The Presence of Culture in Learning

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Abstract

The selection of instructional strategies for learners requires consideration of the role of culture in learning. This chapter reviews current research across disciplines (i.e., mathematics, science, and e-learning) to provide a critical analysis of applications and conceptualizations of culture in learning. Given this research, implications for culture-based instructional strategies are offered.

Keywords

Culture • Learning • Instructional strategies • Culture-specific • Science • Mathematics • e-learning

Introduction

Worldwide there is growing concern about how to educate all people and understand the intricacies of human learning. Given this fact, culture has become a preeminent factor in understanding learners and learning.

The role of culture in learning moves beyond challenging dominate ideologies or world views; it is about defining and identifying instances, methods and processes of learning that are specific to individuals and groups. Thereafter, the selection of instructional strategies begins. That is, instructional strategies cannot be applied to learners; in this sense, instructional strategies must be developed from an ethnographic evaluation of the learner. Instructional strategies are derived from versus applied to the learner.

This chapter reviews international research in the areas of culture, learning, and a specific discipline (i.e., mathematics, science, and e-learning) to determine relevant instructional strategies in this context. Each section begins with a review the qualitative and quantitative studies. This is followed by a review of conceptual and theoretical articles that approach the same topic area. Mathematics, science, and e-learning are each approached differently depending on the literature reviews. In the mathematics and science literature, specific themes arose so those themes were reviewed in context to best compare and contrast the literature.

Other disciplines have been excluded because of the volume of research that is developing in these areas and publishing constraints. In particular, there is a growing body of research related to culture, learning, and disciplines such as computer technology, human computer interaction, instructional design, and game design.

Culture Defined

Culture remains a term institutionally defined and applied. Theoretical and conceptual definitions of culture derive out of the need to make culture discipline specific or to understand processes or practices. Some of these disciplines include: psychology, social psychology, education, anthropology, sociobiology, sociology, and cognitive science to name a few. Matsumoto (2009) situates culture in the field of psychology and associates culture with human behavior and mental processes. For Matsumoto, culture is a "meaning and information system, shared by a group and transmitted

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across generations" that allows for human survival, the coordination and transmission of social behaviors, and the pursuit of happiness, health and a meaningful life (p. 5). For another psychologist like Gurung (2009), culture is static as it captures a groups shared attitudes, beliefs, and goals, but culture is also dynamic; it is always changing because of the beliefs held by human beings in the group. Hollins (2008), an educator in sociocultural theory, positions culture as "who we are and how we exist in the world" (p. 18). Hofstede, a social psychologist and anthropologist, states that culture is "the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede, Hofstede, & Minko, 2010, p. 6). Anthropologists propose that culture is a "system of learned behaviors, and explore the ways that humans use it to organize and give meaning to the world around them" (Wanda & Warms, 2011, p. 74). Anthropologists agree that cultures are shared by people and groups who have learned behaviors. Cultures are adaptive to surviving in the world. Cultures change and are never static. Cultures are patterned and relational to one another. Cultures contain symbols (Pieterse, 2009). Sociobiological representations situate culture as an attribute to natural selection. That is, there is a natural selection for behaviors and these behaviors can be transferred from generation to generation. By example, current research in sociobiological sciences contends that human behavior is influenced by cultural factors and specific genes (Chiao & Blizinsky, 2010; Fincher, Thornhill, Murray, & Schaller, 2008). Then there are sociologists who delve in cultural studies and argue that culture is about meaning making—that is the exchange and production of meaning, between members in a group or society (Hall, 1997). Rogoff (2003), who studies human development and cognition, proposes that culture is what all humans do; further these cultural practices and cultural processes are enacted by humans in different ways, for different reasons but that they are part of the culture of human development.

This review of disciplines confirms the institutionalization of culture as a theoretical and conceptual term that is transmuted based on human need and desire. This mutation suggests the need to clarify the definition of culture as it pertains to human learning. Therefore, within this chapter, culture is all that we know and have come to know, do, and produce as human beings. Culture is everything! It is everything around us and everything ever created. Culture is all that is man-made, and even those things made by nature.

Notions of Culture in Learning

An interdisciplinary examination of research particular to notions of culture in learning reveals similar conclusions—that learning is actively mediated through learners participation in their culture (Choo, Austin, & Renshaw, 2007; Fischer, 2009; Gutierrez & Rogoff, 2003; Ito et al., 2010; Lee, 2009; Nasir, Rosebery, Warren, & Lee, 2006; Thomas & Brown, 2011). This means that situating learners within culture-based contexts enables learning to happen naturally. Culture-based encompasses culture-neutral (generic) and culture-specific (specialized) contexts (Young, 2008, 2009).

Studies in Culture

Studies that have examined culture and learning reveal culture as the primary focus of the research, and that culture is central to determining the learning preferences, styles, approaches and experiences of learners. Culture is determined to be central to learning. These studies are supported through an interdisciplinary selection of theory that relates to sociocultural, Afrocultural, cooperative learning, cognition, culture, learning styles, and language learning. This suggests the need for an interdisciplinary interpretation of culture and its relationship to learning. The methods of analyses considered both qualitative and quantitative research. All of the studies administered culture or learning related questionnaires or surveys to determine learners' learning styles, strategies, preferences, orientations, or cultural knowledge. The findings indicate that there is a positive correlation between culture and learning preferences; this means that culture influences learners preferred learning pathways (Boykin et al., 2005; Charlesworth, 2008; Ellison, Boykin, Tyler, & Dillihunt, 2005; Sulkowski & Deakin, 2009; Tsou, 2005). These learning pathways can be culture-specific or particular to an ethnic or racial group; however, learning pathways are not always dictated by membership in a racial group as it can be by exposure and lived experiences that an individual acquires these preferences (Boykin et al., 2005).

Theoretical and Conceptual Research in Culture

Theoretical and conceptual notions of culture in learning are articulated as "cultural practices" (Gonzalez, Moll, & Amanti, 2005; Lee, 2009; Nasir et al., 2006), "cultures of participation" (Fischer, 2009), a new "culture of learning" (Thomas & Brown, 2011) and "genres of participation" (Ito et al., 2010).

Researchers propose that cultural practices can be observed through an examination of learners everyday interactions with their environment. For example, Taylor (2009) documented the mathematical competencies of African American youth through their purchasing practices of buying candy and other items at a neighborhood store. These cultural practices were exemplified through school aged children engaged in reading priced items, figuring the costs of

purchases, deciding the correct currency for purchase and determining the remaining monies from a transaction as these practices unfolded within a sociocultural context. Observing and analyzing cultural practices supports the modeling of instructional pathways (Lee, 2009); aids in the design of learning environments (Nasir et al., 2006); brings meaning to discipline specific learning; assists in bridging cross-cultural understandings and situates learning in a cultural context (Barta & Brenner, 2009). In this sense, instructional strategies and methodologies are modeled and designed from empirical evidence of learners' interactions with cultural practices; thereby, instruction is derived from versus applied to learners.

Similar research in this area proposes that learning has been altered by twenty-first century networked technologies. In particular, the World Wide Web has shifted the way we learn, why we learn, how we learn, who we learn with, and where we learn. Fischer (2009) argues that there are "cultures of participation" where all individuals can meaningfully interact through networked technologies. Thomas and Brown (2011) conceptualize this digital phenomenon as a new "culture of learning" where individuals learn from and with each other thereby creating collectives. Ito et al. (2010) describes these ongoing learning and technological engagements as "genres of participation," conducted through "networked publics" that engage learners in social and cultural contexts (p. 14). Networked technologies allow individuals to learn by interacting (Fischer, 2009), doing, experiencing and watching (Thomas & Brown, 2011). Learning is mediated by the learner's age, desires, expertise, identity, income, interests, gender, talents, values, etc.—culture.

Ethnography for Culture-Based Analyses

Capturing the culture of learning requires an ethnographic analysis of individuals or groups as they engage in their culture or society. Ethnographic work, in general, aids in describing and understanding "a given process, experience or group" (Orellana & Bowman, 2003, p. 30). An ethnography allows for the construction of in-depth social categorizations that explore the intricacies of culture (Orellana & Bowman, 2003). Kumpulainen and Renshaw (2007) describe it as follows: "To investigate learning as an ethnographer, therefore, is to focus on the practices and understandings of the members of a community, and the interactive processes that establish and maintain such practices and understandings" (p. 110).

It takes an ethnographic analysis of cultures and societies to determine and understand how individuals and groups learn. This point is demonstrated by Ito et al.'s (2010) study where they conducted an ethnographic analysis of youth engagement with new media to better understand literacy and learning.

The use of ethnography for culture-based analyses is becoming common place in cultural studies (Subramony, 2009). Ethnographic work supports the study of learning (Barta & Brenner, 2009), focuses on the localization of knowledge (Crabtree, 2010), assists in the improvement of learning (Lipka et al., 2005), allows for the interpretation of the *purposes* of practices (Carlone, Haun-Frank, & Webb, 2011), enables microanalyses of cultural meanings in learner interactions (Brown, 2004), and encourages the building of learning technologies (Hall & Sanderville, 2009).

This research suggests that notions of culture in learning are real and relevant. If learning happens through learners interactions with their culture; then culture cannot be separated from the learning or learner. Whether it is determined through cultural practices, cultures of participation, cultures of learning or genres of participation, the learner is engaged in a semiotic relationship with their culture and this in turn influences human learning and the acquisition of knowledge. Ethnography can be the method of measurement to better understand the learner and how knowledge is acquired.

Interdisciplinary Applications of Culture and Learning

A growing body of literature in culture and learning proposes that human learning and development are keenly influenced by culture (Lee, 2009; Lee, Spencer, & Harpalani, 2003; Orellana & Bowman, 2003). That is, culture influences and is influenced by human learning and development. Given this, scholars continue to advocate for cultural considerations in the design, teaching, learning, and assessment of content area knowledge (Hood, Hopson, & Frierson, 2005; Swartz, 2009; Warikoo, 2009). This advocacy for the integration of culture seems to have made advances in school aged STEM (science, technology, engineering, and mathematics) related literature and in higher education literature on e-learning.

This section begins first with an overview of theoretical perspectives and paradigms. This is followed by studies and literature reviews in mathematics education, science education and e-learning education. Suggestions about the meanings of the literature are provided throughout.

Perspectives and Paradigms

Theoretical perspectives and learning paradigms that grounded the research in mathematics, science, and e-learning education were diverse. The mathematics education studies situated their research on learners knowledge constructions through social interaction and artifacts (Leont'ev, 1978; Vygotsky, 1978), communities of practice (Lave & Wenger, 1991; Wenger, 1998), cooperative learning and the Confucian

Heritage Culture as advocated in Chinese philosophy (Chang, Hsiao, & Barufaldi, 2006). The science education studies situated their research in sociocultural theory positioning science as a cultural and social process (Aikenhead, 2006) that needs further understanding through human learning, action and development (Cole, 1996; Vygotsky, 1978; Wertsch, 2002). Other science education perspectives and paradigms included the following: cultural historical activity theory that places learners in historical and cultural contexts (Rogoff, 2003), critical and emancipatory theory for the liberation of learners (Freire, 1993), identity as a lens to understand ethnicity, gender and culture (Gee, 2001), cognitive paradigms that allow science learners to explain and predict (Ioannides & Vosniadou, 2002; Wellman & Gelman, 1992), and constructivist paradigms where the learner builds upon prior knowledge (Vygotsky, 1978). The e-learning education studies situated their research in Hofstede et al.'s (2010) five dimensions of culture (i.e., power distance; individualism vs. collectivism; masculinity vs. femininity; uncertainty avoidance; long vs. short term orientation) or general e-learning research. This diversity of theoretical perspectives and paradigms suggests that research about culture and learning can be situated in a multiplicity of ideologies.

Mathematics Education

An analysis of recent studies in the areas of culture, learning, and mathematics reveals a focus on what learners already know as a basis to build mathematical competency. What learners know is articulated as prior understandings (Taylor, 2009); prior knowledge (Hurley, Allen & Boykin, 2009; Leonard, Davis, & Sidler, 2005); or foundational knowledge (Ni, Li, Li, & Zhang, 2011). Collectively, these studies also sought to fill a gap in the mathematics education research.

Several studies administered multiple evaluations to determine learning outcomes. The first evaluation obtained data specific to the learner's cognitive abilities as they engaged in mathematical concepts. Mathematical concepts included calculations and explanation skills (Ni et al., 2011; Wong, 2002); estimation (Hurley et al., 2009); whole numbers (Taylor, 2009) problem solving, word problems and basic geometry (Leonard et al., 2005). The second evaluation obtained learning outcomes data as measured through factors such as behavior, affect, and conceptions. Behavior was measured through learners involvement, communication, participation and affect (Hurley et al., 2009). Leonard et al. (2005) examined behaviors related to tasks, social interactions, dispositions and problem solving. Learning outcomes were also measured through affective factors such as learners' dispositions and interests towards learning mathematics (Ni et al., 2011). Wong (2002) examined learners conceptions to hypothetical mathematical situations to illicit learner feedback on whether performing mathematics was required of the mathematical equation. This suggests that it is important to evaluate mathematical learning outcomes based on cognitive (i.e., knowledge), anthropological (i.e., behavior) and psychological (i.e., affect) states of the learner. Thereby a more holistic portrait of the learner can be fully assessed and accessed.

China and Mathematics Education

Studies from China focused explicitly on the preservation of the Chinese culture. By example, Ni et al. (2011) reported that the goal of the study was to determine whether a new curriculum weakened the foundation of Chinese mathematics particular to mathematical concepts and mathematical skills. In this study and Wong's (2002) the performance of students in mathematical assessments, the culture of schools, and curriculum materials were all intricately tied to the maintenance of the Chinese culture and China's global leadership in mathematics. This suggests that the academic achievement of learners and the maintenance of the nation are intricately tied to the culture of China.

Reviews in Mathematics Education

The role of culture in the learning of mathematics is significant (Eglash, Bennett, O'Donnell, Jennings, & Cintorino, 2006; Ernest, 2009; Leonard, 2008; Martin, 2009; Mukhopadhyay, Powell, & Frankenstein, 2009; Swetz, 2009) enough that it should change the course of teaching, instruction, curriculum and learning theory. Understanding learners can pave the way for understanding human learning across contexts.

Reviews of literature in the learning of mathematics for ethnically diverse populations conclude that culture is integral to the learning of mathematics and learners understanding of mathematics (Kaahwa, 2011; Melis, Goguadze, Libbrecht, & Ullrich, 2011; Ng & Rao, 2010). It is suggested that mathematical language, notations and notions (i.e., story contexts) should be specific to the culture of the learner (Kaahwa, 2011; Melis et al., 2011; Ng & Rao, 2010). In particular, the use of the native language of learners, for the teaching of mathematics content, assists in improving mathematics knowledge. Ng and Rao's (2010) review of literature revealed that the Chinese oral and written language for numbers provided a simpler system to learn counting especially with numbers above ten. These findings disclosed the mathematical advantages and higher achievement of Chinese learners in early grades and beyond based on the Chinese language and other cultural nuances (e.g., days of the week and months are referred to as numbers—Weekday No. 1 or tenth month).

Learners bring their ways of interacting, observing, problem solving, and thinking. These ways of being, seeing, thinking and doing in the world are culture-based and can be utilized to develop instructional methods, avenues for learning, and bridging home and school contexts (Kaahwa, 2011; Leonard, 2008; Moschkovich & Nelson-Barber, 2009). Learners bring their cultural stories and these stories can provide contexts for learning (Gonzalez et al., 2005; Kaahwa, 2011). Kaahwa (2011) used cultural artifacts in teaching mathematics. These cultural artifacts would be evident in the learner's communities (e.g., bean pods in Uganda), thereby bridging home and school learning. The Algebra Project, an urban middle/high school alternative curriculum, drew on the sociocultural and linguistic world of learners to bridge understanding and computing mathematical concepts (Moses, West, & Davis, 2009). According to Moses et al. (2009) the path to learning is enabled through learner's native language articulations and personal experiences that translate into written form and then further articulated into written and verbal mathematical concepts.

Culture-specific learning or framing mathematics learning in a local context signals a valuing of the learners culture, provides a conceptual foundation to build content knowledge (Moses et al., 2009), and validates the local community and its knowledge (Barta & Brenner, 2009). Ethnomathematics exemplifies the use of indigenous or nondominant knowledge to explain and teach mathematics (Eglash et al., 2006). Contrary to this research, Meaney (2002) found that the inclusion of mathematical practices from indigenous cultures presents some areas of concern such as: loss of cultural intent and a focus on more Western dominance.

Nasir, Hand, and Taylor's (2008) comprehensive review of mathematics literature that related to the role of culture in teaching and learning argues that mathematical concepts must be presented to learners in a context that reflects their lived experiences and that these contexts for learning be generated through "conversations and shared experiences (p. 226)." Intersubjectivity or a third space (Gutierrez, Rymes, & Larson, 1995) is offered as a way to bring together cultural knowledge (knowledge acquired outside of school settings) and domain knowledge (knowledge prescribed by math educators) into a hybrid space for discourse about mathematics. Nasir et al. (2008) further argue that these experiential practices should socially and conceptually support deep learning of mathematics and build positive identities for math learners. Math knowing is a "cultural activity, math learning" is a "cultural enterprise, and math education" is a "cultural and political activity (p. 227)."

Similarly, Lipka, Yanez, Andrew-Ihrke, and Adam (2009) argue for a "third way" that is a combination of knowledge and pedagogy – both local and Western. The idea behind the third way is to increase motivation and provide access to the instructional material. Through these curriculum and pedagogical changes both methods as reported by the researchers show improved academic performance as represented by empirical studies (Lipka et al., 2005).

All knowledge (Nasir et al., 2008), curricula, and pedagogy (Lipka et al., 2005) is culture-based. However, whose culture is this knowledge, curricula, and pedagogy based on? Culture-based mathematics education, in the USA in particular, seeks to provide a voice for the marginalized that is as privileged as the dominant cultures (Lipka et al., 2005).

The mathematics education reviews call for a more inclusive examination of how culture influences and is influenced by the learner. It is a rallying call to serve the needs of the few and the many. The lived experiences of learners seem to be the core of this cultural thrust and to use learners lived experiences as a conduit to more culture-specific learning applications.

Science Education

An analysis of studies in the areas of culture, learning, and science reveals a focus on equity, identity, and agency to build scientific competency in marginalized populations living in the USA (Barton, Tan, & Rivet, 2008; Basu, 2008; Brown, 2004; Carlone et al., 2011; Elmesky, 2011; Lee, Maerten-Rivera, Penfield, LeRoy, & Secada, 2008; Lynch, Kuipers, Pyke, & Szesze, 2005; Polman & Miller, 2010; Rivet & Krajcik, 2004; Schademan, 2011; Seiler, 2001; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). The focus on equity, identity, and agency is learner centered with the intention to improve academic achievement.

Equity: Equity is not about offering the same educational experiences, content, instruction, etc. to youth based on their age, gender, race, ethnicity, or socioeconomic status. Equity is about providing the knowledge base, specialized skills, and diverse worldviews needed to succeed in a global economy (Jordan, 2010). In the science classroom, equity allows all students to contribute, participate and perform equally. A hierarchy of race, class, gender, privilege, language, dialect, or difference does not exist (Brown, 2004; Carlone et al., 2011; Jayaratne, Thomas, & Trautmann, 2003; Lynch et al., 2005; Schademan, 2011). This includes the acceptance of diverse learners' ways of knowing, articulating, thinking and what they bring to science (Elmesky, 2011; Schademan, 2011; Warren et al., 2001).

Equity can be achieved through the identification, examination, and elimination of inequitable practices enacted, in educational environments, against minority learners in science classrooms (Carlone et al., 2011; Polman & Miller, 2010). Minority learners' "scientific literacy" has been a source of cultural conflict (Brown, 2004) as their science discourse may offer alternative perspectives than "mainstream" expectations.

Other equity issues relate to the curriculum and educational access. Conflicts exist in the one size fits all curriculums that do not meet the needs of diverse student populations (Lynch et al., 2005). Access to scientific knowledge has been denied to ethnic youth in US public schools. This denial is exhibited through the lack of access to high level science courses (Gollub & Spital, 2002), scientific literacy, and qualified science teachers (Barton et al., 2008).

Identity: Identity is tied to how learners perceive themselves amongst others. In the science classroom, these culturally produced meanings of self can be positive or negative and can influence scientific learning and interactions (Barton et al., 2008; Brown, 2004; Carlone et al., 2011; Polman & Miller, 2010; Schademan, 2011). That is, cultural conflict as manifested through science discourse can challenge or create conflicts that prohibit learning (Brown, 2004). Learners, in the science classroom, need to be able to see themselves as successful and as someone who can be identified as a "scientist" (Carlone et al., 2011; Elmesky, 2011; Warren et al., 2001). Learners cultural commodities are their forms of capital that needs to be respected and valued (Seiler, 2001). By example, Basu (2008) found that when given the freedom to create their own conceptions of physics, high school students situated their understandings of science in their identities; specifically, they enacted lessons through how they understood science and how science aided them in achieving their goals.

Agency: Agency in the science classroom is enacted through learners participation in the act of scientific thinking, being able to engage in science practices that promote learning, feeling comfortable enough to verbalize scientific understanding, and bringing the culture of themselves into the mix. Research studies report that agency is performed when learners feel empowered by their cultural knowledge (Schademan, 2011); express their identity through scientific enactments and articulations (Basu, 2008), and build cultural capital and affiliations with others based on engaging in the act of cultural practices (e.g., African American students used hip-hop culture and developed a rap about the speed of sound as a path to understanding science and expressing identity) (Elmesky, 2011).

These studies found equity, identity, and agency to be important issues in better meeting the academic needs of marginalized groups. This suggests that there are social, political, and economic issues that must be addressed concurrently with the academic issues in order to provide a learning environment where equity is provided, identity supported, and agency given.

Interventions in Science Education

Several studies conducted science interventions with ethnically diverse populations of learners to examine learning gains and considerations of culture in the design of a curriculum unit and professional development materials. Rivet and Krajcik (2004) developed the Big Things program that focused on a sixth grade project based science curriculum with learning technologies and real-world applications that would be of interest to urban youth. Students showed improvement; however, learning gains were not as high as expected.

Lynch et al. (2005) used a "highly rated" preexisting middle school science curriculum called Chemistry That Applies (CTA) with the goal of better understanding student learning and the implementation of CTA in an ethnically diverse setting. In the overall study, academic gains were realized in the content area assessed; however, the impact of the curriculum on a small group of ethnically diverse students was inconclusive.

Lee et al. (2008) developed a science and professional development intervention for elementary school teachers that sought to promote science achievement in English Language Learners. For example, the curriculum integrated science terms in English, Spanish, and Haitian Creole, included teacher guides about misconceptions and disconnects that students encountered with the curriculum, provided literacy development for English Language Learners in their native language, and used multiple modes of communication to educate the learner (e.g., visual, kinesthetic, textual). Overall, students demonstrated a significant improvement in science achievement and performed better on high stakes testing.

These science education interventions demonstrate the need to find new ways to educate all. In particular, the inclusion of more culture-specific content into academic disciplines like science have the potential to improve learning gains for ethnically diverse learners and provide an avenue to truly educate the underserved.

International Studies in Science Education

International studies in science education focused on how learners learned through scientific reasoning (Ozdemir & Clark, 2009; Robottom & Norhaidah, 2008), learning preferences (Chang, Hsiao, & Chang, 2011), and different learning environments (Chang, Hsiao, & Barufaldi, 2006; Chang & Tsai, 2005). Other studies examined affective factors related to beliefs, feelings (Robottom & Norhaidah, 2008), and attitudes (Caleon & Subramaniam, 2008; Chang, Hsiao, & Barufaldi, 2006) of learners engaged in science education.

Consistent across these studies is the use of large sample sizes of students from upper elementary to high school age levels (Caleon & Subramaniam, 2008; Chang, 2005; Chang, Hsiao, & Barufaldi, 2006; Chang, Hsiao, & Chang, 2011; Chang & Tsai, 2005; Robottom & Norhaidah, 2008). Further, the methodology sections of these papers reveal the development of an instrument to measure epistemological beliefs

about science (Robottom & Norhaidah, 2008), actual and preferred learning environments and teaching methodologies (Chang, Hsiao, & Barufaldi, 2006; Chang, Hsiao & Chang, 2011; Chang & Tsai, 2005), general attitudes towards science (Caleon & Subramaniam, 2008), and understandings and appreciations of humans to nature (Chang, 2005).

International studies in science education advocate for a science curriculum that is indicative of learners lived experiences (Chang, 2005; Lewthwaite et al., 2010). By example, the Taiwanese Science and Life Technology Curriculum Standards and Earth Systems Education are curriculums that focus on helping learners apply science in their daily lives (Chang, 2005). Chang, Hsiao, & Barufaldi's (2006) findings argue that student's cultural histories and identity should be considered when designing learning environments. Chang and Tsai (2005) begin to exemplify the inclusion of the Chinese culture by redesigning an American instrument into the Chinese Constructivist Learning Environment Survey. Ozdemir & Clark (2009) found that Turkish elementary, middle, and high school aged students varied greatly in their understandings of the concept of force due to their diversity. That is, student's cultural diversities (i.e., language, understandings, education) attributed to their varied interpretations and meanings of science education content. Robottom and Norhaidah's (2008) research of Islamic learners further supports the notion that learners meanings of science are shaped and constrained by their culture.

The international studies in science education demonstrate a focus on how learners learn but in particular how learners feel about the learning experience. Further there is a focus on learners lived experiences. This suggests that there are psychological (i.e., beliefs, feelings, attitudes, reasoning) and anthropological (i.e., lived experiences) factors to better understanding learning. Studies about learning require more of a holistic orientation to get at the intricacies of human learning that manifest through learner's engagement with their culture.

Worldviews on Science Education

Worldviews on science education argue that there is a space and place for indigenous knowledge and global perspectives that get at other ways of knowing, being and seeing the world within science education. The point is to bring equity into science education through the inclusion of indigenous and marginalized groups' worldviews and perspectives of science and provide these groups with successful science learning opportunities (Aikenhead & Ogawa, 2007).

Studies in science education research argue that Western science education fails to serve the needs of indigenous and marginalized groups due to its (1) epistemological conflicts, (2) irrelevance to lived experiences, (3) domination of Western science and scientific thought (Brayboy & Castagno, 2008), and (4) inability to meet their social needs (Mutegi, 2011). A harmonizing science education that honors two ways of learning from the Western worldview and the indigenous worldview is believed to best serve the needs of the Inuit communities in the Northern Qikiqtani region of Nunavut (Lewthwaite & McMillan, 2007), Māori communities of Aotearoa New Zealand (Wood & Lewthwaite, 2008), and Zulu communities of Chibini, South Africa (Keane, 2008).

Emdin (2010) promotes the inclusion of students lived experience through hip-hop culture as a tool to connect learners to science education; his work continues to explore other urban science education conceptualizations such as neo-indigenous, communal practices and rituals (Emdin, 2007a, 2007b; 2009). Mutegi (2011) advocates for a socially transformative curriculum approach that is particular to the African Diaspora experience and at the core it asks African American students to understand their colonial status, colonialism, and their colonizers.

Lewthwaite et al. (2010) argue that expressions of local and indigenous content in science education can only come through policy and leadership that supports "culture-based education programs" (p. 1). Culture-based education, as endorsed by the Government of Nunavut, Canada, provides children with educational content and experiences that affirms and reflects the Nunavummiut culture; in particular this culture-based education should be integrated throughout the school management, operations, curriculum, pedagogy, and programs.

It is evident that indigenous and marginalized groups around the world are seeking to preserve and document their knowledge, ways of being, identity, etc.—that is their culture. Further, they seek to capture their culture and use it as an instructional tool to advance the academic achievement of children and youth. Some of these cultures chose to exclude all Westernized and Eurocentric interference others seek to find a middle ground where both indigenous and European worldviews can be learned in harmony.

International Perspectives in E-Learning

An analysis of empirical research in the areas of culture, learning, and e-learning reveals predominately a focus on international learners in higher education settings. These studies seek to quantify and qualify learners based on their perceptions about e-learning (Jung, 2011; Ku & Lohr, 2003; Liu & Magjuka, 2011; Wang, 2007), attitudes towards e-learning (Ku & Lohr, 2003; Thompson & Ku, 2005), behaviors (participation and usage) while engaged in e-learning (Yang, Olesova, & Richardson, 2010; Zhao & Tan, 2010), communication styles during e-learning (Yang et al., 2010), and critical thinking in an e-learning environment (Al-Fadhli & Khalfan, 2009).

The studies covered in this review all examined some aspect of culture; however, some research made explicit cultural concerns such as: cultural differences (Chase, Macfadyen, Reeder, & Roche, 2004; Yang et al., 2010), cultural influences (Hannon & D'Netto, 2007; Ku & Lohr, 2003; Zhao & McDougall, 2008), cultural barriers (Hannon & D'Netto, 2007), and cultural orientations (Wang, 2007). Ultimately, it seems that there is concern about how culture influences the learner and learning in an e-learning environment.

The methodological approaches of the e-learning research demonstrate the dynamics of evaluating culture within an e-learning environment. Across the studies, the participants varied greatly in terms of race and ethnicity (e.g., Chinese, Australian, Eastern Slavic, American, etc.); however, all of the studies focused on international higher education aged learners. Sample sizes varied from 6 to 299 participants. The analyses considered qualitative, quantitative, and mixed methods (Al-Fadhli & Khalfan, 2009; Chase et al., 2004; Hannon & D'Netto, 2007; Jung, 2011; Ku & Lohr, 2003; Liu & Magjuka, 2011; Thompson & Ku, 2005; Wang, 2007; Yang et al., 2010; Zhao & McDougall, 2008; Zhao & Tan, 2010). Most of the studies administered research specific surveys, except Liu and Magjuka (2011), Thompson and Ku (2005), and Zhao and McDougall (2008) who conducted interviews. Chase et al. (2004) analyzed content from the courses' online discussion board and Al-Fadhli and Khalfan (2009) administered a critical thinking test. This suggests that multiple methodologies of analyses have been effective in evaluating culture and learning within an e-learning environment.

The findings of culture, learning, and e-learning research indicate that learners are influenced by what they learn, how they learn, how much they learn, when they learn, where they learn, and their culture. The e-learning environment in-turn influences how learners reacted and responded through their perceptions, attitudes, and behaviors—ultimately their culture.

The most emphasized findings across the studies focused on technology, synchronous and asynchronous learning, communications, and the instructor. Overall, the technologies used in e-learning environments failed to support e-learners, serve the cultural and international needs of groups and only highlighted Westernized styles (Chase et al., 2004; Wang, 2007). Cultural issues such as technology experience and differences in cultural backgrounds were not addressed by the technology or through technological supports (Hannon & D'Netto, 2007). A more personalized technological environment is suggested to better improve e-learning environments (Jung, 2011).

Synchronous and asynchronous e-learning environments should better support users. E-learning environments should consider the cultural variability of learners and learning to better address the needs of learners (Jung, 2011; Liu & Magjuka, 2011; Wang, 2007; Yang et al., 2010; Zhao & McDougall, 2008). Asian students in particular found that asynchronous environments allow them time to reflect, think, and learn more (Wang, 2007; Zhao & McDougall, 2008).

Communicating in e-learning environments is a great concern of researchers because learning is supported through communication. Culture affected the way learners approached and responded in the e-learning environment, to classmates and with the instructor (Jung, 2011; Wang, 2007; Yang et al., 2010). Cultural issues were apparent in ways of communicating (Chase et al., 2004; Hannon & D'Netto, 2007; Liu & Magjuka, 2011; Wang, 2007; Zhao & McDougall, 2008), values, language, and learning preferences (Ku & Lohr, 2003); and participation behaviors (Yang et al., 2010).

The power dynamics between teacher and learner is culturally shaped and it influences learner's interactions with the e-learning environment (Chase et al., 2004). Several studies found that Chinese learners operated on the cultural belief of instructor as knowledge source and that these expectations carried into the e-learning environment. When instructors did not respond with these cultural expectations, the learner and learning experience were disengaged (Ku & Lohr, 2003; Wang, 2007; Zhao & McDougall, 2008).

Culture influenced how learners performed and persisted in an e-learning environment (Wang, 2007). Of note, the studies that focused on perceptions and attitudes included participants who were Asian (i.e., Chinese, Korean) (Jung, 2011; Ku & Lohr, 2003; Liu & Magjuka, 2011; Thompson & Ku, 2005; Wang, 2007; Yang et al., 2010; Zhao & McDougall, 2008). This may be significant in that this research finds the analysis of the psychology (e.g., perceptions, attitudes, beliefs) of the learner as important as the anthropology (e.g., behavior, etc.). That is, learning in an e-learning context may require both an analysis of psychological and anthropological factors to best access the intricacies of human learning.

Reviews in E-learning

Reviews of literature in e-learning focus on nation building, formulating frameworks that support sociocultural learning and considering diverse learning needs. Nation building through e-learning involves competing with global economies; educating, preparing, and supporting the countries human capital (Perkins, Gwayi, Zozie, & Lockee, 2005); building and supporting information technology infrastructures; and creating an environment that fosters knowledge construction (Kim & Santiago, 2005). Further, the act of nation building is very particular to the maintenance of culture. Frameworks, models, and guidelines that support e-learning center on knowledge development, building community, supporting learners, considering culture (Gunawardena et al., 2004; Gunawardena et al., 2006; Taylor, 2005), identifying manifestations of culture in e-learning (Gunawardena & LaPointe, 2008), and

evaluating e-learning courses (Edmundson, 2007). Considering the needs of learners means making allowances for their diverse learning approaches (Alias, 2011); attributes and contexts and conditions for learning (Mitchell & O'Rourke, 2008).

It seems that this e-learning research is very much focused on the needs of the learner and how the learner can support country and ultimately their culture. This research suggests that there is much improvement needed to address the international higher education learner in an e-learning environment.

Implications

There are growing concerns across disciplines that learners, from children to adults, need a more specialized education to meet their academic needs. In the twenty-first century, this should not be an issue with the wealth of information, multiple means of literacy outlets and the technological resources available. The present methods and strategies that are being used fail to appropriately address the needs of all learners. Therefore, there is a need to rethink and rebuild curriculum, instruction, theories, methodologies, etc.

This research sought to examine international research in the areas of culture, learning, and mathematics, science and e-learning education to determine relevant instructional strategies in this context. The implications of this literature review indicate the following:

- Explicit instructional strategies that enable learning do not exist for ethnically diverse populations in the USA. Innovative instructional strategies must be derived from versus applied to learners.
- Research about learners should be more broadly structured to include anthropological and psychological factors to acquire a more holistic picture of the learner and their learning. This holistic picture aids in building learning applications that are culture-specific and more appropriately aligned to learner needs.
- Methodologies of analysis vary; however, ethnographies seem to capture a more holistic picture of the learner and more specifically their culture. By example, 10 of the 12 science education studies employed ethnographic methods to acquire information about the learner (Barton et al., 2008; Basu, 2008; Brown, 2004; Carlone et al., 2011; Elmesky, 2011; Lynch et al., 2005; Polman & Miller, 2010; Schademan, 2011; Seiler, 2001; Warren et al., 2001). The collection of ethnographic data can include videotapes, observations, assessments, interviews (Carlone et al., 2011), group interviews, content-based think-alouds, reflection notes, student work, informal conversations in and out of school; social gatherings (Barton et al., 2008); and archival documents (Basu, 2008).
- Multiple assessment methods may be needed to get at academic and affective learning. There is a need to determine if learning is happening and if so in what ways and why. Determining how learners feel about the academic experience may be as important as their academic progress.
- Instructional strategies that are derived from human interactions will prove the most valid in designing curriculum, improving e-learning environments, making learning happen, knowledge construction, and improving academic gains.
- Building on the life experiences of the learner seems to be the nexus of moving towards more culture-specific applications. This need to situate learning in the life experiences of the learner is supported by mathematics education research, science education research, and e-learning education research.

Conclusion

Culture matters in the selection of instructional strategies. However, it is better to assess the learner to let the educational strategies be derived from the learner versus applied arbitrarily to the learner.

A variety of research has been excluded because of space constraints or content. Studies that focused on teachers versus learners were excluded or minimally highlighted to maintain the focus of the chapter on learners. Some of this research examined what instructors should do in relation to culture, learning, and science education (Emdin, 2007a, 2007b; Lewthwaite et al., 2010; Milner, 2011; O'Neill, 2010), math education (Civil, 2002; Correa, Perry, Sims, Miller, & Fang, 2008; Gutstein, 2003; Lipka et al., 2005; Leonard, Brooks, Barnes-Johnson & Berry, 2010; Seah, 2002), and e-learning education (Burniske, 2003; Goold, Craig & Coldwell, 2007; Sánchez-Franco, Martínez-López, & Martín-Velicia, 2009).

Culture, learning and computer technology education offers another area for in-depth study. This research examines a variety of issues such as the following: global knowledge in local contexts, instructor focused concerns, perceptions of using technology, the role of technology in cultural change, ethnically diverse learners, technology enhanced learning, and technology integration (Aydin & McIsaac, 2004; Chitiyo & Harmon, 2009; Ezer, 2006; Gudmundsdottir, 2010; Heemskerk, Brink, Volman, & Dam, 2005; Hornik & Tupchiy, 2006; Lee, 2003; Lieberman, 2008; Lim, 2007; Luck & Peng, 2010; Olaniran, 2009; Robbins, 2007; Swigger, Alpaslan, Brazile, & Monticino, 2004; Zhang, 2007, 2010; Zhao, Zhang, & Tan, 2010).

The areas of culture, learning and instructional design provide guidance in educating diverse populations. This research examines a variety of issues such as: ethnically diverse learners, culture-specific curriculum content, multiculturalism, cultural diversity, culture-specific pedagogy,

indigenous languages and knowledge, and designing in cross-cultural contexts (Amiel, Squires, & Orey, 2009; Campbell, Schwier, & Kanuka, 2011; Frederick, Donnor, & Hatley, 2009; Igoche & Branch, 2009; Joseph, 2009; Kinuthia, 2007; Leonard, 2008; Russell, 2011; Scott, Aist, & Hood, 2009; Thomas & Columbus, 2009; Young, 2009).

Future research in culture, learning, and a discipline might examine the literature coming from Human Computer Interaction and game design. These disciplines are growing in these areas and finding innovative ways to educate learners through information and communication technologies.

Of course, it is possible to miss some important studies or reviews of literature. This chapter has tried to locate a representative sampling of what has been published in the last decade.

If culture matters in educating learners in mathematics and science education, why has there been little movement in North America to design learning technologies to meet the needs of marginalized groups? If e-learning systems do not meet the needs of international populations why have not e-learning companies accommodated to the needs of these groups? Why has culture been ignored?

It seems that considering culture in the development of instructional strategies is only part of a complicated equation to educate learners. There are many factors that must be seriously considered. Situating the learner at the center of this nexus is a place to begin.

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