those answers.

Rsq1: How do Participants' Expressed Attitudes Toward and Use of Web 2.0 Technologies Change During the Training?

Participants' use of Web 2.0 educational technologies related to learning management systems, specific methods such as flipped classroom or online forums, collaboration, and content creation increased noticeably during the program. All data-collection instruments in this study—initial and final surveys, forum discussions, and final projects—showed evidence of this pattern (Table 12).

The increase was most obvious in the areas of Web 2.0 tools for collaboration (43% on initial surveys and 90% in final projects), and content creation (17% on initial surveys and 85% on final projects). The use of LMS's increased from a reported 13% on initial surveys to a demonstrated 77% on final surveys. During the same period, the number of participants using individual-user technologies (Microsoft Office, Photoshop) fell from 100% reported in the initial surveys, to 85% reported in the final surveys, with only 41% of final projects mentioning these technologies. Numerous previous studies showed resistance to collaborative problem-based learning (PBL) and student-led research (SLR) from educators in Central Asia in face-to-face professional development settings (Anichkin & Kovalenko, 2018; Deyoung, 2006; Popa, 2019; Sabzalieva, 2015). Most of the participants in this study, though adopted specific methods for Web 2.0 education, as indicated by no reports of such methods on the initial survey, but 72% of participants demonstrating these methods in their final projects. The breadth and depth of these participants' effective implementation and attempts to diffuse Web 2.0-based methods shows that these Central Asian teachers did not, as a group, have cultural values prohibitive to Web 2.0 ODL.

Rsq2: What cultural values, as described by Hofstede, are most relevant to participants' attitudes toward and use of Web 2.0 technologies?

The relationship between cultural values and attitudes toward and use of Web 2.0 technologies remains unclear due to different findings from the quantitative and qualitative instruments used in this study. Hofstede's Values Survey Module 2013 has been normed in many countries, but there is reason to suspect that its prompts may not produce reliable results when respondents are in or recovering from a pandemic. The coded qualitative responses indicate that the large number of participants who adopted and diffused the technologies and methods from the training had consistently mid-range scores for Individualism (IDV), high scores for Long-Term Orientation (LTO), and low scores for Uncertainty Avoidance (UAI). Their coded scores for Power Distance (PDI) and Masculinity (MAS) decreased during the training.

The coded changes in qualitative responses on self-introductions, initial surveys, mid-term forums, final projects, and final surveys consistently show downward trends in Power Distance (140 on self-introductions; 45 on final projects) and Masculinity (90 on self-introductions; 24 on final projects). These also show relatively stable high Long-Term Orientation values (240 on Survey 1; 230 on final projects), low Uncertainty Avoidance (10 on self-introductions; 11 on final projects), and varying Individualism (80 on self-introductions; 79 on Survey 2; 29 on final projects). The coding does not give any indication of the value of Indulgence vs. Restraint (IDR) (Table 13).

<u>RQ: What is the Relationship between Cultural Values and the Diffusion of Educational Technologies?</u>

This study did not find conclusive results regarding the relationship between cultural values and the diffusion of educational technologies. However, the coded qualitative responses in all instruments (Tables 12 and 13) indicate that Web 2.0 educational technologies are likely to be adopted by in populations with low Uncertainty Avoidance and high Long-Term Orientation. The study also indicates that the adoption of these technologies may be accompanied by a decrease in cultural values associated with Power Distance and Masculinity. This would indicate a possibility of changes in cultural values as these technologies diffuse throughout a society.

Discussion and Questions for Future Research

The introduction to this study described the educational context of Central Asia. The literature review zoomed out to examine ODL in the developing world. The data and analysis zoomed in closer to a group of 59 teachers. However, to continue evolving this metaphor, aiming a camera at something means not noticing the factors that are just outside the frame. Case studies focus by defining limits to questions, time, space, participants, and types of data. Moving the camera a bit beyond those definitions may yield new insights. In the case of this case study, moving the camera involves some speculation about how these findings relate to the following questions:

1. Why did so many of the attitudes and practices that this literature review found to be common among educators in the developing world not apply to the participants in this study?
2. How relevant are the TAM and DoI to cross-cultural Web 2.0 ODL?

3. What is the relationship of Web 2.0 social presence and cultural values in multicultural ODL?
4. To what extend to face-to-face cultural dimensions apply to Web 2.0 ODL groups?
5. To what extent could training in Web 2.0 ODL result in large-scale cultural change?

Why are These Participants Different from Other Educators in the Developing World?

Answering the research questions for this study required a review of the literature on what other educators in the developing world were doing with ODL. This review for this study showed a high level of interest worldwide in several types of ODL, as well as concerns related to the diffusion of this technology in their contexts. Worldwide, educators in developing countries evidenced a high interest in MOOCs, OER, and quality assurance via digital credentials. They also expressed widespread concern about infrastructure, the digital divide, and the latent imperialism of ODL content and methods. However, the participants in this study expressed almost no interest in digital credentials, MOOCs, or OER, no concerns regarding latent imperialism or social changes related to ODL, and almost no interest in MOOCs, OER, or digital credentials.

All participants received at least some digital badges for their accomplishments, and many participants expressed gratitude, but only Aliya and Alisher reported using them in their own courses. Paper certificates are a valued commodity in Central Asia, though. By the middle of February, I had received 23 emails and 17 WhatsApp messages from participants expressing concern that they had not received their paper certificates even though digital badges had been issued at the end of December. It is possible that digital badges are a form of currency too novel to hold value in this part of the world.

There was little awareness of or interest in MOOCs or OER. This could be due to the difficulty of finding these resources in local Central Asian languages. However, the lack of interest in OER could also be related to the notorious disregard for intellectual property rights in Central Asia, which has occasionally led to Western film studios prohibiting their films from being shown in regional theaters (Ridgley, 2019). When intellectual property rights are not recognized or enforced, it is reasonable that OER would not appear especially valuable. It is also likely that the low interest in MOOCs came from the training's focus on practical application, combined with the changes resulting from the COVID-19 pandemic. This combination of factors is likely to have left most instructors without the intrinsic motivation to design a MOOC (Lowenthal et al., 2018).

Unlike many of the educators in the literature review, these participants showed little concern about the potential cultural change that could result from pedagogies encouraging Web 2.0 interaction. While nearly half of the respondents in discussions of hindrances and successes in diffusion referred to possible community opposition collaborative learning, SLR, and PBL, participants discussed the issue in terms of ignorance and efficiency, not in terms of cultural values. None of the assignments in the training program specifically addressed issues such as the digital divide or latent imperialism, and no conclusions should be drawn from the lack of discussion. However, the question remains of whether a term like “developing world” is helpful when it combines Central Asians, Southeast Asians, and Sub-Saharan Africans?

How Much do the TAM and DoI Apply to Pedagogical Dispositions toward Web 2.0 ODL?

In the introduction to this study, I hypothesized a model of the relationship between the use of Web 2.0 technology and cultural values involving a series of decisions based on Hofstede's cultural dimensions and the TAM categories of PU and PEOU (Figure 2). As discussed in the literature review, there are concerns that the Technology Acceptance Model (TAM) and Diffusion of Innovations (DoI) may not predict patterns accurately in cross-cultural settings (Abdullah & Ward, 2016; Dwivedi et al., 2011; Hetrick, 2019; Jaradat & Al-Mashaqba, 2014, p. 2; Lala, 2014, p. 2; Lyytinen & Damsgaard, 2001; Petridis & Petridis, 2020; Rogers, 2010; Tarhini et al., 2017; V. Venkatesh et al., 2011). However, I felt the TAM's basic categories to be sufficiently clear to validate including it in this analysis.

As previously described, this study did not find the TAM categories of Perceived Usefulness and Perceived Ease of Use helpful in explaining participants' choices. Over 30% of the participants in the study either merged the PU and PEOU categories in their answers or reported going with the group decision (Figure 19). In this case, another factor affecting technology acceptance appeared in the summer of 2020 when Moodle announced that its cloud-based service would no longer be free indefinitely. Five of the seventeen participants who had chosen to use Moodle for their projects changed to Google Classroom or hyperdocs because the $250 Australian dollar price was too high. This study gives reason to question the predictive value of the TAM in all cultural contexts. This finding also indicates that the hypothesized model is insufficient. The formation of a new model of the relationship of innovations to pedagogical dispositions and cultural values would require more data than is available from this study.

The participants in this study applied for the training program with the intent of learning to diffuse innovations, so it would be expected that they would have a higher percentage of innovators and early adopters than the typical population (Robinson, 2009). According to the DoI, communication is the major factor affecting the rate of diffusion, and the conversation-group clustering patterns of the participants when coded for extent of diffusion supports the importance of communication. It appears, then, that the DoI was not only effective in predicting the patterns of diffusion of Web 2.0 educational technologies within this training program, but further such training programs may benefit from maximizing communication from the innovators and early adopters.

Could Training in Social Presence Affect Cultural Values?

“Social presence” has an, admittedly, vague definition (Biocca et al., 2003; Lowenthal & Snelson, 2017; Öztok & Kehrwald, 2017; Trespalacios et al., 2021), but it was introduced to participants early in their training as a combination of a sense of belonging, meaningful relationships, and collegial learning characteristic of effective ODL (Trespalacios et al., 2021). Participants were encouraged to share personal comments in the forums and interact on personal media because, as Lowenthal and Dunlap observed, “people who have a strong relationship outside of class might have an easier time with interactive, cohesive, and affective types of communication than people who do not” (2020, p. 505).

All interpersonal communication requires “an infinite cycle of concealment, discovery, false revelation, and rediscovery” (Goffman, 1959, p. 20) as language is used to protect privacy, extend relational territory, establish social power (Foucault, 2005; Steiner, 1998). This creates a situation in which,

> the lack of fixity experienced by learners, juggling multiple professional and personal roles while experiencing transformation of self in the course of learning, can produce insecurity and cause learners to retreat to the backstage (Jaber & Kennedy, 2017, p. 227).

Since "there is no such thing as a generic cultural representation in digital space (Brown & Edouard, 2017, p. 427), even disclosing different educational backgrounds and professions or being required to use unfamiliar icons in Web design can lead to a sense of "otherness" that decreases the desire to create an authentic social presence (Evans et al., 2020; Phirangee & Malec, 2017). This lack of a consistent markers of identity is aggravated when one of the few commonalities in the online community is the loss of identity provided by one's native language.

While there are numerous studies examining social presence in relationship to identity (Dang & Robertson, 2010; Fattah & Sujono, 2020; Jaber & Kennedy, 2017; Lowenthal & Dennen, 2017; Phirangee & Malec, 2017), teaching (Evans et al., 2020; Song et al., 2019; Zanjani et al., 2016), and learning (Loizzo, 2015; Park & Bonk, 2007; J. C. Richardson et al., 2017) there are very few that address its relationship to national culture. Some have noted that the "social affordances of technologies might vary along cultural dimensions" (Vatrapu & Suthers, 2007, p. 1), making some activities especially conducive to helping people of some cultures establish social presence while setting up hindrances to people of other cultures. Also, many have given practical advice for noting potential cross-cultural problems in ODL and making reasonable accommodations (Sadykova & Meskill, 2019; Skelcher et al., 2020; Somekh & Pearson, 2002; Song et al., 2019). However, the training in this study removed people from their habitus and culture, placed them in a "non-place" (Augé, 1995) void of historical, physical, linguistic, or geographical markers of culture, where they had to create a new "face" (Rose, 2017), and use new tools a foreign language to communicate, learn, and pass on knowledge.

The development of social presence contributes to online learning, but this contribution is not free from cultural values. Therefore, further studies of the cultural values associated with aspects of social presence would be beneficial in developing online learning for multicultural situations.

Could Web 2.0 ODL Result in an "Interculture"?

Initial research on personality traits shows similarities between the personalities people presented online and those they presented offline (Gackenbach & von Stackelberg, 2007; Gaible & Burns, 2005; Gosling et al., 2011; Marriott & Buchanan, 2014). However, longitudinal research in face-to-face settings shows that personality may be more dynamic than originally postulated, changing over time, in specific situations, and with the use of different languages (Dewaele & Oudenhoven, 2009; McAdams & Olson, 2010; D. G. Myers & DeWall, 2015; Roberts & Mroczek, 2008). Moreover, longitudinal research on Hofstede's cultural dimensions and the World Values Survey show that culture is dynamic, changing across generations and within subsectors in response to historical and socioeconomic factors (Beugelsdijk & Welzel, 2018; Dennehy, 2015; Inglehart, 2017; Inglehart & Welzel, 2005, 2010; Welzel et al., 2001). This raises the question of the extent to which Web 2.0 ODL could facilitate long-term changes to personality or culture in face-to-face interactions. Moreover, what would the process of such a change look like?

Adult learners of foreign languages often seem to form an "interlanguage" that combines elements of the native and target language with forms that belong to neither. For instance, my young son came in crying one day, saying, "I *upalled.*" *Upal* is the past-tense of the Russian verb "to fall", but my son, having only heard the word in the past-tense, added the English *-ed* to indicate past tense. This type of incorrect transfer from the native language and overgeneralization of patterns in the target language can fossilize if uncorrected, especially when groups of language learners do not interact regularly with native-speakers of the language. Given enough time, this can lead to the standardization of new patterns within the community, eventually leading to new dialects such as the "Spanglish" or "Konglish" of people who are in the process of learning Spanish and English or Korean and English simultaneously (Selinker, 2009; Selinker & Rutherford, 1992; Tarone, 1983, 1985) (Figure 19).

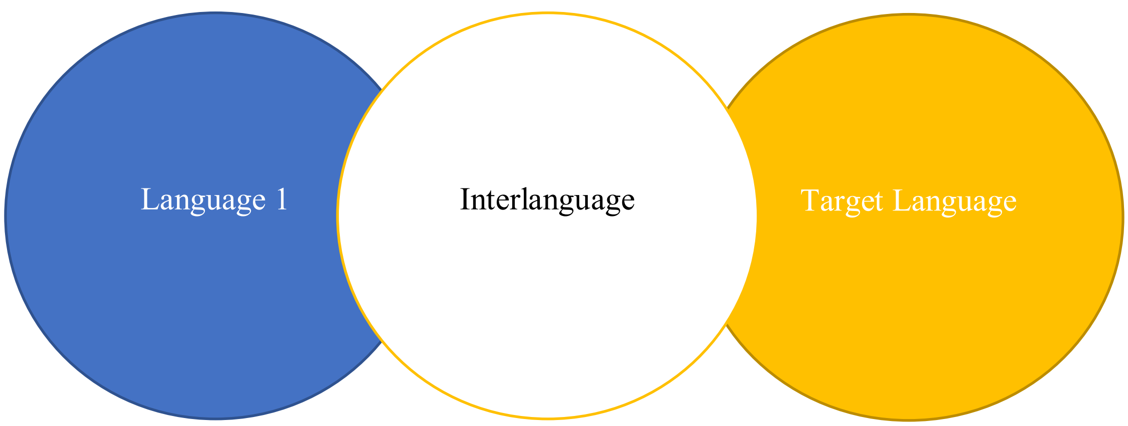


Figure 19 Interlanguage

Could the constant negotiation required to establish identity and community online, especially when using a foreign language with people of multiple cultures lead to this type of unusual transfers of behavior and overgeneralizations of perceived desired behavior? Could cross-cultural Web 2.0 communities develop a type of "interculture"? One may suspect that "online collaborative communication is bound within a culturally and contextually framed communicative purpose, expectations of social relations and expression of individual identity" (Lawrence, 2013, p. 306). However, that is not necessarily the case for cross-cultural, multilingual Web 2.0 learning communities. In the same way that my son combined Russian vocabulary with English grammar, many of the participants in this study displayed cultural values that applied aspects of their home cultures in new ways (such as moving unusually quickly to using familiar names), or appropriated aspects of the perceived "foreign" culture (such as referring to colleagues as "my dears" or "girls and boys"). This leads to the possibility that the participants in this Web 2.0 training were negotiating new standards of community in ways analogous to trying to understand the difference between "could" and "could have". This negotiation led the participants in this study to see themselves as members of an international, innovative community of professional educators who could address each other with familiar names and terms of affection regardless of age or gender. The extent to which this process would be replicate in other multicultural Web 2.0 ODL settings, and the extent to which the "interculture" values and practices would endure across generations or influence face-to-face cultures would warrant further study (Figure 20).

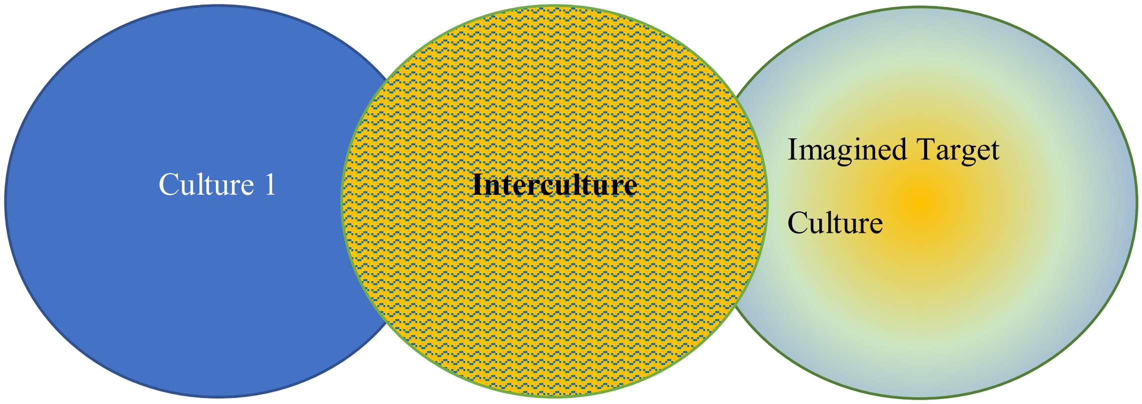


Figure 20 Interculture

Could Web 2.0 ODL Result in Large-Scale Cultural Change?

This study's research question and purpose contribute to addressing the problem of how educational decision-makers, especially in less developed or developing countries, can maintain agency in choosing which educational technologies to implement in their cultural contexts. Since some have noted that the concept of "culture" is sometimes "incoherent" and "conceptually muddled" (C. Smith, 2016, p. 38), it may be worthwhile to revisit the definition. Hofstede defined culture as "the programming of the human mind by which one group of people distinguishes itself from another group" (Hofstede Insights, 2021b). Culture is not only a system of education and identification, but a dynamic composition of "attitudes, values, beliefs, and behaviors" that a group shares and communicates "from one generation to the next" (Matsumoto et al., 1996, p. 16). Its essence "is primarily a system for creating, sending, storing, and processing information" (Hall, 1998, p. 53). These definitions have different nuances, but they all imply that major changes in educational practices, identity, communication, and dispositions toward technologies could result in changing culture.

Since the beginning of the Internet, researchers have studied digital communities as cybercommunities, highlighting their online environment (Fernback, 1998), digital nomads, highlighting their geographic dislocation (Makimoto & Manners, 1997; Müller, 2016; Olga, 2020) or "native" status, highlighting their age at exposure to the Internet (Thinyane, 2010; Wilson et al., 2020). All of these community descriptions agree that online communities are more complex than discourse communities that use specialized communication styles to achieve a specific goal (G. Brown & Yule, 1983; Swales, 1987). However, there is reasonable caution against naming these groups as new cultures or subcultures (Mulder, 2015; Wilson et al., 2020) because

> defining a specific 'culture' brings that entity into being, rather than recognizing something that already exists, and once a 'culture' in this sense has been created, the idea and representation of it can be utilized to govern in various ways the people and things understood as being included within it (Inglis et al., 2007, p. 15).

While it is reasonable to caution against naming something too soon, the issues of latent cultural values in Web 2.0 ODL should be acknowledged by ODL practitioners. The cultural values inherent in Web 2.0 ODL are easy to see, and sometimes presented with celebration. For instance, Canada's Fully Online Learning Community model openly supports "democratized learning" (i.e. low Masculinity) that "decreases transactional distance" (i.e. low Power Distance), "builds community" (i.e. low Individualism), and "refuses to privilege the experiences of pedagogues in pursuit of meaningful and socially-useful knowledge" (i.e. high Long-Term Orientation) (Blayone et al., 2017, p. 13). It may be fine for Canadians to celebrate technologies that they believe will facilitate the transmission of their cultural values. However, is it ethical to encourage the use of Web 2.0 technologies to cultures that oppose its embedded values (Bardakci et al., 2018)?

"Identity is a fluid construct…negotiated both with our interaction partners and within the context in which it is being performed" (Lowenthal & Dennen, 2017, p. 137), but people usually have some idea of some cultural values guiding the negotiation. In the case of the participant in this study, they entered without knowing the values of their colleagues from other cultures or the values embedded in Web 2.0. Moreover, whereas speakers of an interlanguage have some idea of the target language, the participants in this study needed to use a foreign language and novel educational tools to negotiate the cultural values with which to form their identities. This raises the question, if a group formed a new identity based on new tools, new means of education, and new values in a space void of historical, geographic, linguistic, or physical norms for interaction, and if it passed those new principles on to the next generation, would a new culture emerge?

I will return, in this speculation, to the metaphor of the camera lens, changing the angle to focus on two incidents that occurred during the training described in this study but not included in that data for the study. These incidents occurred in the physical world, not online, and are presented here to promote discussion of future studies, not as findings of this study. To appreciate the significance of these events, one must note that, in Central Asia, as a rule, men and women do not touch. On entering a room, men shake hands with men, and women shake hands or kiss women; the lines are clear and not crossed.

In January 2019, after working together online for five months, the Phase 1 participants met in Bishkek for three days of intensive training on STEM methods. I was saying goodbye to the participants after our last meal together, when I was shocked to find myself being hugged by a female teacher. As she released me, she laughed and said to the group, in English and then her native language, “It’s normal! We’re family online! Thank you, brother!” Immediately, a cluster formed of male and female participants shaking hands, patting arms, hugging, and occasionally kissing cheeks. Many addressed me in local languages, using familiar pronouns, and many called me *baikei* [older brother, uncle] and used similar familial terms for each other. This incident is unlike any farewell I had experienced in seventeen years of working in Central Asia. That hug, followed by the multilingual declaration of its normalcy because of being “family online”, seemed an attempt to confirm a virtual relationship in the physical world. In the months of Web 2.0 interaction following that event, many participants continued to refer to me as *baikei,* transliterating the term when writing in English.

In February 2021, I entered the staff lunchroom at an English-language school to find several of this study’s Phase 3 participants, none of whom had been present for “the hugging incident” having tea. They were speaking in Kyrgyz, but I heard the English phrases, “PBL” and “social presence” before they noticed me. The four women immediately stood, putting their pandemic masks back on, asking about my health, shaking my hand, patting my arm, and hugging me. In the prior ten years I had known them, none of them had touched me. Our conversation switched to English and Russian, for my sake, but they referred to me with the Kyrgyz phrase, “Randall *baikei”* [older brother] instead of “Mr. Gwin” or “Mr. Randall”. When the greetings were finished, one of them said, in Russian, using the familiar pronouns with me even though I'm fifteen years older than she is, "We were just talking about how to do more social presence and PBL when we go face-to-face again. Do you have any ideas?" They explained that the training in social presence had helped them build deeper personal relationships with some students through Web 2.0 ODL than they usually did face-to-face. After several minutes, I had to leave for the meeting that had brought me to the school. "It's okay, *baike,*" Djamila said, "We'll figure out PBL and SLR in the classroom. We're already using it to train our own kids."

In both incidents, participants violated traditional norms of pronoun use and physical touch due to identities and norms formed in Web 2.0 ODL. In both instances, the changes indicated decreases in the cultural values of Power Distance and Masculinity. In the second instance, the participants specifically mentioned applying Web 2.0 ODL methods to face-to-face educational situations, and one speaker said she was using it for the next generation. The General Systems Theory (GST) reminds us that systemic changes are "wicked problems," (Banathy & Jenlik, 1996, p. 46), so we should not expect to find a causal relationship between the use of Web 2.0 educational technologies and cultural values. However, the GST would also indicate that we should not be so naïve as to assume we can let people experience a means of communication and education that they found helpful and empowering, and then expect them not to use it with their children. This may warrant further study.

Limitations and Further Research

The primary limitations of this study come from the way in which participants were selected, the way in which the data was collected, and the introduction of the

COVID-19 pandemic during the data collection process. Each of these limitations deserves discussion when considering the transferability of the findings.

Participants were self-selected through a lengthy application process for a training program on STEM or ODL methods. The application process required receiving support from their supervisors to implement methods in their courses, and it required a demonstration of access to the required technology. This means that the participants were predisposed to adopt the technologies and methods presented in the training. Therefore, other populations may not adopt the technologies or methods to the extent that this population did.

The data was collected from instruments used for teaching an ODL course on STEM and ODL methodology. Because many of the participants had withdrawn from the training and were unable to be reached when the study began, the data analyzed needed to be limited to information shared publicly within the course setting. This prohibited the analysis of the participants' group chats through WhatsApp, social media interactions, personal emails, or face-to-face interactions. In addition, since the data collection instruments (the self-introductions, surveys, forums, and projects) were designed for pedagogical purposes, they resulted in different types of data, making it impossible to directly compare their results. This limits the findings in the same way that tracing someone's health by measuring their height, weight, cholesterol, and blood pressure randomly and in different combinations over a year is not as effective as using each tool consistently. The surveys were identical instruments offered to all participants. However, there is no way to guarantee that the same people completed the first and last surveys. Also, while all took the final survey in December 2020, some took the initial survey six months before the pandemic, and others took the initial survey months after pandemic restrictions had begun. All of this makes statistical comparisons between the survey results impossible. Moreover, the surveys, self-introductions, surveys, and final projects were different genres of communication. The surveys were anonymous, so one would expect little evidence of social presence. The self-introductions and final projects were genres in which the participants were sharing openly for anyone in the training to see, which may have encouraged them to produce what they felt was the desired behavior from the facilitators rather than display their personal values. In the forums, however, participants interacted primarily with their facilitator and a group of 10-15 other participants with whom they had interacted for several months. This makes the forums the most likely instrument to give insight into the participants' true Web 2.0 ODL adoption patterns and cultural values. This variation in data-collection instruments indicates that discrepancies on individual instruments should not be seen as contradicting the others, but rather adding a need for nuance in interpretation. Likewise, when all instruments indicate the same tendency, it is reasonable to conclude that the tendency is present. Finally, limiting the data to "found" material made it impossible to follow up with participants to ask for clarification of their contributions to forums, explanations of final projects, or descriptions of their cultural contexts. Also, the iterations of the training, and the change from a focus on STEM to ODL methodology resulted in participants not all receiving the same training. It is possible that findings may have been different if the research had been designed before the courses were.

It cannot be stressed strongly enough that the advent of the COVID-19 pandemic affected the findings from this study. As previously discussed, the stress caused by the pandemic is also likely to have made the quantitative Hofstede Values Survey Module 2013 results less reliable than they would be in other settings. More importantly, though, while everyone knows that the pandemic had severe impacts on social life, we have no way of knowing the ways in which it may have influenced long-term cultural shifts. In this study, the first “hugging incident” occurred before the pandemic, but the second one occurred after my family and I had just spent three weeks very ill with the virus, and the school where the women worked was under strict protocols for distancing and social bubbling. While their actions were consistent with the decrease in Power Distance and Masculinity that they had shown online, their joy at seeing someone new and healthy was probably greater than it would have been in other times.

This study indicates the need for further research on the cultural dimensions and values that emerge in multinational Web 2.0-based communities. Although not all participants in this study fully engaged with Web 2.0 for education, most did, and they did so in a way that allowed intercultural collaborative learning to an extent that would have been impossible in these countries five years ago. Thanks to the global educational crisis prompted by the pandemic, it seems reasonable to expect accelerated diffusion of Web 2.0 educational technology. It is likely that many teachers in 2021 would agree with Tatyana’s skepticism when she entered the ODL training saying, “This may not be that necessary now that the whole world knows online learning doesn’t work.” However, in this case, professional development that allowed educators to learn through Web 2.0 ODL seemed to change most participants’ dispositions positively toward the technologies. Tatyana’s final project included an anecdote of how she had recently given a five-day ODL professional development training for teachers spread across a region the size of Idaho, concluding, “and now they are with us in ODL.” The referent for “us” was unclear, but it sounds like a reference to a community.

Implications

The purpose of this case study was to examine the way in which teachers’ cultural values influence and are influenced by Web 2.0 technologies used in online professional development, as demonstrated by participants’ attitudes toward and use of these technologies in their courses. The study did not find evidence of a clear relationship between Web 2.0 use and cultural values or vice versa. However, it found evidence that using Web 2.0 educational technologies for collaborative learning, especially within a supportive community, leads toward a pedagogical disposition favorable to both the technologies and the associated methods. As participants acted on that disposition, they formed a new community with others using the same means of communication and education. This community was initially characterized by high values of Power Distance and Masculinity, but the importance of these values decreased during the training.

The combination of youthful demographics, the rapid rise of Web access, and the remote geographic locations of much of the population gives reason to believe that Web 2.0 ODL could diffuse quickly throughout Central Asia. However, the decisions about adopting Web 2.0 educational technologies could result in unforeseen systemic changes—a special consideration when diffusing this technology combines people of different ethnicities, languages, religious, and nationalities in a relatively unstable part of the world (Anichkin & Kovalenko, 2018; Kaplan, 2012; Megoran & Sharapova, 2013). While most of the participants’ attempts at spreading new knowledge from the training resulted in course-level applications, several reported and demonstrated successfully spreading it at school, university, and regional levels – all of which could have consequences unanticipated by the organizations and people associated with this diffusion.

To ensure that the key stakeholders in the diffusion of Web 2.0 ODL into the developing world—the people living in the developing world—are allowed agency, practitioners of the technologies must be transparent about the cultural values likely to be promoted by the technologies. As Öztok observed, there is a "hidden curriculum" of democratization in Web 2.0 ODL, and "erasing race, ethnicity, and nationality may lead to loss of essential parts of felt identity" (2019, p. 86). While some may appreciate these "hidden" goals it must be acknowledged that "digital learning ecologies are not pedagogically neutral, but rather, through their very design, influence and guide teaching" (Guo et al., 2020, p. 448). Since culture if a function of tools and communication, there are no value-neutral communication technologies. However, this study's diverse participants' quick adoption and creative diffusion of Web 2.0 ODL technologies indicates that they may be ready for some changes.

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APPENDIX A

Institutional Review Board Compliance

The data in this study did not involve minors, is not private, and was collected through normal educational activities that did not involve interventions for the sake of research. Therefore, according to Boise State University's IRB policy, it is exempt from IRB review.

APPENDIX B

Design Document for Phase 1 of the Training

June 2019

STEM PD in CA: science, technology, engineering, and mathematics professional development in Central Asia

This one-year, grant-funded professional development program provides 36 teachers from universities and private high schools in four Central Asian countries with training in research-supported STEM methodologies and means for applying and diffusing their training in their courses and professional communities.

PART 1: Front-end Analysis

Problem Analysis

What problem are you trying to address?

The countries represented in this program consistently score among the worst in the world for STEM education. While this problem has multiple causes, including lack of funding, corruption in the educational systems, and low prestige of STEM fields in local cultures, a final often-cited factor is that of lack of trained teachers. This program aims at providing a group of specially selected influential teachers with training in STEM methods and training in diffusing their knowledge.

The project manager, the director of a private language school in Bishkek, applied for the grant to fund this project in May 2018 and received confirmation of funds in May 2019. The project is endorsed by the U.S. State Department, the Ministry of Education of Kyrgyzstan, and all the schools and universities with participants in the program.

Is instruction an appropriate solution for the problem?

Instruction alone will not solve the problems of low STEM performance of participants in Central Asia, but it could reasonably be expected to help with the issue of untrained teachers. Most teacher-trainings in Central Asia still rely heavily on top-down curricular and lesson-planning decisions based on behaviorist methodologies. Giving potential influencers experiential training involving STEM education through constructivist methodologies, and requiring them to share their knowledge to colleagues, could help address one of the many factors leading toward low STEM proficiency of Central Asian populations.

Moreover, this type of "specialist training" has been a staple of professional development in this region since the 1920s, as Soviet ideology prohibited direct financial compensation for most achievements, but could reward outstanding teachers with travel, an audience for their learning, and enhanced prestige for their schools. Because of that, it is common for professional communities to send members to annual conferences and then provide them with opportunities to give seminars or mini courses in which they present what they have learned.

This program hopes to build on those cultural elements by not only presenting participants with new information and evaluating their application but including diffusion of their learning as a program objective.

Is web-based instruction an appropriate solution for the problem?

The target audience for this program includes 40 practicing teachers spread over four countries that, together, are one-third the size of the United States. This geographic expanse combined with the difficulty of traveling across borders and natural barriers such as deserts and mountain ranges in the region make the web an ideal medium for content delivery. In addition, the program outcomes include disseminating the information further via Internet technology, so web-based delivery allows a self-referential teaching mechanism in which participants receive instruction in the medium they need to use in demonstrating their mastery of objectives.

What will learners learn in this program?

Learners will learn to explain foundational educational theories and their application to STEM education, analyze their current curriculum and educational practices, and create original unit and project plans that implement research-based methodologies and assess participant achievement according to standards-based outcomes. Learners will also learn to evaluate their projects through group discussions and disseminate their knowledge to their professional communities through culturally appropriate media.

Description of Organization

This is a one-time program funded by grants from a governmental organization and offered through a private school in Bishkek, Kyrgyzstan. The program was publicly advertised through social and printed media from December - May 2019. 36 participants (8 from Kazakhstan, 16 from Kyrgyzstan, 8 from Tajikistan, and 8 from Uzbekistan) were selected according to a competitive refereed process by members of the sponsoring organizations who are not involved in developing or teaching the program. Admission to the program depends on numerous factors such as…

- Availability during program dates;
- Support for participation and income of constructivist-based STEM methodologies by their employers;
- English language proficiency;
- Experience and current employment as a STEM teacher;

- Purpose statement by the participant explaining means of diffusing the education that they receive in the program.

Learner Analysis

General Demographics and Learner Characteristics

As of 24 May 2019, no specific information is available about the participants or their sponsoring institutions. Therefore, the following information is based on statistical and anthropological probabilities.

Currently-practicing STEM instructors in Central Asian universities most likely began their formal education under the Soviet Union (pre-1991) and completed it after the fall of the U.S.S.R. (1991). The Soviet model of education included centralized decision-making for all aspects of curriculum and materials, from standardized tests to daily lessons. The fall of the Soviet Union resulted in the decision-making center, Moscow, suddenly losing power, while decentralized Ministries of Education lacked the experts required to develop curriculum and write textbooks. Therefore, the average participant in this program is likely to have experienced a severe disruption in their formal education for a significant part of their childhood and university experience.

Secondly, although the participants in this program speak English and come from four countries, they come from a variety of native languages. To add to the complexity, several of these languages have been primarily based on orality, not writing. Moreover, each of these languages is associated with cultural identities that often contribute toward long-standing prejudices, such as those found worldwide between pastoralists, agriculturalists, and urban dwellers.

Motivations

Participants in this program will receive expense-paid travel, room, and board for the face-to-face trainings in Bishkek, and will receive certificates from The Lingua School and the U.S. Embassy, Bishkek, on completion of their training. However, the main extrinsic motivations are for the personal and institutional honor they and their schools receive due to their selection to the program.

Prior Knowledge

Participant should have at least an intermediate English proficiency and the ability to use email and standard office production tools. This was assessed in the selection process.

However, the preliminary survey of participants and their participation in the one-week Orientation Module will indicate specific language or technical weaknesses that can be accommodated through differentiated instruction once the program begins.

The more difficult accommodation will be for participants who lack knowledge in their content areas or teaching methods. Although all participants are practicing teachers, the educational systems of Central Asia are known to be corrupt, so the professional responsibilities may not correlate with actual training or skills. This area of assessment will primarily occur during the first face-to-face training, and participants deemed to be lacking requisite skills will be advised to complete supplemental readings and skill-building tasks.

Technical Skills

Entrance to the program requires only the ability to use email and standard word processing. However, success requires the ability to learn common educational technology apps quickly. Because of this, the Orientation Module of the program will provide opportunities for participants to:

- Produce short YouTube videos;
- Create a simple collaborative document using Google Docs;
- Create a simple collaborative presentation using Google Slides and WhatsApp.
- Create a simple collaborative infographic using Canva;
- Participate in and analyze a survey using Google Forms;
- Participate in a forum discussion in Moodle.

Since this is a stand-alone, grant-funded program, there is no institutional help desk available for technical issues. participants experiencing technical trouble are expected to notify their instructors but are also expected to use the abundant documentation on Moodle, G Suite, and YouTube to address the problems.

The program instructors are both available to respond to questions regarding academics or assignments within 24 hours during the school week. Each of the program instructors has an assistant/ participant mentor who will reply to technical questions within 24 hours.

Abilities and Accommodations

Although none of the participant countries for this program endorses widespread inclusive education, the U.S. Embassy funding allows us to require all materials to comply with ADA standards for online learners and ensure compliance with U.S. policies on accessibility.

However, if additional accommodations are required, participants will need to contact the instructors. According to grant specifications, the final decision regarding additional accommodations is the responsibility of the project manager.

Other Learner Characteristics

Most of the learners come from cultures that have high values of cooperation and collaboration, which would seem to fit well with constructivist methodologies. However, the cultures involved did not have strong formal educational systems prior to the Soviet Union. As previously noted, the Soviet educational model emphasized top-down compliance to exterior standards. These conflicting values of collaboration and compliance with exterior (and possibly irrelevant) assessments has resulted in a learner culture with a high tolerance of collaborating to ensure that all members of a community measure up to an external standard (i.e. *cheating.*)

Relevant Standards

At the conclusion of this training, participants will be able to...

1. Explain the theoretical foundations of effective STEM education.
    a. Explain and give examples of how 21st-Century Skills (Critical Thinking, Communication, Collaboration, Creativity) can be employed in STEM education.
    b. Explain ways in which changes of STEM methods could affect educational systems in their local contexts and give examples of practices that could increase stakeholder buy-in for the diffusion of innovations.

c. Evaluate the value of the theories of behaviorism, cognitivism, and constructivism apply to teaching specific STEM objectives.

d. Evaluate methods of course change regarding design concerns such as inclusion, access, documentation, and iterative processes.

2. Contribute to the enhancement of professionalism in STEM education.

a. Analyze ways in which social presence varies in developmental, social, or disciplinary contexts.

b. Evaluate the appropriateness of specific methodologies for their specific contexts.

c. Evaluate the appropriateness of varieties of formative and summative assessments for their specific contexts.

d. Evaluate the appropriateness of educational technologies for research, communication, collaboration, and reflection (e.g. G Suite, Moodle, YouTube, social media, flipped classrooms, makerspace) for their specific contexts.

e. Analyze ways of enhancing professionalism in specific developmental, social, or disciplinary contexts.

3. Apply the theoretical and professional principles to the development of original curriculum units.

a. Describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.

b. Create an original project or unit that uses backward planning and research-based STEM methodologies.

c. Demonstrate the ability to work within a collegial community to elicit and deliver effective feedback on teaching.

4. Change their educational communities by sharing what they've learned.

    a. Identify and develop strategies for dealing with innovators, early adopters, and laggards about STEM methods changes in their community.

    b. Develop an online community of teachers and decision-makers regarding STEM methods in Central Asia.

    c. Create and present a face-to-face or online training for STEM teachers in their community.

Program Goal

STEM PD for CA enables participants to describe current research-based STEM methods, evaluate the appropriateness of methods related to specific tasks and contexts, create projects and units employing those methods, and help other teachers develop in STEM methods.

Program Learning Objectives

1. Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills.

2. Given a specific local context (e.g. subject area, level, course size, and cultural setting), participants will evaluate the appropriateness of STEM

methods and associated technologies for increasing stakeholder buy-in and the diffusion of innovations.

3. Given a course design template, participants will describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.
4. Having chosen a specific learning objective from their own courses, participants will demonstrate principles of documentation, inclusion, access, and iterative processes in the design of an original project or unit.
5. Given peer-designed projects or units, participants will discuss the appropriateness of alternate methodologies and formative and summative assessments for the units.
6. Given peer-designed projects or units, participants will discuss means of developing appropriate social presence in relation to contextual issues.
7. Given peer-designed projects or units, participants will evaluate the appropriateness of educational technologies for research, communication, collaboration, and reflection (e.g. G Suite, Moodle, YouTube, social media, flipped classrooms, makerspace).
8. Given specific community and professional contexts, identify and develop strategies for dealing with innovators, early adopters, and laggards regarding STEM methods changes in their community.
9. Create and present a face-to-face or online training for STEM teachers in their community.

PART 2: Design (Mapping the program & instructional planning)

Program Map

Course Level Objective	Module Level Learning Objective	Description of Assessment
1. Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills.	Describe their understanding of STEM methods.	Create a 2-3-minute YouTube video describing STEM methods in an informal, conversational style. Then post and comment on at least two works by colleagues.
3. Describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.	Diagram the curricular structures of their schools.	Work with a partner in Canva to make an infographic diagraming the curriculum structure at their institutions. Then post and comment on at least two works by colleagues.
6. Given peer-designed projects or units, participants will discuss means of developing appropriate social presence in relation to contextual issues.	Create a wiki of short bios for each participant.	Use Google Docs to create a table that includes a self-portrait and <200-word bio of each participant.
	Identify norms of "Netiquette" for our learning environment.	Complete a Twine story identifying the netiquette practices for this project and the possible social consequences of failure to follow the social norms of

		asynchronous text-based communication.
1. Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills.	Design an infographic showing how each theory of learning could be applied to their content area. Analyze other groups' work.	Work with cohort members in the same subject area to design a Canva infographic explaining the ways theories of learning could be applied to STEM education. Then write comments in Moodle Forums analyzing the work of at least two other cohorts.
8. Given specific community and professional contexts, identify and develop strategies for dealing with innovators, early adopters, and laggards about STEM methods changes in their community.	Outline and analyze potential opportunities and barriers for implementing the course content in their community.	Outline a SWOT Analysis of their community regarding the implementation of constructivist STEM methods. Post comments in Moodle Forums analyzing the work of at least two colleagues.
1. Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills. 2. Given a specific local context (e.g. subject area, level, course size, and	View or read a description of a STEM method, summarize the prompt, and outline and evaluate the theory, method, and assessment used.	Participants will choose one or two of dozens of sample texts and videos provided by the teachers. They will write brief (<200 word) summaries of the material and produce a table outlining and evaluating the effectiveness of the sample. They will provide an evaluative response in Moodle Forums to the prompts of at

cultural setting), participants will evaluate the appropriateness of STEM methods and associated technologies for increasing stakeholder buy-in and the diffusion of innovations.		least two members of their cohort.
3. Describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.	Explain key terms related to curriculum and assessment in English and contrast them with analogous concepts in their learning environments.	Following completion of the key readings and video lecture, complete a short-answer quiz using Moodle Quizzes explaining and contrasting curriculum development concepts (e.g. objectives, essential questions, standards). Create a 5-minute YouTube video explaining the key differences between concepts of curriculum in their local environment and that in the West. Comment in Moodle Forums on at least two of the colleagues' work.
3. Describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.	Describe their focus course and assessment processes in Western curricular terms.	Participants will use a Google Doc template to describe their current focus course and focus unit/ project standards, essential questions, objectives, and assessment.
5. Given peer-designed projects or units, participants will discuss the appropriateness of alternate methodologies	Contrast formative and summative assessments and evaluate	Upon completion of the course readings and the UCD online mini-course on assessment, participants will complete a short-answer

and formative and summative assessments for the units.	various assessment tools.	Google Form quiz requiring them to evaluate the potential effectiveness of various formative and summative assessment tools. Upon completion of the quiz, participants will be able to see the responses of others.

The specific assessment activities for Modules 7-10 will be determined based on analysis of the participant progress during the first five months of the program. The outline below shows the general objectives of these modules.

1. Module 7: Designing (3 weeks; December)
    a. Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills.
    b. Having chosen a specific learning objective from their own courses, participants will demonstrate principles of documentation, inclusion, access, and iterative processes in the design of an original project or unit.
    c. Given specific community and professional contexts, identify and develop strategies for dealing with innovators, early adopters, and laggards regarding STEM methods changes in their community.
2. Module 8: This 3-day face-to-face module is not included in the design document.
3. Module 9: Doing (5 weeks; February – March)

    a. Having chosen a specific learning objective from their own courses, participants will demonstrate principles of documentation, inclusion, access, and iterative processes in the design of an original project or unit.

4. Module 10: Evaluating (2 weeks; April)
    a. Given a specific local context (e.g. subject area, level, course size, and cultural setting), participants will evaluate the appropriateness of STEM methods and associated technologies for increasing stakeholder buy-in and the diffusion of innovations.
    b. Given peer-designed projects or units, participants will discuss the appropriateness of alternate methodologies and formative and summative assessments for the units.
    c. Given peer-designed projects or units, participants will discuss means of developing appropriate social presence in relation to contextual issues.
    d. Given peer-designed projects or units, participants will evaluate the appropriateness of educational technologies for research, communication, collaboration, and reflection (e.g. G Suite, Moodle, YouTube, social media, flipped classrooms, makerspace).
5. Module 11: Presenting (5 weeks; May)
    a. Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the

problem in a way that promotes learner development of at least one of the 21st-Century Skills.

b. Given peer-designed projects or units, participants will discuss means of developing appropriate social presence in relation to contextual issues.

c. Given specific community and professional contexts, identify and develop strategies for dealing with innovators, early adopters, and laggards regarding STEM methods changes in their community.

d. Create and present face-to-face or online training for STEM teachers in their community.

e. Module 12: Beginning Again (1st week of July 2020): This face-to-face module is not included in the design document.

Assessment Planning

This is an adult learning, professional development program. The assessments, and participation in the course activities are all optional. This results in a high need for formative assessment so that the course can in continual development to meet the participants' needs and ensure their continued participation. The only truly summative assessments are the presentation of an original unit or project (Module 8) and the presentation of findings to their professional community (Module 10).

Module 1

Participants will demonstrate their ability to communicate effectively, collaborate in solving problems, and use the technology required for the training. This involves completing several tasks using different online apps. First, participants will identify the rules of Netiquette for the program by completing a Twine story. They will then use Google Docs to create a biographical Wiki for cohort member. After that, they will create 3-minute YouTube video describing their current understanding of STEM methods and use Canva to collaboratively design a model of their institution's curricular structure, Following the YouTube video and Canva project, they will apply their understanding of Netiquette through short responses analyzing the responses of at least two members of their cohort. After completing these activities, participants will use a Google Form survey to assess their own performance and outline personal goals for upcoming face-to-face unit. All posts and discussions will occur asynchronously in Moodle.

Module 2

Participants will synthesize the most important lessons from the face-to-face training. This involves, first, collaborating to create a Canva infographic explaining the ways theories of learning could be applied to STEM education. They will then evaluate the relevance of concepts from the face-to-face training to their specific communities through a SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats) of the key concepts from the training. This will be completed in a Google Doc and shared with cohort members for further analysis in a Moodle Forum.

Module 3

In each week of Module 3, participants will complete the same activity, but with different prompts. They will read or watch the assigned materials for the week and summarize the content in a brief (<200 word) synopsis. They will then collaborate with their cohort members to create a Wiki using Google Docs that includes the summaries and evaluations of the effectiveness of the methods in their local contexts. Each participant will receive different materials for review each week, so the Wiki will include approximately 50 items by the end of the module. In the final week of the module, participants will synthesize the most important lessons they have gained from the unit and assess their own performance. This will be posted in a Moodle forum in which participants will apply the Netiquette norms in their comments.

Module 4

Following completion of the key readings and video lecture, participants will complete a short-answer quiz using Google Forms, giving defining approximately 20 common curriculum development terms (e.g. objectives, essential questions, standards) and contrasting the Western concepts or structures with those in their local society. They will then create a 3-5-minute YouTube video summarizing the similarities and differences between their community's concepts of curriculum and courses with those in Western societies.

Sample Prompt: Describe the process that would result if your principal or director said, "We need to align our standards and activities more closely."

Module 5

Participants will demonstrate their understanding of the course materials on a Google Doc template describes their current focus course in terms of standards, essential questions, objectives, and assessment. They will then analyze the work of at least two members of their cohort and refine their own work in response to their colleague's feedback.

Module 6

Upon completion of the course readings and the UCD online mini-course on assessment, participants will complete a short-answer Google Form quiz asking them to evaluate the potential effectiveness of various formative and summative assessment tools in specific cases. The quiz will consist of approximately 20 prompts that present course objectives, types of assessment, and contexts, and asks participants to explain ways to improve the assessment.

Sample Prompt: An instructor in an introductory statistics course in Jalalabad, Kyrgyzstan, uses data from the U.S. Census of 1960 U.S. Census to examine differences in income between people of different races. This data is readily available and has been used in many popular textbooks. The answers are readily available. What are some ways the instructor could make the assessment more effective for increasing learning?

Instructional Planning

The types of interaction for this program considers the models of both Moore (1989) and Horton (2011). Moore's model focuses on the agents interacting (learner-instructor, learner-content, learner-learner), while Horton's focuses on the types of interaction (absorb, do, connect). These models are both well-tested and intuitive in their simplicity, thus reducing the amount of time likely to be spent in discussions over categorical terms.

Module	Learning Objective	Possible Activity
1	Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills.	• Create a 3-5-minute YouTube video describing their understanding of STEM methods. • Then comment on each other's videos.

	Describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.	• Create a collaborative Canva (canva.com) infographic describing their educational system. The comment on each other's videos
	Given peer-designed projects or units, participants will discuss means of developing appropriate social presence in relation to contextual issues.	• Complete a Twiney story to identify the rules of netiquette. • Tweet regularly about their learning at including the course hashtag. • Make a program Wiki of participant bios and pictures.
2	Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills	• Create a collaborative Canva infographic synthesizing the instruction given in the face-to-face section. Then comment on the work of colleagues.
	Given specific community and professional contexts, identify and develop strategies for dealing with innovators, early adopters, and laggards about STEM methods changes in their community.	• Conduct a SWOT analysis of their community. The comment on the work of colleagues. • Conduct research on the question using social media (Twitter, LinkedIn, Facebook, MoiMir)
3	Given a STEM objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills. Given a specific local context (e.g. subject area, level, course size, and cultural setting), participants will evaluate the appropriateness of STEM methods and associated technologies for increasing stakeholder buy-in and the diffusion of innovations.	• Read assigned texts or watch assigned videos. • Construct a collaborative Wiki using Google Docs summarizing and evaluating the videos in relation to theoretical background and applicability to the intended audience. • Comment on the work of others. • Continue to do research and expand their influence through social media.

4	Describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.	• Read or watch required materials. • Take a Google Forms quiz • Make a YouTube video summarizing what they've learned. • Comment on the videos of colleagues. • Continue to do research and expand their influence through social media.
5	Describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.	• Read or watch assigned materials. • Complete a description of their course using a Google Doc template. • Comment on the work of colleagues. • Revise the Google Doc to incorporate colleagues' suggestions. • Continue to do research and expand their influence through social media.
	Given peer-designed projects or units, participants will discuss the appropriateness of alternate methodologies and formative and summative assessments for the units.	• Read or watch assigned materials. • Complete a short-answer quiz analyzing the appropriateness of various types of assessment in various situations. • Continue to do research and expand their influence through social media.

Motivation Planning

The ARCS model (Keller, 1987) describes the key elements of motivation as attention, relevance, confidence, and satisfaction. While this model is simple and intuitive, it seems to overlook research on the importance of anxiety as a motivator (Eysenck & Calvo, 1992). This critical amount of anxiety can come from many sources, but for Central Asian culture, it is likely to be facilitated most readily by building on their collectivist values, which encourage the group to maintain its identity by keeping group cohesion even at the expense of individual accomplishment. The activities outlined below are chosen to build group identity, clarify the group's expected standards of performance, and provide means for struggling participants to rejoin the group.

Other cultural considerations

As celebrations of life events and cultural holidays are exceptionally important in Central Asian cultures, instructors will note participant birthdays and local holidays, and recognize them within Moodle. Moreover, work missed due to cultural or life celebrations (including, for instance, the wedding of a cousin), will be granted an automatic extension.

Many aspects of privacy that are protected in the West are not only unvalued in Central Asia but are opposed to Central Asian cultures. For instance, most Central Asians cannot choose a word for *you* unless they know if you are male or female and if you are younger or older than they are.

Participants may expect a response to an email about the course from the instructor or teaching assistant within 48 hours. In addition, instructors will be available via Moodle's messaging or WhatsApp, with a commitment to reply within 48 hours.

Although this program does not involve graded assignments, it will introduce aspects of gamification throughout by awarding Moodle badges for activities such as…

- Meeting deadlines.
- Replying effectively to more cohort members than required.

- Showing exceptional 21st-century skills (communication, collaboration, critical thinking, creativity) or research.
- Using social media with exceptional effectiveness.
- Providing exceptional help to a colleague in order to master the objectives.

In addition to badges, the list below shows specific motivational techniques that will be use in each module:

1. Module 1
    a. A Google Form survey of participants' current understanding, practice, and attitude toward STEM methodologies, current teaching practices, and general cultural values. This anonymous survey will include Likert-scale and qualitative prompts. The survey will be repeated at the end of the program. The initial survey will help with formative assessment, and the final survey will be used to examine the effectiveness of the program as the final summative assessment.
    b. A general Google Forms survey of participants' demographic information, interests, hobbies, etc., set to reveal survey results to everyone who has taken the survey.
    c. Short video introductions from all the teachers.
    d. The participant biography Wiki that includes pictures.
    e. Participant videos explaining their concept of STEM, but also building social presence by introducing their action, expressions, and voice.

    f. Technology that will be new to many, but is easy to use, builds community, and provides immediate reward for success (Twitter, LinkedIn, Canva).
    g. Personal connection with each participant via WhatsApp (Central Asia's dominant means of electronic communication).
2. Module 2
    a. Personal connection with each participant via WhatsApp.
    b. Comments on each participant's initial posts.
    c. A video from each of the teachers summarizing their cohort's learning activities that week and introducing the next module.
    d. Continued use of social media.
    e. Continued use of badges.
3. Module 3
    a. Increasing learner's internal locus of control allowing them to choose 2-5 texts and videos each week out of more than 20 options.
    b. Increasing learner's sense of interdependence as they share their knowledge in order to produce a Wiki that will, in the end, be published on the course's public website.
    c. A video from each of the teachers summarizing their cohort's learning activities every two weeks.
    d. Personal comments on posts each week.
    e. Synchronous "Teatime" in early October.
    f. Continued use of social media.

g. Continued use of badges.
h. Personal connection with each participant each week via WhatsApp.
i. Anonymous satisfaction surveys at the end of the module (using Google Forms), with results viewable by the participants. Survey prompts include "most important lessons learned" and "changes in my courses because of this training."

4. Module 4
    a. Video lectures from the teachers on key content.
    b. A video from each of the teachers summarizing their cohort's learning activities each week.
    c. Personal comments on each person's first post.
    d. Continued use of social media.
    e. Continued use of badges.
    f. Personal connection with each participant each week via WhatsApp.
5. Module 5
    a. Synchronous "Teatime" in early December.
    b. A video from each of the teachers summarizing their cohort's learning activities each week.
    c. Personal comments on each person's first post.
    d. Continued use of social media.
    e. Continued use of badges.
    f. Personal connection with each participant each week via WhatsApp.

g. Send a thank-you letter to each of the participants' institutions to highlight the participants' accomplishments.

Content Planning

More information about the participants' English reading proficiency is necessary before identifying the exact texts to be used. The instructional designer and content specialist have agreed to focus on research-based articles for wide markets of educators rather than primary research articles. They have also agreed to use video instruction often - both original videos and those available through YouTube or Vimeo - to accommodate the instruction to orality-based learners.

Social Interaction Planning

For this program, there is a lot of overlap between Motivation and Social Interaction. Since the main social-presence elements should occur throughout the course, they are summarized here in text rather than presented in a table that would prove redundant.

As mentioned in the Motivation section, participants can expect weekly WhatsApp messages from their instructor, as well as public recognition of holidays and life events. Also, in keeping with the culture of the participants, all will be expected to share details about the place they grew up, their family of origin, and their current family. Instructors who share personal life events ("my son is on a trip", "my wife got a new job") will most likely be perceived by the participants as being open and sociable.

Social media and WhatsApp have diffused quickly in Central Asia, so each week will include encouragement for participants to share their knowledge and experiences and build their social networks. Bitmoji has also diffused quickly, possibly for the way it allows people to step out of their traditionally defined social roles. Instructors and participants are encouraged to use Bitmoji or similar avatars to increase their social presence in the course.

The program will also include at least one synchronous “Teatime” approximately once every six weeks. More may be scheduled at learner request.

There is one potential pitfall, though, that instructors should watch for throughout the program. This program brings together people from four countries that do not have a history of close cooperation. Animosity between the Kyrgyz and Uzbeks in the Ferghana Valley exploded in the 2010 revolution, resulting in thousands killed and hundreds of thousands dislocated in a process that verged on ethnic cleansing. Nationalism and racism are prevalent in many regions of these countries, often leading members of one group to use racial slurs for members of another, to avoid eating at the same restaurants, and to occasionally resort to violence against inter-racial couples. While this program should not cater to prejudices, instructors should be aware that such prejudices might disrupt learning in some cases.

PART 3: Prototype

This program will use Moodle as well as G Suite for Education. Both programs include recent modifications to allow easy auto-translate functions and ample documentation in Central Asian languages. Moodle will be the primary tool for managing learners and activities in an online environment, but many assignments will incorporate Google Docs, Forms, Sheets, and Sites. Also, the course will use a Google Site for its publicity.

All the functions of the course could be managed through Moodle; however, since one of the program goals is replication, it seems worthwhile to help participants gain proficiency in the most widely used free tools. Likewise, the program could be run through G Suite (Classrooms, Docs, Sheets, Sites, and Forms), but those programs are difficult to present in a way that seems organized and inviting to people unfamiliar with the technology.

Although Moodle's functionality makes it a superior LMS for this program, G Suite for Education's ease of use makes it a powerful tool for encouraging the diffusion of ideas. The Google Site for the class will serve primarily as the public face of the program - a place participants can point to when asked where they are studying or what they are learning.

Design Justification

Three main considerations influenced the design of this prototype: accessibility, replicability, and cultural appropriateness.

The learners in this program are all non-native English speakers. Because of that, the program is designed to ease auto-translation tools. The newest version of Moodle allows Google Translate functionality of all text areas when using the Chrome browser, so all design changes were optimized for Chrome. In addition, videos were only selected if they had enabled auto-translation functions or official transcripts or subtitles. Also, although it may not appear at first as a design feature, the use of vocabulary and grammar was designed to assist with English Language Learner (ELL) capacity. This includes writing with standard sentence structure, using precise academic terms rather than colloquialisms or jargon (e.g. received a high grade, not aced it!; failed, not bombed or flunked.), and basing humor on universal constructs rather than cultural allusions (e.g. the meme of a kitten holding a branch, not the meme of Morpheus saying, “What if I told you…?”). A final accessibility consideration influenced the choice of standard Helvetica/Arial fonts, which are easily recognized by auto-translation programs.

The second main consideration is replicability. Since the goal is to have the program ideas diffused as effectively as possible, the design intentionally limited choices to Google and MoodleCloud templates with modifications requiring nor more than a few clicks.

Thirdly, the design is intended to feel culturally familiar. Central Asian art is famous for geometric patterns in textiles, pottery, and carpets. Also, the colors red, green, and gold all have strong positive associations in local cultures, so they feature prominently in the site design. These considerations led to choosing a wallpaper of muted red, green, and gold geometric patterns and font colors that matched those of the background.

Finally, although local design often includes color and pattern combinations that Westerners find disorienting, this site design has emphasized the research-based findings that minimalism aids focus in online design environments. The site includes only two font colors and only white backgrounds for text in order to minimize any distraction from the patterned wallpaper.

PART 4: Summative Assessment

Summative assessment of the training’s effectiveness be based on four primary tools. The first is a comparison of surveys given at the beginning and end of the training to measure changes in attitudes and practices. The second is learner engagement in activities throughout the course, especially when the engagement demonstrates understanding and application of core concepts from the training. The third is the final project, in which participants will design original units of a course using methods from the training and teach the unit in a course. The final assessment will occur after participants conduct professional development training for their colleagues and reflect on their learning experience.

APPENDIX C

Design Document for Phase 2

May 2020

Enhanced Instructional Methods in Distance Learning

This four-month training builds on the STEM program in which STEM and English teachers from four Central Asian countries worked together in an online distance environment to understand and apply STEM methodologies. This training gives participants the foundational theories, technical skills, and basic methodologies to begin teaching professionally in online environments.

PART 1: Front-end Analysis

Problem Analysis

What problem are you trying to address?

Even before the COVID-19 virus, online distance learning was growing as a potential solution for the geographically marginalized people of Central Asia. The school closures resulting from the virus made the implementation of high-quality online learning a high priority throughout the region. This program will prepare approximately 50 STEM and English teachers with the skills needed to conduct online courses effectively and help train their colleagues to do the same.

Is instruction an appropriate solution for the problem?

While many Central Asian teachers are learning to teach online through practice, it is reasonable to assume that focused training will help. When transitioning to online teaching, most classroom teachers attempt to transfer their existing course to a new platform; online courses are most effective when designed for online delivery using specific design principles. Proper training in how to teach and design for online delivery will increase the likelihood that future courses are efficient and effective.

Is web-based instruction an appropriate solution for the problem?

This program will use the LMS Moodle and G Suite for Education tools to self-referentially teach the participants how to use the tools. The online format allows the participants to experience all the methodologies from a student's point of view as they consider how to use the methodologies as teachers.

What will learners learn in this program?

Learners will learn the key similarities and differences in online and face-to-face teaching with relation to different ages of learners and subjects being studied. They will experience and design learning activities that build 21st-century skills (collaboration, communication, creativity, and critical thinking). They will then design an online unit for a course that they teach using synchronous and asynchronous methods, present the unit to a class, reflect on it, and present their findings to their wider professional community.

Context Analysis

Description of Organization

This is an extension of a program funded by a governmental organization and administered by a private school in Bishkek, Krygzyzstan. The original program was publicly advertised through social and printed media from December - May 2019. 36 participants (8 from Kazakhstan, 16 from Kyrgyzstan, 8 from Tajikistan, and 8 from Uzbekistan) were selected according to a competitive refereed process by members of the Lingua School and U.S. Embassy, Bishkek, who are not involved in developing or teaching the program.

The original program grew to accommodate over 40 participants. In early April 2020, the program leaders determined that the original program objectives were untenable due to virus-related school closures. In mid-May 2020, the US Embassy gave permission to extend the program through November 2020, redesigning it to focus on online distance learning, and bringing in new specialists in that field.

Learner Analysis

General Demographics and Learner Characteristics

The participant group has grown to 50 people representing many aspects of Central Asian education. They have multiple native languages and different levels of English proficiency. Their students range from elementary through university, and courses taught include computer science, mathematics, physics, chemistry, and English. Some are also school administrators. Some have taught online courses prior to entering the program, and some are participating in online learning for the first time in the program.

Motivations

In addition to the motivations of intrinsic knowledge and external rewards, such as certificates, the participants are motivated for the training due to the necessity of stopping face-to-face education in almost all Central Asian schools beginning in March 2020 due to COVID-19.

Technical Skills, Abilities and Disabilities, and Learner Characteristics

This are the same as in Phase 1.

Relevant Standards

At the conclusion of this training, participants will be able to...

1. Explain the theoretical foundations of effective online education.

a. Explain ways that common educational theories (behaviorism, cognitivism, and constructivism) can be applied in online settings.
b. Evaluate the appropriateness of synchronous and asynchronous activities in relation to specific learning objectives.
c. Describe ways of enhancing social presence in online distance learning (ODL) environments.
d. Describe ways in which online learning can benefit from gamification and project-based learning.
e. Discuss means of motivating students, encouraging autonomy, accommodating different needs, and managing student-to-student interactions in ODL environments.
f. Design valid and reliable tools for assessing online learning.

2. Contribute to the enhancement of professionalism in online education.
   a. Analyze ways in which social presence varies in developmental, social, or disciplinary contexts.
   b. Evaluate the appropriateness of specific methodologies for their specific contexts.
   c. Evaluate the appropriateness of varieties of formative and summative assessments for their specific contexts.
   d. Evaluate the appropriateness of educational technologies for research, communication, collaboration, and reflection (e.g. G Suite, Moodle, YouTube, social media, flipped classrooms, makerspace) for their specific contexts.

   e. Analyze ways of enhancing professionalism in specific developmental, social, or disciplinary contexts.

3. Apply the theoretical and professional principles to the development of original ODL curriculum modules.
   a. Develop a design document for an original ODL module using an outcomes-based instructional focus and backward planning.
   b. Apply the concepts from the design document to an ODL module hosted through Moodle or G Suite.
   c. Present an original ODL module of 5-10 lessons to other members of the cohort.
   d. Collaboratively analyze the results of the ODL module.
4. Change their educational communities by spreading what they've learned.
   a. Identify and develop strategies for dealing with innovators, early adopters, and laggards regarding ODL changes in their community.
   b. Develop an online community of teachers and decision-makers regarding ODL methods in Central Asia.
   c. Create and present at an online conference for teachers throughout Central Asia.

Program Goal

This program enables participants to describe current evidence-based constructivist methods for asynchronous ODL, evaluate the appropriateness of methods related to specific tasks and contexts, create projects and units employing those methods, and help other teachers develop in ODL methods.

Program Learning Objectives

1. Given an ODL environment and an objective related to their field, participants will explain how behaviorism, cognitivism, and constructivism would address the problem in a way that promotes learner development of at least one of the 21st-Century Skills.
2. Given a specific local context (e.g. subject area, level, course size, and cultural setting), participants will evaluate the appropriateness of ODL methods and associated technologies for increasing stakeholder buy-in and the diffusion of innovations.
3. Given a course design template, participants will describe their current courses in terms of standards, curriculum, units, projects, materials, and lessons.
4. Having chosen a specific learning objective from their own courses, participants will demonstrate principles of documentation, inclusion, access, and iterative processes in the design of an original project or unit.
5. Given peer-designed projects or units, participants will discuss the appropriateness of alternate methodologies and formative and summative assessments for the units.
6. Given peer-designed projects or units, participants will discuss means of developing appropriate social presence in relation to contextual issues.
7. Given peer-designed projects or units, participants will evaluate the appropriateness of educational technologies for research, communication,

collaboration, and reflection (e.g. G Suite, Moodle, YouTube, social media, flipped classrooms, makerspace).

8. Given specific community and professional contexts, identify and develop strategies for dealing with innovators, early adopters, and laggards regarding ODL methods changes in their community.
9. Create and present a face-to-face or online training for ODL teachers in their community.

PART 2: Design (Mapping the program & instructional planning)

Program Map

Learning Objective	Motivation and Assessment
1. Given models and a choice of tools, participants will design professional online profiles involving websites and social media. 2. Given specific teaching scenarios, participants will discuss appropriate ways for creating social presence for teachers and learners.	● Participant video introductions through Flipgrid ● Create their Moodle profile ● Create their "Colleagues" profile ● Create professional websites
3. Given specific learning objectives, participants will discuss the pros and cons of asynchronous and synchronous learning for the objective.	● Moodle discussion
4. Given a set of course and technology perimeters, participants will discuss the pros and cons of various LMS platforms.	● Moodle discussion ● Participants describe potential students and courses in relation to technology proficiency and objectives.

	● Participants choose an LMS and give write a <300-word explanation for their choice with a target audience of their peers or administrators ● Participants start their own course site in the LMS of their choice ● Peer evaluation of each other's initial online course
5. Given learning objectives and a class description, participants will design a course module that involves synchronous and asynchronous components, following a standard design document template for online courses.	● Develop a simple Design Document in Google Docs and submit it to the Moodle forum ● Peer review of 2 colleagues using the same LMS
6. Given a design document for an online module, participants will create an online module using G Suite for Education, Moodle, or an equivalent.	● Fully design an online module. ● Give a 5-10-minute presentation of it using Screencast-o-matic or a similar tool and post it to the Moodle forum. ● Peer review and discussion
7. Given a well-designed module for online distance learning in Moodle or G Suite, participants will lead a group of learners through the module.	● After the teaching, reflections from both ends (learner and teacher). Potentially shared in Moodle discussion.
8. Given data from learner experience and performance in an ODL module, participants will collaborate with colleagues to evaluate the program and make recommendations for improvements.	● Critical analysis
9. Given a critical analysis of their ODL module, participants will	● Presentation plan explaining changes/developments in the

collaborate to prepare presentations of their findings in an online conference for their colleagues.	module (video or live meeting), turned in to instructors for feedback (shared in a Moodle discussion for more feedback, perhaps?)
10. Given an online platform of 6-30 minutes, involving synchronous or asynchronous interaction, participants will present their findings to colleagues throughout Central Asia.	● Presentation explaining changes/developments in the module (video or live meeting); include interaction with audience (whether synchronous or via comments, etc.)
11. Given feedback from their presentations and guided individual and collaborative reflection, participants will create a plan for the widespread diffusion of research-based online teaching methods in Central Asia.	● Complete a reflective analysis document individually ● Participate in a MEET session with 4-7 others in their cohort for a 3x5x7 analysis and proposal ● Share 3x5x7 results with their cohort ● Facilitators synthesize results and present to the whole program

The remainder of the Phase 2 design document is the same as for Phase 1.

APPENDIX D

Surveys Given in the Training

All surveys were given through Google Forms using five-point Likert-scale responses with choices indicated in the prompts below. Items marked as "open" allowed free responses. The Cultural Values prompts are adapted from the Values Survey Manual (VSM) 2013 with minor only changes to focus on educational instead of corporate work settings. Survey 1, given at the beginning of the training, is identical to Survey 2, given at the end of the training except for changes in verb tense indicated in some items.

Internet Infrastructure

1. I have reliable Internet access at home. [Likert Never-Always]
2. I usually have access to an internet-enabled mobile device. [Likert Never-Always]
3. I use the Internet a lot in the courses I teach. [Likert Never-Always]
4. I can use the Internet reliably for classes in my school. [Likert Never-Always]

Cultural Values (VS 2013)

1. ["In an ideal job, how important is it to…"; Likert: of very little or no importance □ of utmost importance]
    a. Have enough time for your personal or home life
    b. Have a boss (direct supervisor) you can respect
    c. Get recognition for good performance
    d. Have security of employment
    e. Have pleasant people to work with
    f. Do work that is interesting
    g. Be consulted by your boss in decisions involving your work

   h. Live in a desirable area
   i. Have a job respected by your family and friends
   j. Have chances for promotion

2. ["In your private life, how important is it to…"; Likert: of very little or no importance □ of utmost importance]
   a. Keeping time free for fun
   b. Moderation; having few desires
   c. Doing a service to a friend
   d. Thrift (not spending more than needed)

3. [Likert: never □ always]
   a. How often do you feel nervous or tense?
   b. Are you a happy person?
   c. Do other people or circumstances ever prevent you from doing what you really want to do?
   d. All in all, how would you describe your state of health these days?
   e. How proud are you to be a citizen of your country?
   f. How often, in your experience, are students afraid to contradict their teachers?

4. [Likert: strongly disagree □ strongly agree]
   a. One can be a good teacher without having a precise answer to every question that a student may raise about his or her work.
   b. Persistent efforts are the surest way to results.

c. An organization structure in which certain subordinates have two bosses should be avoided at all cost.

d. A company's or organization's rules should not be broken – not even when the employee thinks breaking the rule would be in the organization's best interest.

Dispositions and Practices

1. What is your personal theory of education? How do people learn best?
2. How often do you use the following technologies or methods for teaching? [Likert Never - Every Class]
   a. Email
   b. Social media (e.g. Facebook, Instagram, Twitter)
   c. Messaging tools (e.g. WhatsApp, Messenger)
   d. Notebook computers or tablets
   e. Student mobile devices
   f. Augmented or Virtual Reality
   g. Online or electronic textbooks or workbooks
   h. Interactive games (online or face-to-face)
   i. Online collaboration tools (like student-created wikis, or collaborative Google Docs)
   j. Virtual science labs
   k. Group discussions (online or face-to-face)
   l. Laboratory work
   m. Group research projects

n. Makerspace

o. Flipped classrooms

p. Individual research projects

q. Lecture

r. Project-based learning

3. What other methods or technologies do you often use in courses you teach?
4. Describe your experience learning about your field of specialty. What methods did your teachers use? How did you learn?
5. Describe one of your best lessons using technology in your course.
6. What do you think are the most important principles for teaching science, technology, engineering, or mathematics? Why?
7. Describe a typical lesson in a course that you teach. What would a visitor see if they came in unannounced?
8. How do you show evidence that your students are learning? Give examples.
9. How do you think your lessons will be different after participating in this program? Why?
10. How will you share what you learn in this program with your colleagues? Why will you use these methods?