A conceptual view of ICT in a socio-constructivist classroom

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Paper Category: Research-in-progress

ABSTRACT

The proliferation of Information and Communication Technologies (ICTs) in the classroom has brought about exciting opportunities for understanding and reasoning about teaching and learning within a technology-empowered environment. This paper first places ICTs in the classroom within the context of Information and Communication Technology for Development (ICT4D). It then proceeds to present a conceptualisation of a school classroom in the context of the social constructivism theory and thereafter, overlays the presence of ICTs in the classroom as a function of this conceptualisation. Social constructivism is a learning theory that views learning and human development from a social interaction point of view, underpinned by the cognitive framework under which learners learn. We argue that framing the presence of ICTs within the said conceptualisation will enable for a better understanding of the impact ICTs have in the development of learners' cognitive activity within a classroom setup. Ultimately, as part of ongoing research and amongst other objectives, we aim to develop some insights and methodologies that could be used to positively influence mindsets around the use of ICTs in the classroom to transcend developmental boundaries.

Keywords:

Technology in the Classroom; ICT for Educational Development; Educational Technology; Constructivism Theory; Social Constructivism

INTRODUCTION

It is an indisputable fact that the field of technology has seen remarkable growth since the mid-1990s. Whereas the early years of the technology boom were focused on commercialisation, profiting and growing market share, the major players in the field have matured and have gone on to employ humanitarian-type approaches to bring their technology closer to the people. We have seen prominent organisations, such as Microsoft, collaborating with government ministries in the African continent with the sole aim of promoting inclusive digital access in schools and local communities (Karikkandathil, 2016). In the same spirit, not-for-profit organisations are driving initiatives, such as the worldwide *One Laptop per Child* initiative or the *One Child One Tablet* initiative seen in countries like Ghana and South Africa, aiming to empower the poorest of children all over the world through technology and education. Arguably, the underlying emphasis in all these and other similar initiatives is on fostering knowledge-creating competencies in technologically-supported collaborative knowledge development environments.

In the recent years, technology as a tool has been linked by many researchers to improved levels of engagement and learning in students, resulting in improved academic performance and achievement across many educational disciplines (Wenglinsky, 1998; Schacter, 1999; Yang & Wu, 2012; Eyyam & Yaratan, 2014; Fonseca, Martí, Redondo, Navarro, & Sánchez, 2014). Blackwell, Lauricella, Wartella, Robb, and Schomburg (2013) re-iterate that in many circumstances, technology has been shown to increase learning in the context of early education, while in a study focusing on the technological interventions in teaching the subject of mathematics to seventh grade students, Eyyam and Yaratan (2014) found, amongst their other findings, strong ties between the use of technology in the classroom and improved student academic achievement. Other studies have also shown similar results in the use of technology as a tool to teach certain aspects of mathematics (Bakar, Ayub, Luan, & Tarmizi, 2010; Rajagopal, Ismail, Ali, & Sulaiman, 2015). In short, there is a social process facilitated by technology, which has effect on the process of cognition. However, there must be a systematic approach especially since learning activities are processes of both externalisation and internalisation (Cress & Kimmerle, 2008).

Considering the foregoing, and because of varying views on the best approaches to integrate technology in the classroom formally, researchers have argued extensively that an effective way

to integrate and model technology into the teaching and learning process in a classroom environment is to follow a constructivist approach (Papert, 1993; Dede, 1995; Rieber, 1996; Doolittle & Hicks, 2003; Ford & Lott, 2012). Constructivism is a learning theory grounded on the idea that "*meaning is imposed on the world by [people], rather than existing in the world independently of [people]*" (Duffy & Jonassen, 1992, p. 4). Looking at it differently, this means that in a constructivist world, people construct their own understanding, meaning and knowledge based on experiences and contexts rather than accepting the status-quo. Ford and Lott (2012) further state that *"[t]echnology offers flexibility and adaptability reflective of pedagogies across various learning models based in constructivism*" (p. 1). This view has several implications in the teaching and learning process but centrally, technology has the potential to bridge the distance between learners and teachers (Beldarrain, 2006) through sociable technologies and social software. Subsequent sections of this paper elaborate further on some of these implications.

The remainder of this paper unfolds by first defining and positioning education (together with technological tools that enable education (i.e. ICTs), collectively, educational technology) within the ICT4D context. The paper then proceeds to present an elaborate definition of constructivism, together with its various flavours but with specific focus on social constructivism, ultimately conceptualising a socio-constructivist classroom. This all culminates in a conceptualisation of ICT within a typical socio-constructivist classroom setup. Concluding sections then discuss and synthesise the antecedent, and present next steps in the on-going research, a subset of which this paper presents.

EDUCATIONAL INFORMATION AND COMMUNICATION TECHNOLOGIES FOR DEVELOPMENT

Educational ICT (or ICTs in the classroom, or just simply, educational technology) goes by several labels that mean different things within different schools of thought. In a book chapter aptly entitled *What Field Did You Say You Were In?,* Reiser (2007) tracks the definition of educational technology from its apparent roots in the early 1900s with the advent of educational film. What followed thereafter was a series of definitions, predominantly by the Association for Educational Communications and Technology (AECT) and the Commission on Instructional Technology (CIT) – both from the US, that likened educational technology to a process, with one

such definition defining it as a "*complex, integrated process involving people, procedures, ideas, devices, and organization, for analysing problems and devising, implementing, evaluating, and managing solutions to those problems, involved in all aspects of human learning*" (AECT Task Force on Definition and Terminology, 1977 cited in Reiser, 2007, p. 3).

Over the years, other researchers and organisations have also contributed to the definition soup of what educational technology is. The then National Council of Educational Technology (NCET) in the UK defined it as "*the development, application and evaluation of systems, techniques and aids to improve the process of human learning*" (cited in Wilkes, 1978, p. 79); while Unwin (1969) asserted that it "*is concerned with the application of modern skills and techniques to requirements of education and training. This includes the facilitation of learning by manipulation of media and methods, and the control of environment in so far as this reflects on learning*" (cited in Aggarwal, 2014, p. 5). All these (and other) definitions of educational technology are powerful and intricate in their own right, but there are strands of similarity in them.

Amongst these strands, in one way or another, is the encompassing by each definition of what ICT has become (for instance as succinctly defined in Hatakka, Thapa, and Sæbø (2016); or as elaborately defined in Zuppo (2012)); but more importantly, they are all *developmental* by construct. Whether they emphasise the development of tools or techniques to be utilised in an educational setup, or emphasise that the very nature of utilising these tools or techniques is developmental in itself or they advocate for the development of human lives as the end-state of learning through these tools or techniques, these definitions all subscribe to the elementary dictionary definition of development. Although there is still some contention over what a precise definition of development in ICT4D encompasses, it is generally accepted to mean human development (Gholami, Higón, Hanafizadeh, & Emrouznejad, 2010; Xiong & Qureshi, 2015; Sein, Thapa, Hatakka, & Sæbø, 2016); and arguably, by this definition too, educational technology does subscribe to the developmental aspect of ICT4D.

Many countries[1], developing and developed, have proceeded to incorporate educational technology into their school and curricular policy frameworks and developmental plans on the premise that educational technology fosters much needed development at a global stage. While the stance taken by the said countries shows some confidence in (and optimism towards the future of) educational technology, some researchers have argued that these efforts of technologising education will all be in vain if not implemented in tandem with revolutionary pedagogical methods of embracing and adopting these "*fancy tools*" (Wong & Li, 2006). Such then have been the efforts of Papert (1993), Dede (1995), Rieber (1996), Doolittle and Hicks (2003), and Ford and Lott (2012) in emphasising the foregrounding of the adoption of a constructivist theory approach when integrating technology in classroom pedagogy.

THEORETICAL FOUNDATION

The basis of any constructivist theory is that those who are defined as learners actively, continually and adaptively construct their own understanding, meaning and knowledge based on their lived experiences rather than acquiring understanding, meaning and knowledge from sources external to self (Duffy & Jonassen, 1992; Cobb, 1994). From a philosophical perspective, constructivism is a view which "*holds that any so-called reality is, in the most immediate and concrete sense, the mental construction of those who believe they have discovered and investigated it*" (Saunders, 1992, p. 136). For many scholars, constructivism has its roots in the works of Jean Piaget (a Swiss clinical psychologist), Lev Vygotsky (a Soviet psychologist) and Ernst von Glasersfeld (a German philosopher). Their works have led to the three most familiar categories of constructivism: *cognitive constructivism* (the Piagetian approach), *social constructivism* (the Vygotskian approach) and *radical constructivism* (the von Glasersfeld approach) (Pass, 2007; Blake & Pope, 2008; Powell & Kalina, 2009). While these three approaches share a common general epistemological stance (Gray, 2014), they each differ in their theoretical perspectives and applicability, with the Piagetian and Vygotskian approaches

[1] The World Bank maintains a working document containing a master list of policy documents related to ICT/education from around the world spanning all educational levels, with Kuwait having the earliest dated policy document (1983) entitled Kuwait Educational Technology. This working document can be accessed via: http://go.worldbank.org/T9DTRKUXR0

strongly favoured by many researchers as the most applicable theories of learning in the classroom (Palincsar, 1998; Blake & Pope, 2008; Powell & Kalina, 2009).

Social and cognitive constructivism both emphasise the learner as the centre of the learning process. Whereas the latter advocates for individual learning (i.e. a learner learning in his or her own space), the former emphasises collaboration and social interaction as cornerstone to the learning process (i.e. a learner learning within a group setup, as one instance) (Powell & Kalina, 2009, pp. 242-247). While radical constructivism may also emphasise the learner as the centre of the learning process, it differs from the other two categories in that its foundation is in the learner cognising and internalising external reality, thus forming internal knowledge (Doolittle & Hicks, 2003).

Characteristics of Social Constructivism

In a broad sense, McMahon (1997) articulates that learning in a socio-constructivist environment is facilitated through a collaborative effort within an educational group consisting of teachers, parents, peer learners, amongst many other members of community, with a strong emphasis on culture and context. Sivan (1986) identifies three fundamental elements that underpin social constructivism and which are key in the learning process. These elements are i) *cognitive activity*; ii) *cultural knowledge, tools and signs*; and iii) *assisted learning*. Henceforth, this paper subscribes to the definition of social constructivism as so far defined (albeit piecewise), and adopts these three fundamental elements (as flashed out over the next subsections) as part of the social constructivism definition.

Cognitive Activity

Cognitive activity is a developmental process of meaning-making (Sivan, 1986). This process is "*shaped through association with adults*" Sivan (1986, p. 212) and "*shapes and regulates behaviour by mediating context and behaviour*" (Cole & Scribner, 1974 cited in Sivan, 1986, p. 212).

Cultural Knowledge, Tools and Signs

There is no universal definition of what culture is (Sivan, 1986; Hofstede, 2003; Valsiner, 2007; Alhashemi & Weistroffe, 2015). In the context of social constructivism, Sivan (1986) defines

culture as "*the features in a group of people, such as beliefs, social forms, knowledge, and the means of transmitting knowledge, that distinguish those people from another group*" (p. 213). Through a culture, one then gets extensions such as tools and signs (such as language and numbers) as well as knowledge (a definitive body of effective and cognitive information), however in most cases, these are said to be unique only to a particular culture (Sivan, 1986). Noteworthy in social constructivist theory, language is an important tool of thought and cognitive activity. Together with knowledge, language is a culturally fashioned activity and a means by which an individual's psychological functioning develops (Sivan, 1986).

Assisted Learning

Assisted learning is a process whereby cultural elements are transferred from one member of society to another through structured sets of information with an aim of developing independent functioning. Sivan (1986) asserts that there are three distinguishing characteristics of assisted learning which collaboratively facilitate the process of assisted learning.

The first one is that assisted learning requires a committed involvement by both the learner and a more knowledgeable member of the culture. The second distinguishing characteristic is the Zone of Proximal Development (ZPD); Vygotsky (1978) cited in Sivan (1986, p. 215) describes the ZPD as the difference between the child's "*actual development level as determined by independent problem solving*" and the "*level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.*" The third distinguishing characteristic of assisted learning is to view the process as a means of internalisation. This means that cultural knowledge is transferred to an individual such that there is no need to further rely on external interventions for that same piece of cultural knowledge.

These characteristics of assisted learning articulated by Sivan (1986) are also consistent with the "*scaffolding*" instructional technique as demonstrated in the works of Chi and her colleagues (Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001; Chi, Roy, & Hausmann, 2008).

Social Constructivism in the Classroom

The view of Powell and Kalina (2009) is that "*[t]eachers from every subject area need to develop psychological or strategic tools to create a constructivist environment for all students*" (p. 247). In a socio-constructivist classroom, the role of the teacher switches from that of being

an instructor (the traditional approach to teaching) to that of being a facilitator (a socio-constructivist approach to teaching), with the learner becoming the centre of classroom activity. Wilson-Strydom, Thomson, & Hodgkinson-Williams (2005) maintain that "*if teachers' epistemological assumptions are defined by constructivist beliefs of knowledge and their pedagogical practice informed by cognitive constructivist theories of learning, then they are likely to extend the use of computers to generative uses*" (p. 74). In line with the above arguments, teachers need to innovate and come up with appropriate methods and mechanisms which align with the characteristics of social constructivism across its three fundamental elements as presented by Sivan (1986).

Element	**Conceptual Alignment in the Classroom**
Cognitive Activity	▪ Teachers need to encourage group activities where learners' cognitivism is stimulated as learners embark on the process of constructing meaning ▪ Teachers also need to maintain an intermediary role during group interactivity so to regulate the learners' behaviour and bring appropriate context to group tasks and activities
Cultural Knowledge, Tools and Signs	▪ Teachers need to recognise the classroom environment as a culture in itself, which exists within the culture of the school, which in turn exists within the cultural bounds of the local community ▪ Teachers need to encourage learners to bring with them their cultural experiences external to the classroom into the learning process (while embracing and leveraging on any manifestations of diversity) ▪ Teachers need to refer to relevant and contextually appropriate examples which learners can immediately relate with or to

Element	Conceptual Alignment in the Classroom
Assisted Learning	▪ Teachers need to demonstrate high levels of commitment to the classroom discourse and craft ways to instil this level of commitment onto the learners ▪ The primary target of where learning is mostly effective is within the ZPD; targeting the ZPD avoids the issuing of tasks and activities that are too easy (and therefore too boring for the learners to even attempt) or too complex (and therefore too frustrating for the learners to even attempt); in both extreme cases, no learning takes place ▪ Teachers need to subscribe to the notation of scaffolding to assist learners through the learning process within the ZPD ▪ Teachers need to encourage group activities as scaffolding also happens intragroup (i.e. amongst peer learners)

Table 1: Conceptual alignment of the three fundamental elements of social constructivism in a classroom setup

Table 1 presents a desirable and teacher-reliant conceptual alignment of Vygotskian classroom practices which are aligned with these elements. The formulation of this conceptual alignment borrows from similar efforts by Doolittle and Hicks (2003), where they devised six theoretical principles for social constructivism in a social studies setup (pp. 83-86). By construct, the three elements ought to work collaboratively during classroom discourse. It is important that teachers are able to identify a point when individual learners reach internalisation (the third distinguishing characteristic of the *assisted learning* element), especially since the process of learning and constructing meaning is dynamic (i.e. once knowledge and experiences are constructed, they become the basis of constructing new knowledge and experiences). Once individual learners reach internalisation, they can subsequently be *scaffolded* onto their new ZPD. The learning process thus becomes a conical spiral of meaning-making.

INFORMATION AND COMMUNICATION TECHNOLOGIES IN A SOCIO-CONSTRUCTIVIST CLASSROOM

When used correctly and appropriately, technology has the power to facilitate social collaboration in ways way beyond what is possible in an ordinary classroom. Ford and Lott (2012) affirmatively state that "*[i]ntegrating the powerful and common tool of technology, collaboration extends beyond the four walls of a classroom to communities around the world.*" With just the prospects of facilitating collaboration alone, and because social constructivism advocates for collaboration, it is clear why a socio-constructivist approach would be an effective manner with which to integrate technology into the teaching and learning process in a classroom environment. The socio-constructivist approach emphasises the active construction of knowledge through the use of technology-based tools merged with social practices.

Beyond being used as a tool for collaboration, technology can also be used to facilitate the scaffolding technique, which is central to the three fundamental elements of social constructivism. Table 2 presents a conceptual role of technology across the three fundamental elements of social constructivism in a classroom setup. Similar to Table 1, the formulation of this conceptual role of technology borrows from similar efforts by Doolittle and Hicks (2003), where they devised six theoretical strategies for integrating technology into a socio-constructivist social studies setup (pp. 88-93).

Element	**Conceptual Role of Technology**
Cognitive Activity	▪ Technology can be used to get up-to-date, context-relevant information that can be used as part of the learners' knowledge construction process ▪ The process of using the technology can in itself be seen as a cognitive stimulant and facilitate learner creativity

Element	Conceptual Role of Technology
Cultural Knowledge, Tools and Signs	▪ Technology can be leveraged as a tool to find context-fitting material to be used during classroom discourse ▪ Technology can then be enculturated into the classroom and become what Sivan (1986) calls a classroom "*cultural norm*" (p. 209)
Assisted Learning	▪ Technology can be leveraged as a tool to facilitate scaffolding to assist learners through the learning process within the ZPD ▪ Where particular learning concepts are complex to articulate or demonstrate, technology can be used as an illustrative tool to assist the teacher to assist the learners

Table 2: Conceptual role of technology modelled across the three fundamental elements of social constructivism in a classroom setup

The successful use of technology in the classroom is premised on both the teachers' and learners' attitudes towards the utility of the educational technology. In fact, the adoption attitudes could potentially extend beyond the classroom all the way to the school headmaster. In addition, teachers' perceptions of ICT in their professional environment is crucial and as key actors in the socio-constructivist approach, they must be digitally fluent and pedagogically grounded on the use of technology as an enabler in the interactive teaching environment. Researchers have highlighted some of the risks and challenges inherent in using ICTs for educational purposes (Mumtaz, 2000; Sime & Priestley, 2005; D'Angelo & Woosley, 2007; Al-Zaidiyeen, Mei, & Fook, 2010). Some of these challenges include perceived usefulness of technology in teaching, the disruptive nature of technology as a pedagogical tool, digital literacy skills, and the level of confidence and competence in the use of technology. Therefore, there must be adequate professional development activities or interventions rather than those once-off training events.

DISCUSSION AND FUTURE WORK

What this paper has presented is a foundational concept of integrating ICTs into the classroom from a socio-constructivist point of view. This setup allows for further socio-psychological inquiry to gain in-depth insight into firstly, the various practical uses of technology in classrooms

where such technology has been deployed, secondly, the impact that such practical uses of technology have in classroom discourse, and thirdly, the appeal of adopting a socio-constructivist approach towards integrating technology in the classroom environment within the ambit of ICT4D. This is an effort to link how teachers use technology in creative ways to create interactive environments. The concept of interactivity is associated with the 21st century environment characterised by bringing opportunities for greater access to education. There are various literacies to be cultivated using technology in the knowledge society, all of which are pre-requisites to development. The presence of ICT has sped up knowledge access and has enabled sharing of information beyond the formal education setting which in the long-term contributes to socio-economic development.

While there are pockets of evidence across isolated studies (as referred to elsewhere in this paper) which suggest that within specific boundaries technology has been found to be impactful, many other researchers have argued differently. The works of Pade-Khene and Sewry (2011), Xiong and Qureshi (2015) as well as Yim (2015) have stated that while many countries have proceeded with efforts to integrate technology into their current and future development plans, with hopes that technology will promote development, there is still a grey area at policy-maker level in understanding whether or not technology actually does or does not facilitate and promote development; and if it does, *how?* This is especially the case in education, where the impact of technology interventions are not yet fully comprehensible (World Bank, 2011 cited in Yim, 2015).

The process of learning in the classroom can be characterised as development at a very elementary level, and by definition, so too is the use of educational technology. The multiplicative power of this developmental process cascaded from an individual learner to a classroom of learners, from a classroom to a school, from a school to a community, and so on, has the potential to yield progressive levels of development at a global scale. In fact, the progressive levels of development lead to further innovation and technological development. As alluded to earlier, it is also important to point out that the development of various literacies such as information literacy, critical literacy, mobile literacy, media literacy, cultural literacy, legal literacy, and visual literacy is key (Meleisea, 2006, p. 5).

If current research can give insight into best ways in which to use educational technology (which is one of the overarching aims of this ongoing research), proponents can start applying some of these best ways to attend to various societal challenges. One such challenge is as underlined by the Trends in International Maths and Science Study (TIMSS)[2], where there is a significant performance gap between learners from well-off countries (for instance Singapore, Hong Kong, Korea and Japan) and developing countries (for instance Botswana, Egypt, Lebanon and South Africa); and even within countries themselves, there are significant performance gaps between the learners from so-called rich schools and so-called poor schools (Spaull & Kotze, 2015).

One of the challenges with this ongoing research is to identify or set up such Vygotskian classroom environments as conceptualised earlier, upon which future work concerned primarily with studying the impact of educational technology from a socio-psychological point of view can take shape.

CONCLUSION

This paper has defined educational technology within the context of ICT4D and has further drawn similarities between the developmental nature of educational technology and the development aspect of ICT4D. It has presented a view, drawing from other researchers, which holds that an effective way to integrate technology into a classroom environment is to follow a constructivist approach. To that end, the paper explored the theory of constructivism, ultimately asserting that the most favoured constructivist approach is that which adopts Vygotskian principles of constructivism because of their socio-collaborative appeal.

The central argument that this paper was driving is that in a Vygotskian (i.e. socio-constructivist) modelled classroom, it is possible to overlay technology on top of this classroom configuration, thereby providing a testbed for further inquiry into the impact of adopting educational

[2] The Trends in International Mathematics and Science Study (TIMSS) is a series of international assessments of the mathematics and science knowledge of students around the world. The participating students come from a diverse set of educational systems (countries or regional jurisdictions of countries) in terms of economic development, geographical location, and population size. The TIMSS also collects extensive data about the contextual factors that affect learning, including school resources, student attitudes, instructional practices, and support at home. - *https://timssandpirls.bc.edu/*

technology in classroom discourse. We are hopeful that what this research will ultimately uncover will contribute to the global dialogue around how to effectively use ICTs in the classroom to transcend developmental boundaries.

ACKNOWLEDGEMENTS

Siyabonga Mhlongo is a Lecturer in the School of Computing of the College of Science, Engineering and Technology at the University of South Africa (UNISA). He is a PhD scholar in the field of Educational Information Technology at the School of Education of the University of the Witwatersrand (Wits) under the supervision of Dr Reuben Dlamini and the co-supervision of Dr Samuel Khoza.

Thanks are due to both UNISA and Wits for supporting this research, with special thanks to Prof Hossana Twinomurinzi for his unwavering encouragement during the authoring of this paper.

REFERENCES

AECT Task Force on Definition and Terminology. (1977). In *Educational Technology: Definition and Glossary of Terms* (Vol. 1). Washington, DC: Association for Educational Communications and Technology.

Aggarwal, J. (2014). *Essentials of Educational Technology* (3 ed.). New Delhi: Vikas Publishing House.

Alhashemi, Y., & Weistroffe, H. R. (2015). Cultural Impact on Information Technology Use and Implementation in the Arab World. *Proceedings of SIG GlobDev Eighth Annual Workshop*. Fort Worth.

Al-Zaidiyeen, N. J., Mei, L. L., & Fook, F. S. (2010, May). Teachers' Attitudes and Levels of Technology Use in Classrooms: The Case of Jordan Schools. *International Education Studies, 3*(2), 211-218. doi:10.5539/ies.v3n2p211

Bakar, K. A., Ayub, A. F., Luan, W. S., & Tarmizi, R. A. (2010). Exploring secondary school students' motivation using technologies in teaching and learning mathematics. *Procedia-Social and Behavioral Sciences, 2*(2), 4650-4654. doi:10.1016/j.sbspro.2010.03.744

Beldarrain, Y. (2006, August). Distance Education Trends: Integrating new technologies to foster student interaction and collaboration. *Distance Education, 27*(2), 139-153. doi:10.1080/01587910600789498

Blackwell, C. K., Lauricella, A. R., Wartella, E., Robb, M., & Schomburg, R. (2013). Adoption and use of technology in early education. *Computers & Education, 69*, 310-319. doi:10.1016/j.compedu.2013.07.024

Blake, B., & Pope, T. (2008, May). Developmental Psychology: Incorporating Piaget's and Vygotsky's Theories in Classrooms. *Journal of Cross-Disciplinary Perspectives in Education, 1*(1), 59-67.

Chi, M. T., Roy, M., & Hausmann, R. G. (2008). Observing Tutorial Dialogues Collaboratively: Insights About Human Tutoring Effectiveness From Vicarious Learning. *Cognitive Science, 32*(2), 301-341. doi:10.1080/03640210701863396

Chi, M. T., Siler, S. A., Jeong, H., Yamauchi, T., & Hausmann, R. G. (2001). Learning from human tutoring. *Cognitive Science, 25*(4), 471-533. doi:10.1207/s15516709cog2504_1

Cobb, P. (1994, October). Where Is the Mind? Constructivist and Sociocultural Perspectives on Mathematical Development. *Educational Researcher, 23*(7), 13-20. doi:10.3102/0013189X023007013

Cole, M., & Scribner, S. (1974). *Culture & thought: A psychological introduction.* John Wiley & Sons.

Cress, U., & Kimmerle, J. (2008, June). A systemic and cognitive view on collaborative knowledge building with wikis. *International Journal of Computer-Supported Collaborative Learning, 3*(2), 105-122. doi:10.1007/s11412-007-9035-z

D'Angelo, J. M., & Woosley, S. A. (2007). Technology in the classroom: Friend or foe. *Education, 127*(4), 462-472.

Dede, C. (1995). The evolution of constructivist learning environments: Immersion in distributed, virtual worlds. *Educational Technology, 35*(5), 46-52.

Doolittle, P. E., & Hicks, D. (2003). Constructivism as a Theoretical Foundation for the Use of Technology in Social Studies. *Theory and Research in Social Education, 31*(1), 72-104. doi:10.1080/00933104.2003.10473216

Duffy, T. M., & Jonassen, D. H. (1992). Constructivism: New implications for instructional technology. In T. M. Duffy, & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 1-16). Hillsdale: Lawrence Erlbaum Associates.

Eyyam, R., & Yaratan, H. S. (2014). Impact of use of technology in mathematics lessons on student achievement and attitudes. *Social Behavior and Personality: an International Journal, 42*(1), S31-S42. doi:10.2224/sbp.2014.42.0.S31

Fonseca, D., Martí, N., Redondo, E., Navarro, I., & Sánchez, A. (2014). Relationship between student profile, tool use, participation, and academic performance with the use of Augmented Reality technology for visualized architecture models. *Computers in Human Behavior, 31*, 434-445. doi:10.1016/j.chb.2013.03.006

Ford, K., & Lott, L. (2012). *The impact of technology on constructivist pedagogies.* Retrieved from Theories of Educational Technology: https://sites.google.com/a/boisestate.edu/edtechtheories/the-impact-of-technology-on-constructivist-pedagogies-1

Gholami, R., Higón, D. A., Hanafizadeh, P., & Emrouznejad, A. (2010). Is ICT the Key to Development? (F. B. Tan, Ed.) *Journal of Global Information Technology*, 66-83. doi:10.4018/jgim.2010091104

Gray, D. E. (2014). *Doing Research in the Real World* (3 ed.). Sage Publications.

Hatakka, M., Thapa, D., & Sæbø, Ø. (2016). A Framework for Understanding the Link Between ICT and Development: How Affordances Influence Capabilities. *Proceedings of SIG GlobDev Ninth Annual Workshop.* Dublin.

Hofstede, G. (2003). What is culture? A reply to Baskerville. *Accounting, Organizations and Society, 28*(7), 811-813. doi:10.1016/S0361-3682(03)00018-7

Karikkandathil, S. (2016, March 28). *Ethiopia gearing up to transform education through technology.* (Microsoft Inc.) Retrieved 2017, from MEA News Centre: https://news.microsoft.com/en-xm/2016/03/#VtLUst2W7jzB7Tho.99

McMahon, M. (1997). Social Constructivism and the World Wide Web - A Paradigm for Learning. *ASCILITE.* Perth.

Meleisea, E. (2006). *Using ICT to Develop Literacy.* Bangkok: United Nations Educational, Scientific and Cultural Organization (UNESCO). Retrieved from http://files.eric.ed.gov/fulltext/ED494262.pdf

Mumtaz, S. (2000, October). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342. doi:10.1080/14759390000200096

Pade-Khene, C., & Sewry, D. (2011). Towards a Comprehensive Evaluation Framework for ICT for Development Evaluation - an Analysis of Evaluation Frameworks. *International Conference on Information Management and Evaluation* (pp. 360-369). Reading: Academic Conferences International Limited.

Palincsar, A. S. (1998, February). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology*, *49*(1), 345-375. doi:10.1146/annurev.psych.49.1.345

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer.* New York: Basic Books, Inc.

Pass, S. (2007). When Constructivists Jean Piaget And Lev Vygotsky Were Pedagogical Collaborators: A Viewpoint From A Study Of Their Communications. *Journal of Constructivist Psychology, 20*(3), 277-282. doi:10.1080/10720530701347944

Powell, K. C., & Kalina, C. J. (2009, December). Cognitive and social constructivism: developing tools for an effective classroom. *Education, 130*(2), 241-251.

Rajagopal, S., Ismail, Z., Ali, M., & Sulaiman, N. (2015). Attitude of secondary students towards the use of GeoGebra in learning loci in two dimensions. *International Education Studies, 8*(13), 27-32. doi:10.5539/ies.v8n13p27

Reiser, R. A. (2007). What field did you say you were in? In R. A. Reiser, & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (3 ed., pp. 1-7). Boston: Pearson Education publishing as Allyn & Bacon.

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research and Development, 44*(2), 43–58. doi:10.1007/FBF02300540

Saunders, W. L. (1992, March). The Constructivist Perspective: Implications and Teaching Strategies for Science. *School Science and Mathematics, 92*(3), 136-141. doi:10.1111/j.1949-8594.1992.tb12159.x

Schacter, J. (1999). *The impact of education technology on student achievement: What the most current research has to say.* Santa Monica: ERIC. Retrieved from http://files.eric.ed.gov/fulltext/ED430537.pdf

Sein, M. K., Thapa, D., Hatakka, M., & Sæbø, Ø. (2016). What theories do we need to know to conduct ICT4D research? *Proceedings of SIG GlobDev Ninth Annual Workshop.* Dublin.

Sime, D., & Priestley, M. (2005). Student teachers' first reflections on information and communications technology and classroom learning: implications for initial teacher

education. *Journal of Computer Assisted Learning, 21*(2), 130-142. doi:10.1111/j.1365-2729.2005.00120.x

Sivan, E. (1986). Motivation in social constructivist theory. *Educational Psychologist, 21*(3), 209-233.

Spaull, N., & Kotze, J. (2015). Starting behind and staying behind in South Africa: The case of insurmountable learning deficits in mathematics. *International Journal of Educational Development, 24*, 13-24. doi:10.1016/j.ijedudev.2015.01.002

Unwin, D. (1969). *Media and methods: Instructional technology in higher education.* London: McGraw-Hill.

Valsiner, J. (2007). Culture in minds and societies: Foundations of cultural psychology. *Psychological Studies (September 2009), 54*, 238-239.

Vygotsky, L. S. (1978). Mind in society: The development of higher mental process. Cambridge, MA: Harvard University Press.

Wenglinsky, H. (1998). *Does it compute? The relationship between educational technology and student achievement in mathematics.* Educational Testing Service, Princeton, NJ. Policy Information Center. Princeton: ERIC. Retrieved from http://files.eric.ed.gov/fulltext/ED425191.pdf

Wilkes, J. (1978). Theory in Educational Technology and Curriculum. *Innovations in Education & Training International, 15*(1), 79-82. doi:10.1080/0033039780150113

Wilson-Strydom, M., Thomson, J., & Hodgkinson-Williams, C. (2005, December). Understanding ICT integration in South African classrooms. *Perspectives in Education, 23*(4), 71-85.

Wong, E. M., & Li, S. C. (2006). Is ICT a Lever for Educational Change? A Study of the Impact of ICT Implementation on Teaching and Learning in Hong Kong. *Informatics in Education, 5*(2), 317-336.

World Bank. (2011). *Information for Development Program (infoDev) annual report 2010-2011 : growing innovation.* Washington DC: World Bank.

Xiong, J., & Qureshi, S. (2015). Information Technology for Development in Small and Medium-Sized Enterprises. *Proceedings of SIG GlobDev Eighth Annual Workshop.* Fort Worth.

Yang, Y.-T. C., & Wu, W.-C. I. (2012). Digital storytelling for enhancing student academic achievement, critical thinking, and learning motivation: A year-long experimental study. *Computers & Education*, *59*(2), 339-352. doi:10.1016/j.compedu.2011.12.012

Yim, M. (2015). Towards A Comprehensive Framework for ICT for Education Evaluation. *Proceedings of SIG GlobDev Eighth Annual Workshop.* Fort Worth.

Zuppo, C. M. (2012, August). Defining ICT in a boundaryless world: The development of a working hierarchy. *International Journal of Managing Information Technology, 4*(3), 13-22. doi:10.5121/ijmit.2012.4302