Round Table: What has Africa Been Saying About Educational Technology?

Japari Ngilari
Department of Learning Technologies
University of North Texas
United States
japaringilari@my.unt.edu

Abstract:This paper is a report on the findings of a study on educational technology literature that reference Africa. A systematic search of such literature was conducted and then subject to a content analysis of the results. The results showed the most common keywords, from which predominant themes emerged. Findings indicate that the major themes in academic discourse congregate around teaching practices, technological devices and technology for development. The least represented themes are on gender, literacy and government. This is discussed in light of its implications for current and future research.

Introduction

International education is poised to gain momentum as the world progressively becomes a global village. Knowledge that is traditionally only confined to brick and mortar classrooms, is finding it's way out to far off, non-western territory. This is only aided by the advent of the web and other emergent technologies. As education finds its way around the world, it is not unusual to expect that educational literature will begin to represent a more diverse narrative being documented.

Africa has been the center of much discussion in mainstream media notably for its denotion as an emerging nation. One of the areas of focus has been the lack of or inequitable access to education. Expectedly, technology has been purported as one major innovation to remedy the educational challenges. This paper dwells on a single narrative, the African perspective. The aim is multiplexed but overall demonstrates;

- discussions about educational technology use in Africa which offers new insight to the practicum of technology as an aid to learning
- publications emerging from Africa which is indicative of indigenous effort to contribute to academic discourse and
- research about Africa from the rest of the world showing a real transcendency in global education

A good indicator of academic prowess is usually the level of research activity. Academic literature demonstrates what researchers find fascinating or worthy of studying. It is not personal opinion or mass marketed ideas but is rooted in some empirical evidence. In a peer-reviewed setting, credibility is established. In an international setting, it reveals a global and diverse point of view. Exhaustive studies in educational technology trends and themes have been conducted from as far back as 1977 all the way through to 2009. One of such early studies focused on doctoral dissertations completed between 1977 and 1998. Its findings showed a major focus on instructional design, gaming and audiovisual devices. (Caffarella, 1999). This is consistent with some of the trends from the year long study between october 1990 to september 1991 by Ely (1992). This study, though narrow in timespan has been the most comprehensive to date covering all of the available educational technology literature at the time. The predicted trends were in the field of instructional design, performance evaluation, emphasis on the role of the teacher and a need for technological adoption in classrooms. Two contemporary studies on educational technology literature, conducted concurrently between 2000 to 2009, have had a more limited topical scope. Zawacki-Richter, Bäcker, and Vogt (2009) dwells on publications in the research area of distance education whilst the other is geographically confined to Turkey (Goktas, Kucuk, Aydemir, Telli, Arpacik, Yildirim, & Reisoglu, 2012). The latter mirrors the study herewith in both context and methodology.

According to Zawacki-Richter et al. (2009), publications from 5 western countries dominated the discourse (up to 80%) in their report which is an incentive, consistent with the aims of this paper, to further consider a more geographically diverse perspective in educational technology literature. Therefore, with a focus on all of the countries in Africa, a systemic search of conference proceedings within a 15 year span produced 783 articles. These articles were subject to content analysis of its text resulting in the following emergent educational technology themes; teaching practices, technological devices, technology for development, learning environment, subject areas, higher education, adult learning, collaboration, culture, virtual reality/environments, digital divide, gaming, mobile learning, elearning, gender, Information Communication Technology (ICT) literacy, secondary education, government, perception (attitudes and behaviors) and curriculum.

The Study

A systematic keyword search of all content in a leading educational technology database was conducted. This database was helpful with its focus on learning and technology, it contains academic content spanning three decades and more than 30,000 peer-reviewed conference papers as at the time of the study. The query searched for an exact match of each african country mentioned within the title, abstract or body of the article. The african countries referenced were; Algeria, Angola, Benin Republic, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea Bissau, Guinea, Ivory Coast, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritius,Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion Island, Rwanda, Senegal, Seychelles, Sierra Leone, Sao Tome & Principe, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Western Sahara, Zambia, Zanzibar and Zimbabwe. The results of all the matches were merged to mitigate for overlaps. The search covered articles from 2001 to 2015; only full articles were included, abstract only articles were excluded; the selection was narrowed to conference papers. This resulted in 783 articles. The titles and abstracts from these papers were examined for word frequency evaluation by a computer-aided program. The result were all dictionary words 3 characters or more in length with the exception of common conjunctions.

Findings

The systematic search produced 783 unique articles. The Titles and Abstracts from that result set returned a word frequency count of more than 1,000 words. Words with a common stem were grouped together e.g. educate, education, educational. The results were tabulated with the following columns;

- *keyword* : consisting of the root word, and similar stemming words
- *count* : referencing the total number of times the keyword occurred in all the articles
- *percentage* : weighted (to 2 decimal places) in relationship to other keywords on the list

Keywords with percentages less than 0.1% when rounded up to one 1 decimal place, were eliminated from the tabulated result. This produced 245 keywords with the weighted percentages adjusted accordingly. General purpose words that were unrelated to education and/or technology were eliminated e.g data. Where ambiguity was encountered as regards the semantics of a word, it was considered in the context of each sentence it is referenced. A wide variation in its contextual use by authors will result in the keyword being discarded. A convergence retains the word on the list. The resultant list of keywords was analyzed and grouped into themes. For each theme, the weighted percentages of the comprising keywords were summed up to produce the total percentage representation. Table 1.0 below shows the 20 themes that emerged and percentages rounded up to whole numbers.

Theme	Percentage representation (%)
Teaching Practices	17
Technological Devices	17
Technology for Development	12
Learning Environment	8
Subject Areas	8
Higher Education	7
Adult Learning	5
Collaboration	5
Culture	3
Virtual Reality/Environments	3
Digital Divide	3
Gaming	2
Mobile Learning	2
Elearning	2
Gender	1
ICT Literacy	1
Secondary Education	1
Government	1
Perception	1
Curriculum	1

Table 1.0. Educational Technology Themes in Africa

Conclusion

The findings from Table 1.0 provides some illuminating results, if grouped by educational levels. Studies are concentrated mostly in higher education and among adult learners with secondary education making a fleeting appearance. Middle and elementary school levels, although appeared in the initial keyword search, were a negligible percentage of the overall result set and thus didn't make it into the dominant themes. This presents a direction for future research,; to examine educational technology among children within the 0 to preteen years.

Further, the subject areas covered were arts, language, science, english, mathematics, engineering and programming. The studies in the STEM subject areas were considerably higher than that of the social science subjects. But as Whitworth and Berson (2002) point out, "Research is also needed in the area of how technology use in the social studies impacts academic achievement and learning outcomes."

Digital divide is still an issue in Africa yet its representation in this discourse is low as evidenced in the findings. Ely(1992) noted a pervasive use of computers in the United States which is in stark contrast to the African setting. In Africa, technology in educational institutions arrived later than the rest of the world (Karsenti, Toure, Harper-Merret, & Mbangwana, 2008).

On the other hand, there is an upsurging interest in the area of collaborative learning con-

sistent with the study by Zawacki-Richter et al. (2009). Goktas et al. (2012) also noted a similar thematic dominance in the areas of educational environments (represented in table 1.0 as virtual and learning environment) and technology (captured in table 1.0 as technological devices) in their findings.

Mobile learning and learning also emerged as worthy alternatives and/or additives to traditional classroom blackboard-and-chalk lectures. Other general interest issues like gender, ICT literacy, technology and learning perception represent the bottom tier of the discourse.

It might seem farfetched to be analyzing educational technology in a continent were there has been a proven digital divide (Karsenti et al., 2008), but it is also plausible that it is a double-edged sword that should be considered for its potential benefits. The top tier of the findings makes up nearly 50% of all the themes and addresses presuppositions about educational technology as a possible tool for development in Africa. As Keats and Schmidt (2007) suggest, one way to do this is by establishing "good solid evidence-based research on the … implications of education 2.0 and 3.0 [educational technology]"

Limitations

The limitations of this study regards the use of content analysis and the scope in which it was applied. More representative keywords will be obtained from analyzing the body of the article in addition to the title and abstract. Reliance on manifest content as opposed to latent content in analyzing the keywords might also have made the resulting thematic representation too literal.

If replicated, a future study should be geared towards peer-reviewed journal articles which are perceived to be more academically rigorous than conference publications. A multi-database search and publications in other languages (especially those spoken in african countries like french and portuguese) should also be considered.

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Peer Tutoring in Higher Education: A Review of Empirical Research.

Japari Ngilari

University of North Texas

Abstract

Peer tutoring is a pedagogical strategy that is purported to be beneficial to both the tutors and the tutees. In this paper, a systematic review of the literature on peer tutoring in higher education (primarily, colleges and universities) was conducted. This involved a comprehensive search of an electronic education research database for empirical studies on peer tutoring in higher education from 1997-2017. The aim is to determine the likely factors that influence peer tutoring effectiveness in higher education. The Attitude, Skill, Knowledge (ASK) peer tutoring model proposed by Fitch and Semb (1993) was employed for this purpose. Findings showed that attitude, skills and knowledge of the tutor affect learning outcomes in peer tutoring contexts as does the attitude of the tutee. These findings are juxtaposed in the framework of Piaget, Vygotsky and Bandura's learning theories with emphasis on self-reflection and self-efficacy in peer tutoring. This paper concludes with implications for practice.

Keywords: peer tutoring, higher education, tutor, tutee, Piaget, Vygotsky, Bandura

Peer Tutoring in Higher Education: A Review of Empirical Research.

"The beginnings of peer tutoring lie in practice, not in theory" (p. 87, Bruffee, 1995). The history of "older children instructing younger children"(p. 107) can be traced back to first century AD, under the Roman rhetorician, Quintilian; journeying thereafter through Spain and India in the 1700s to 1800s (Krouse, Gerber & Kauffman, 1981). It found formal institutional adoption in the nineteenth century as a matter of economic convenience for the working class populace in London (Fogarty & Wang, 1982). Laced with moral repudiation for lackluster academic performance, higher ranking students monitored their lower ranking peers under the overall supervision of the teacher. Tokens were used as reinforcements to order students through these ranks. This approach, known as the Lancasterian method, after its founding proponent Joseph Lancaster, achieved immediate mass popularity (Gerber & Kauffman, 1981). Seating preferences, classroom discourse and other pedagogical practices were filtered through the ranks which promoted a competitive rather than collaborative environment amongst peers. The popularity waned as later educational reforms morphed some of the punitive aspects of Lancaster towards a focus on mutual tutor-tutee learning outcomes.

By the early sixties, peer tutoring experienced a resurgence in Eastern, then Western Europe and further westwards until it began to make a dominant appearance in American schoolhouses. The Mobilization of Youth in New York City project was one of such early examples where younger students were tutored in reading by older ones to reported success (Ehly & Larsen, 1976). However, literary discourse prior to the 1980's did not reflect these developments; it was still focused on the study of student-teacher relationships, specifically providing instructional guidance on teacher interactions with students (Johnson, 1981).

Citing a need for more student-student empirical research, Hanser (1982) studied the dynamics of peer approval and disapproval in a musical classroom. It was discovered then that "...only subjects who received high rates of approval from fellow subjects improved to any degree from pretest and posttest" (p. 226). This indicated a strong correlation between peer behavior and academic performance. Educators' view of students gradually began to evolve from seeing them solely as recipients of instruction to potent pedagogical change agents (Fogarty & Wang, 1982). Several more observations were drawn on the impacts of peer relationships on students' wellbeing. According to Johnson (1981), peer relationships could;

(a) influence educational aspirations and achievement

(b) inspire openness to divergent values, attitudes and ways of perceiving the world.

(c) teach students the social competencies necessary to reduce social isolation

Whitman and Fife (1988) classified these peer relationships into two broad types; near-peer and co-peer. Near-peer refers to a dynamic where there is a considerable knowledge gap between the students whilst co-peer relationships occur within students of similar knowledge levels. In higher education, undergraduate teaching assistants, tutors and counselors would be considered near-peers. Partnerships and work groups are co-peers. Peer tutoring, simplified for its purpose here, explores both near-peer and co-peer relationships where one student offers short-term instructional assistance to another student. This, now familial practice in education is considered here from a student-centered purview. A justification for this study is provided on the heels of other well-versed reviews. The results are presented via the ASK peer tutoring model (Fitch & Semb, 1993). Findings are subsequently discussed in light of their theoretical antecedents; Piaget, Vygotsky and Bandura's perspectives.

Literature Review

Over the last few decades, several literature reviews and meta-analyses have been conducted in the field of peer learning, education and assessment. This section discusses some of the pertinent ones and identifies the gaps that necessitated this effort.

Secomb (2008) conducted a review of peer teaching in undergraduate health education of publications from 1980 to 2005; it uncovered some positive impacts which includes the improvement of students' confidence in clinical practice. A subsequent review, also in the medical field, spanned peer assisted learning in general (training, teaching and assessment) and ascertained the previous findings (Burgess, McGregor & Mellis, 2014). However, a related meta-analysis of 10 studies in undergraduate medical education revealed no significant differences between peer-teaching and faculty teaching (Rees, Quinn, Davies & Fotheringham, 2016).

When Osguthorpe and Scruggs (1986) investigated peer tutoring in special education, they discovered that handicapped/remedial students can be trained to be tutors themselves; a role in which they were as much personal/social beneficiaries as those whom they tutored. Similar results were reported amongst students with mild disabilities (Stenhoff & Lignugaris/Kraft, 2007). They also observed therein, that the degree of training the tutors received significantly influenced tutee learning outcomes. A more recent study by Bowman-Perrott, Davis, Vannest, Williams, Greenwood and Parker (2013) focused on single-case research experiments for the K-12 group. They found peer tutoring to be immensely effective across different grade levels, competences and content areas; but more so, for socially disabled students. Maheady, Harper and Mallette (1991) discussed the instructional approaches, merits and concerns of employing peer-mediated instruction in special education classrooms.

These accounts of peer tutoring offer up niche perspectives on the status of peer tutoring in medical and special education. Others reveal important gaps. For instance, though Rohrbeck, Ginsburg-Block, Fantuzzo and Miller's (2003) meta-analytic review identified peer tutoring to be an effective intervention strategy with young, urban, low-income and minority students; it also revealed that many of the examined studies were missing descriptive demographic information. More comprehensive reviews have been conducted. Topping (1996) synthesized much of the literature on the effectiveness of peer tutoring in higher education prior to 1997, documenting a working definition and typology. In an extended review of literature up till 2006, he offers an integrated theoretical model of peer learning; opining that despite the well-documented benefits of peer learning, it was an under-theorized field (Topping, 2005).

This effort here builds upon the previous reviews two-fold. First, it constitutes the inclusion of more up to date literature, 1997 - 2017, on peer tutoring in higher education. And secondly, it extrapolates the theoretical underpinnings of the operational aspects of peer tutoring. There are related reviews that approach this topic similarly. Stigmar (2016) tackles the first account with its recency. Ward, Lee and Lee's (2005) theoretical leanings mirrors the second. However, Stigmar (2016) reports mostly descriptive statistics such as regions where the studies were conducted, disciplines covered and oft preferred research methodology. In addition, previously documented benefits of peer tutoring on improving critical thinking, collaboration and communication skills of students, are reiterated. On the other hand, Ward, Lee and Lee (2005) studied peer influences in physical education from the analytical view of Piaget's equilibration theory, Vygotsky's sociocultural theory and Skinner's behavior analytic theory. The study here offers both theoretical and empirical perspectives. It also unveils other contexts that were not explicitly mentioned in the others.

Research Motivation

Peer tutoring is becoming popular as focus shifts from traditional didactic lecturing approach to more collaborative strategies. When viewed as a social context for collaborative learning, peer tutoring appears less a mediative intervention and seems simply attuned to the norms of academic life. In a sense, it reinforces one's natural propensities to socialize, belong and be part of a group of peers or likeminded individuals, also known as a community of practice. In another, it eschews self-oriented learning tendencies. As Knox (1980) notes "adults who actively seek to enhance proficiencies tend to see themselves as users of, rather than recipients of, education" (p. 79). Academia is one arena where peer tutoring is beneficial for immediate compensation in the form of achieving learning outcomes. The non-academic skills developed however remain relevant in later professional life successes where collaboration is vital.

Research Questions

In light of the information presented, the research questions and model for interpreting the findings follows. This research is stemmed from admitting that indeed peer tutoring works, many more times than not; but there are some unaddressed concerns regarding the nuances. This study attempts to address this by investigating this research question; what factors have been shown to influence the effectiveness of peer tutoring in higher education?

The Attitude-Skills-Knowledge (ASK) model of tutoring is the analytical tool. Fitch and Semb (1993) posit that effective tutoring is characterized by;

- attitude: the tutor must be approachable and have a positive attitude towards teaching

- skills: the tutor must have good communication skills such as listening, asking questions and providing feedback
- knowledge: the tutor must have a good command of the subject matter

It is hypothesized here that tutors in effective peer tutoring programs exhibit these characteristics. This model will also be extended to explore the reciprocal ASK characterization for tutees in the same programs. The knowledge obtained from the findings will improve the practice of peer tutoring. Educators will be better informed about creating contexts for effective peer tutoring to occur.

Research Methodology

To address the highlighted research concerns, a systematic literature review methodology was employed. A search of the electronic database Education Resources Information Center (ERIC) was conducted using the keywords ‘peer tutoring’ for articles published between 1997 and 2017. The search options ‘peer-reviewed only’ and ‘full text available on eric’ were selected. Additional filtering options restricted the articles by publication type and education level, to journal and higher education articles, respectively.

The inclusion criteria maintained that the articles must be empirical studies where mention of peer tutoring (or its variant) is explicit in the abstract/keywords or otherwise introduction/conclusion sections. Participants must include student tutors/tutees in higher education and findings are expected to be student-centered. Review or opinion articles were excluded.

For each identified study, the basic background information about the paper is gathered; geographical region, discipline and publication year. This forms the descriptive statistics of the review. The findings in the body of the research are then analyzed with the ASK model (Fitch & Semb, 1993). Further, the theoretical underpinnings of these findings are synthesized in the frameworks of Piaget, Vygotsky and Bandura. Recommendations for applying these findings are also suggested.

Results

A total of 63 articles were returned from the initial search and filtering process on the electronic database (http://www.eric.ed.gov) as at the time it was conducted, march 2018. Certain articles that bypassed the search criteria due to systemic errors were identified; 30 articles were excluded for not belonging to higher education and/or being empirical studies. When the inclusion criteria was applied on the remainder 33 articles, it was discovered that 4 more articles did not emphasize student-centered findings in their results. The final result is 29 empirical studies of peer tutoring in higher education that were reviewed in this study. These are listed in Table 1.0 in no particular order.

Ciscell, Foley, Howe and Gjsedal (2016)	Kieran and O'Neill (2009)	Yurt and Aktas (2016)
Bell, Arnold and Haddock (2009)	Bell and Elledge (2008)	Arendale (2014)
Marx, Wolf and Howard (2016)	Alrajhi and Aldahfri (2015)	Cooper (2010)
Townsend, Delves, Kidd and Figg (2011)	Rae and Baillie (2009)	Michael (2016)
Baek, Yoo, Lee, Jung and Baek (2017)	Outhred and Chester (2010)	Lelis (2017)
Linda, Thespiso and Andrew (2017)	Zamberlan and Wilson (2015)	Martin (2015)
Grinnell, Muise and Litvin (2009)	Walvoord and Pleitz (2016)	Sanford (2012)

García, Morales and Rivera (2014)	Lueg annd Lueg (2014)	Al Kharusi (2016)
O'Brien, Freud and Sinanan (2014)	Johnson and Galluzzo (2014)	Lin and Yang (2013)
Zamberlan and Wilson (2017)	Gerhardt and Olan (2010)	

Table 1.0: Empirical studies in higher education from 1997 - 2017

Descriptive Statistics

The descriptive statistics are presented by the discipline of the study, the region where it was conducted and the publication year

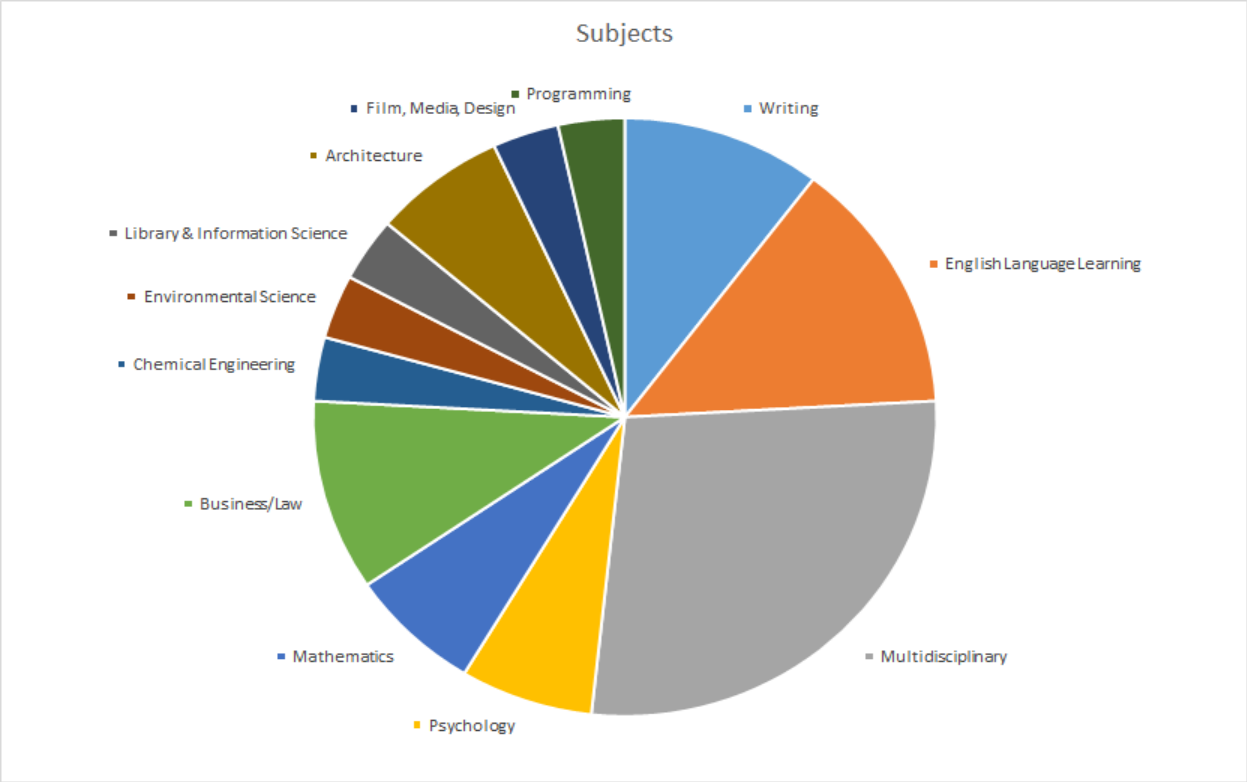

Fig 1.1: Empirical studies by discipline

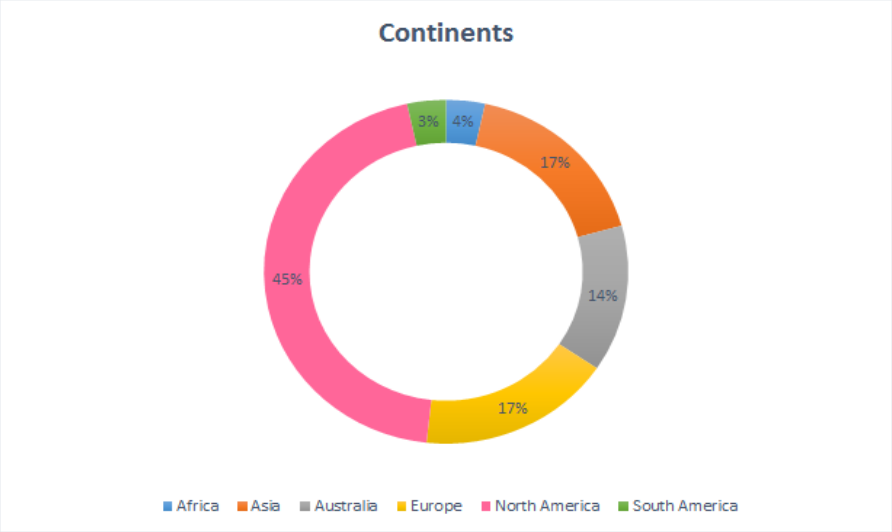

Fig 1.2: Empirical studies by region

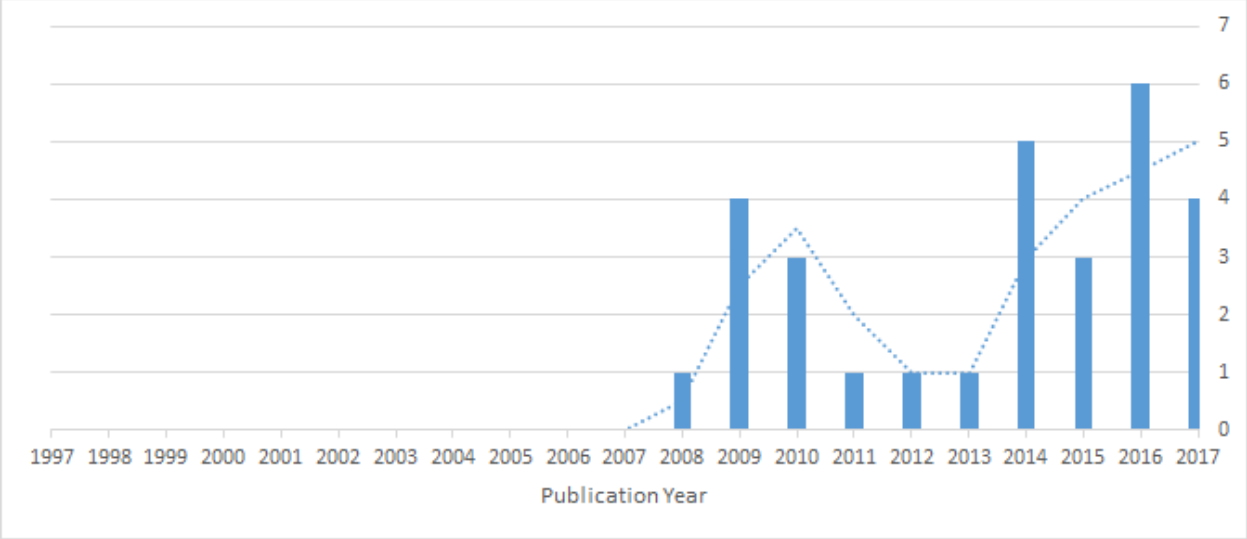

Fig 1.3: Empirical studies by year

Findings show that all disciplines are equally represented. Most of the reviewed studies emanate from North America. In a distant second is Asia, Australia and Europe, trailing at a 50% marginal difference. African and South American representation is negligible. For the yearly distribution, no study was accounted for from 1997 to 2007. From 2008 to 2017, the number of studies rises, falls, then rises again, peaking in 2016.

ASK Model Analysis

The synthesized details of the findings are presented for both the tutor and tutee.

ASK: Tutor

The findings showed that some tutors initially doubted their own competencies (O'Brien, Freud & Sinanan, 2014). Even though tutors needed to be knowledgeable about the subject matter their roles often involved offering moral/non-academic support to struggling students (Linda, Tshepiso & Andrew, 2017). The ones who were effective demonstrated a combination of commitment, tutoring experience, good communication skills, empathy, personality match with tutee and enthusiasm for tutoring (Townsend, Delves, Kidd & Figg, 2011; O'Brien et. al, 2014). The tutors with poor interpersonal skills received the lowest ratings in the feedback from their peers (Johnson & Galluzzo, 2014). In effective peer tutoring programs, tutors skills improved in problem solving, punctuality, understanding of subject matter and sharpened personalities (Al Kharusi, 2016).

ASK: Tutee

The research showed that frequent users of peer tutoring programs were already high achieving students (Walvoord & Pleitz, 2016). Ciscell, Foley, Howe and Gjsedal (2016) concurred, adding that the students who struggled the most academically were the least likely to seek help. In part this is because students in academic danger have negative self-imposed views of themselves and feel shame/stigma prohibiting from seeking help for peer tutoring. On a positive note, peer tutoring was shown to positively influence the tutees' self-concept (Alrajhi & Aldahfi, 2015) and self-efficacious learning skills (Michael, 2016). Academically, it also improved tutees self-confidence in tackling difficult problem sets (Kieran & O'Neill, 2009; Johnson & Galluzzo, 2014). Non-academic skills like communication and knowledge mediation

also improved in groups where peer tutoring was applied (Lueg & Lueg, 2014; Yurt & Aktas, 2016).

ASK: Tutor-Tutee relationship

Tutees indicated that they wanted to belong or fit in. Tutors also expressed similar sentiments, that it was important to have an authentic connection with the tutee for a successful tutoring relationship (Linda, Tshepiso & Andrew, 2017). Hence, tutees are likely to book the same tutor over and over again if they have developed a friendship with him or her (Al Kharusi, 2016). This positive tutor-tutee relationship and high levels of peer engagement are important because they are positively correlated to tutoring success (Michael, 2016). A sustained, healthy, positive and trusting relationship between tutor and tutee opened up more channels of communication which led to improved study skills directly and improvement of grades indirectly (Marx, Wolf & Howard, 2016; García, Morales & Rivera, 2014; Arendale, 2014). In some cases, bidirectional learning occurred (Lin & Yang, 2013)

Discussion

The interpretation of the findings covers both the anticipated and unanticipated research concerns; the latter first. A broad variety of tutoring contexts were covered:

- Locations: Classroom, tutoring centers, writing centers, online and library were the most frequented locations
- Group dynamics: The one-to-one, one-to-many and many-many, tutor-to-tutee matching was observed.
- Both near-peer and co-peer relationships were reviewed, and they were represented in equivalent proportion.

- Prescheduled appointments and walk-in tutoring sessions were accounted for.
- Also, instances of periodically reoccurring and one-off tutoring were recorded
- Some peer tutoring activities were mandated by the instructor and others were voluntary services offered by the school

There is very little research on peer tutoring amongst graduate students as evidenced in this review. Most graduate students were employed in the role of tutors and only one reviewed study indicated having the graduate students in a tutee role. Peer tutoring adoption was low in a study of MA students in the school Media, Film and Design (Lelis, 2017). They were graduate students without more advanced peers to work with. For this reason, they reckoned that their same-year peers will be at similar knowledge levels. The resultant anticipation of negligible learning outcomes was a self-fulfilling prophecy in this study.

On the same note, majority of the studies were reported amongst undergraduate students, primarily freshmen. They did find it effective unlike the singular aforementioned graduate case. The study by Cooper (2010) reports that "students who visited the TC more than 10 times per quarter had approximately 10% higher rates of persistence and approximately 0.2 points higher average GPAs than students who infrequently visited or who do not visit the TC during their first year of college" (p. 21). They may also need it more; freshmen are just transitioning from high school and it is likely that they are not yet familiar with deeper learning skills that go beyond regurgitating information (Zamberlan & Wilson, 2015).

Volition plays an important role in peer tutoring effectiveness. Where the choice to undergo peer tutoring is not made by the participants e.g. as an assigned percentage of course credit, the learning motivation is at risk. Lueg and Lueg (2014) found that some students did not like the mandated in-class peer tutoring and found it to be more time consuming than traditional

lecture/note-taking. The learning outcomes were also affected in such contexts; the weaker students relied on the higher performing students to pass the course. But this is not in the best interest of the student. Peer tutoring is intended as an intermediary recourse/measure; the goal is not for the tutee to be permanently dependent on the tutor (Arendale, 2014).

These discussions illuminates several points about the effectiveness of peer tutoring in higher education. At this point, substantial data has been elicited from which inferences can be drawn about the research question and hypothesis. The reviewed studies have shown that tutor attitude, skill and knowledge is correlated to effectiveness in peer tutoring. A positive disposition, tutoring ability and subject matter expertise will positively influence learning outcomes. For the tutee, there is an overarching emphasis on his/her active role in the peer tutoring process. The ASK purview of the tutee from the reviewed studies tilts heavily towards the 'attitude' component. A self-efficacious attitude is a tutee prerequisite for achieving learning outcomes. For both tutor and tutee, the dynamic of social interactions and self-reflections are also beneficial. The following theoretical analysis of peer tutoring expounds these precepts.

Theoretical Considerations

Piaget's theory focuses on childhood cognitive development in general and not just explicitly on learning (Piaget, 1958). But considering that learning is inextricably linked to cognitive development, the inclusion of Piaget's theory here is apropos. The theory holds that children develop an understanding of the world around them that is consequent on self-reflection of existing mental models and the new information they perceive from their external environment. This process consists of;

- *assimilation*, exposure to new information,
- *accommodation*, identifying discrepancy between the known and new information
- *equilibration*, steady progression towards knowledge mastery (Wadsworth, 2004)

A key criticism of the Piagetian perspective is that it neglects the role of the social environment and associated interactions on cognitive development. For this reason, it's often presented in literary discourse as a contrarian position to his contemporary, Vygotsky's work.

In Vygotsky's sociocultural theory of learning, he enthuses that a child can do much more with guided help than he/she can do alone (Vygotsky, 1987). This competency gap between what a child can do unaided and with help is known as the Zone of Proximal Development (ZPD). This gap can be narrowed through scaffolding which"...is an interactive process by which learners come to perform a task beyond their initial ability" (p. 13, Fitch & Semb, 1993). In a school environment, this can result from a student-teacher relationship which is mostly outside individual volition or a student-student relationship which is often self-selected. Peers can relate with and support each other due to their social and sometimes cultural similarities.

The purview herein is that both Piaget and Vygotsky's theories are not mutually exclusive where peer tutoring is concerned. Social learning is essentially learning together; that is, from and/or with one another. This is a notion that both theorists recognize in their work with children. The distinctions in their approaches largely stem from the precedence in which the social learning events occur. Piaget holds that children construct knowledge on their own which they then bring to the social environment. Vygotsky dissents noting that children construct their knowledge with others within the social environment. The obvious interpretation is to reckon

that Piaget's stance is *anti* social learning and Vygotsky's is *pro* social learning. However, there are some overlaps that may not be initially apparent.

These begin in noting that Vygotsky and Piaget were building their body of research at the same time, though independently and in vastly different cultural settings. Both used children as the focus of their study. Further, the initial (modeling) phase of Piaget's work was actually observing these children in social situations. And though his later conclusions will highlight the autonomous construction of knowledge in children, his earlier works accounted for a substantial role of peers in childhood learning (Golbeck, 2014). Also on a related note, Vygotsky's oft lauded ZPD was a part but not the focus of his vast work on sociocultural influences (persons, places, things) on cognitive development. He also admitted some of the inherent constraints on the applications to learning; "What collaboration contributes to the child's performance is restricted to limits which are determined by the state of his development and his intellectual potential" (p. 209, Vygotsky, 1987). This caveat has Piagetian leanings. The comparisons here are constrained to Piaget's early work and a subset of Vygotsky's work; drawing these parallels sets the tone for the interspersion of their work as it relates to peer tutoring.

The tutoring process requires that both tutor and tutee reflect on how they learn, if not actively on their own, at least passively in the course of their interactions. For the tutor, reflecting on his/her existing knowledge as he/she teaches or prior to, improves understanding of the knowledge. The tutee also has to reflect on what he/she knows and the information received from the tutor. This step is necessary because consequent on this reflection is the momentum for continued interest and engagement in tutoring. As the tutor and tutee interact, one with the other, the tutee may encounter cognitive conflict which Piaget posits in his assimilation, accommodation, and equilibration model. Unconfronted conflict can lead to frustration and

actually deter the learning experience for the tutee. But this conflict could develop into a positive learning experience with the guided help of the tutor (Piaget, 1958). This series of internal self-reflections in the tutoring process are all marked with a Piagetian approach. Where mutual interactions shape the knowledge of the tutor and the tutee, knowledge can be said to have been co-constructed in line with Vygotskian sympathies (Hogan & Tudge 1999). This illustrates the actual symbiosis of Piagetian and Vygotskian concepts in a typical peer tutoring context.

The social cognitive theory of learning can be viewed as a natural progression on the theories of Piaget and Vygotsky. It is a revision on the original social learning theory which states that knowledge is obtained via an individual's reciprocal interaction with his environment. A key component of the revised theory is the emphasis on self-efficacy; one's perception of their abilities to achieve a goal (Bandura, 1977; Bandura, 1986). Oettingen (2005) surmised that self-efficacy can be improved by:

- *performance experiences*; "successes build a sense of self-efficacy; failures weaken it" (p. 149)
- *vicarious experience*; "the successes of similar others raise one's own sense of efficacy, whereas failures lead to lowered levels" (p. 150)
- *verbal persuasion*; competent, trustworthy, attractive and knowledgeable individuals can positively influence self-efficacy beliefs
- *physical and emotional reactions*; high emotional arousal is often associated with low self-efficacy

Performance experience is likely to affect the tutee in adverse ways. The existence of academic failure or wherewithal would have caused the tutee to need the tutoring experience. In such a case, there is already an initial poor self-efficacy on the part of the tutee prior to the

session. The review here revealed that the effectiveness of peer tutoring is limited by negative self-efficacy beliefs.

Verbal persuasion in particular is relevant in peer tutoring, since the tutoring activities rely on good communication skills for any meaningful learning to occur. Though it isn't the tutor's job to improve tutee self-efficacy, he or she should be so inclined (in attitude, skills and knowledge) since it can positively influence peer tutoring effectiveness.

Peers are made up of individuals who engage both their introspective and extrospective learning tendencies in tutoring situations. This section has offered theoretical perspectives to contextualize peer tutoring. The Piagetian and Vygotskian accounts are provided because understanding how individuals construct knowledge independently and collectively will aid dynamics of peer tutoring groups (Golbeck, 2014; Hogan & Tudge 1999). Bandura's theory was also considered because as this review has shown tutees active role in the peer tutoring process can lead to its effectiveness. And students who are self-efficacious about learning will seek effective contexts for that to happen (Schunk &Pajares, 2009)

Implications for practice

One perceived challenge was a poor on-campus awareness of the available peer tutoring programs. Some students come in to the tutoring center as part of a directive from their instructor (Sanford, 2012). Hence, peer tutoring awareness can be improved by announcing it in class and issuing regular reminders to students. Instructors can provide extra credit for attendance (Gerhardt & Olan, 2010). Alrajhi and Aldhafi (2015) add that peer tutoring should be included in a teacher's plan.

There is also need for mentoring/tutoring programs to have pedagogical structure (Townsend et. al, 2011). Zamberlan and Wilson (2015) decipher that training should be provided to tutors, their roles clarified and the need for providing tutee feedback emphasized.

Conclusion

This study has demonstrated the effectiveness of peer tutoring in higher education. Mutual academic and non-academic benefits exist for the tutor and tutee. For peer tutoring effectiveness to be maximized, the tutor must possess a positive attitude, adequate tutoring skills and know-how of the subject matter. The tutee with positive self-efficacy beliefs is more likely to achieve the intended tutoring outcomes.

Peer tutoring is often a student initiated, led and minded process. The downside to this is that peer interactions which resemble a friendship are also more likely to lack certain instructional competencies that teachers provide (Sarbin, 1976). As such, peer tutoring is better championed as a '*supplement to'* not a *'replacement for'* classroom teacher-led instruction.

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Digital Fabrication in Education

Japari Ganama

University of North Texas

Abstract

Digital fabrication is quickly gaining a momentum that transcends its niche industrial roots into formal educational environments. This trend is akin to that found in the early adoption of previous other, now commonplace, technologies (such as personal computers); ubiquitous and promising. Thus, the rationale for this research then lies in the growing use of these digital fabrication technologies (especially 3D printing) for learning; the consequent pedagogical implications of which, warrant a critical look. By adopting a literature review approach, this paper first relays the theoretical underpinnings of making; the nature of and extended motives for researching digital fabrication then follows. The collected classroom case studies of fabrication in action later reveal that it stimulates logical thinking, concretizes understanding of abstract concepts, provides hands-on learning and can be beneficial cross-disciplinarily. These outcomes suggest that digital fabrication could potentially play a pivotal role in re-orienting traditional pedagogy towards a culture of making on the basis of technological constructionism.

Keywords: digital fabrication, constructivism, making, learning, emerging technologies

Digital Fabrication in Education

'Making' has always existed in some form in our everyday world as we live, work and play. There seems to be an inherent and intuitive component of man that seeks to confer otherwise theoretical abstractions into empirical constructions (Smith & Tillman, 2015). From the early childhood stage, children have been known to be experimental and curious, tinkering with and poking the world around them. Informal learning environments, characterized by their exploratory flexibility and freedom, particularly champion this idea of learning through creative play, which consists of making and other constructivist activities. It is this formative inquisition that is honed by guided discipline into later life scientific innovations and/or artistic masterpieces.

Making things by one's self tends to be empowering for the students (Brennan & Resnick, 2012). Little wonder then that the notion of the maker culture being an alternative to traditional pedagogy is gradually shifting; formal education is becoming more progressive in its embrace. Championing the art and practice of 'making', the United States for instance, is leading a national imperative to encourage creativity and invention skills amongst students, especially those in STEM oriented disciplines. This position was upheld by the former President, Barrack Obama in an address to the National Academy of Sciences (Obama, 2009).

The series of activities that constitute the making process is no longer reserved just for artisans; technology's increasing affordability and affordances "enables anyone to make anything" (Smith & Tillman, 2015, p.133). Dialing in on this, one will notice what seems to be a deliberate and nascent consideration for the employment of technology-driven 'making' in mainstream education; how to integrate it into school curriculums, how to optimize the learning

based outcomes and (chiefly of interest here), how to leverage the technological affordances thereof.

Derivative of the latter, is the digital fabrication concept, also sometimes incorrectly referred to as one of its composite subsets- '3D printing'. This literature review aims to investigate, based on some of the preliminary studies that have been conducted, 'The Role of Digital Fabrication in Learning'. The sections that follow discuss the elicited findings which span the underpinnings, nature, research rationale, learning outcomes, integration concerns and future research agenda for digital fabrication.

Literature Review

'Making', outside of the educational purview, has some theoretical antecedents in several disciplines; mainly philosophy, physiology and psychology. In this light, one can consider some examples such as the Montessori Method of learning, which thrived on allowing children to make and manipulate things with their hands (Montessori, 2013), or similarly, Piaget, whose research extensively described the sensorimotor tendencies of young children and its relationship to cognition (Piaget, 1970). These examples are characteristically Deweyan, so named after John Dewey, who is famed for his pragmatic philosophy of education. Dewey advocated that learning be experiential, that learners be exposed to the realities of the knowledge they were acquiring - essentially, learning by doing (Dewey, 1909). That said, the arguably most credited modern 'father' of making and by extension, inventing things in education, was Seymour Papert. His seminal work in the theory of constructionism, propounded upon, of course, several constructivist perspectives - Piaget and Dewey inclusive (Halverson & Sheridan, 2014).

Whilst constructivism is a general learning philosophy that emphasizes the learners' ability to independently create their own knowledge and meaning, constructionism is a distinctive implementation of this school of thought. Papert's 'constructionism' is best summarized, in his own words, as "... a mnemonic for two aspects of the theory of science education…" He adds;

> From constructivist theories of psychology we take a view of learning as a reconstruction rather than as a transmission of knowledge. Then we extend the idea of manipulative materials to the idea that learning is most effective when part of an activity the learner experiences as constructing a meaningful product. (Papert, 1986, para 1).

The crux of this theoretical purview is that this hands-on, manipulable, malleable aspects of making is vital to learning. In essence, the maker culture is simply put - 'making and sharing'. Therefore, the digital fabrication treatment of it is (at least, as referenced herein), the 'deep' use of technology to make something digitally and share it physically. Depth here implies use that goes beyond the surface, harnessing the immersive aspects of the technology in question.

The Nature of Digital Fabrication

Digital fabrication originally regarded as a personal computing peripheral is increasingly becoming a focal point in and of itself (Eisenberg, 2009). This change heralds more creative control for the user, orienting them towards being also producers rather than just sole end-users of readymade artefacts. The novel aspects of this innovation environment offers learners direct physical control of multi-dimensional modelling, which could be two (2D) or three (3D) dimensional. 2D fabrication includes shapenets, pop-up books, shadow puppets, cultural kirigami

and mathematical puzzles whereas the 3D options consist of creating wearable art, musical instruments and museum artifacts (Smith & Tillman, 2015)

For example pop-ups, which are gaining popularity in early childhood education settings, are just one of the many enactments of the digital fabrication movement; they are essentially "movable books" (Smith, 2012, p. 1072). They allow for exploration via the push, pull and press mechanisms built into the books. Naturally, the learners may also ascend into creating their own pop-ups; this will hone their engineering and design thinking skills. The mental process by which the young learners come to understand how to use or make these pop-up books is laced with wonder, curiosity, intrigue and surprise, thereby enabling the achievement of specific learning outcomes as well as positive associations with learning in general.

Some factors to consider as regards utilizing digital fabrication, especially with children are; the materials to build with, the subject matter for fabrication and the physical settings for fabrication (Eisenberg, 2011).

Materials. This could be wood, paper, yarn, acrylic. There is also the ABS plastic (synonymous with LEGOs) which is preferred for 3D printing. Other alternatives include wax, Styrofoam and aluminum.

Subject Matter. There are the technical disciplines e.g. architecture which involve a great deal of modelling or construction type activities. However, it does require some instructional resourcefulness to realize how fabrication might be employed in other subject areas without an obvious modelling/construction component like languages, arts and the like. Some creative examples could include recreating museum historical artefacts/objects (history) or creating street models (geography).

Physical Settings. It is apparent that communities congregate around larger fabrication devices. They have been seen to be deployed in libraries, afterschool maker clubs, museums, shop classes, laboratories etc. Where a 1:1 convention is advocated, personal fabrication devices are suitable (Eisenberg & Buechley, 2008).

Needless to say, safety, nature of the desired object and cutting capability/appropriateness of technology-to-materials will influence the decision of the overall fabrication set-up.

Rationale for Researching Digital Fabrication

Research on digital fabrication is nigh for many plausible reasons which rest on its evolutionary trajectory, peculiar novelty and pedagogical potential; each discussed in turn.

To start with, digital fabrication has been the most popular in industry because it required costly and extensive heavy duty manufacturing equipment. Likewise, more discourse has surrounded the industrial notion of fabrication than say its educational contextualization (Eisenberg, 2011). Now that personal fabrication can be carried out with a personal computer, Computer Aided Design (CAD) software and fabrication hardware (Tyler-Wood, 2015); Bull, Maddox, Marks, McAnear, Schmidt, Schrum et al. (2010) hypothesize that the introduction of digital fabrication into education will be similar to the trajectory of personal computing technologies, where they were first expensive and inaccessible but subsequently became ubiquitous.

Secondly, “digital fabrication is the process of translating a digital design developed on a computer into a physical object” (Berry, Bull, Browning, Thomas, Starkweather & Aylor, 2010, p. 168). This stirs up novelty in the classroom in a manner unlike other emerging technologies; the peculiar advantage being that it is trans-medial, merging both virtual and physical

manipulation skills (Smith, 2012). With this, learners can utilize appropriate technologies to create digital models which they can then print or transmit into a physical artefact. A typical scenario will require construction/customization using suitable modelling software i.e. setting the desired object's visual and dimensional properties (shape, color, scale etc). This is followed by a layered 'depositing' and/or 'cutting' of the raw material by the fabrication hardware as it builds into a tangible prototype. The manufacturing process as well as the meaningful application of the resulting artefact opens up new dynamic avenues for learning.

Lastly, the practice-based accounts that have been documented so far of digital fabrication indicate a demonstrated enthusiasm for this emerging technology; some positive postulations have been made about its beneficial role in education. Trumble (2017) concurs, adding that though there is this much interest around digital fabrication, there is also a concurrent need to know how it impacts students' skill development. Situated in this context, the onus herein is to, amongst other things, establish if the said benefits of digital fabrication for learning are ascertained or *simply*, postulated. One way to do this is to consider some case studies; an overview of which follows.

Case Studies of Digital Fabrication

The study by Kjellstrom, Tillman and Cohen (2012) examines the use of a 'models and modeling framework' in elementary level mathematics education. The lesson units, which were intentionally architected to employ real world problem scenarios, contained a series of activities on designing airplanes using digital fabrication techniques. No particular solution paradigms were enforced, offering the students any applicable liberties. Findings however revealed that the students often struggled to conjure up or adhere to appropriate mathematical strategies. This implies a dissonance between comprehension of theoretical and applied math; that is, regular

classroom math with defined problem sets versus situations where there isn't an obvious and predictable solution. Because the latter more closely mimics how math works in the real world, digital fabrication now becomes a vehicle to address some of the weaknesses in that regard.

In a similar study, Corum and Garofalo (2017) investigated how including a digital fabrication component into a fifth grade arithmetic curriculum will impact the students' understanding of surface area and volume. The students' ability to complete tasks improved as did their recognition of three dimensional properties often absent in traditional two dimensional depictions. This is a rather welcome quest as surface area and volume are rudimentary concepts, often tested on national standardized tests. More than that, the outcomes obtained in this study underscore the correlation of concrete manipulatives such as digital fabrication to students' comprehension of seemingly abstract concepts.

Oliver and Houchins (2018) thereafter explored the intersection of making and computational thinking at an all-girls public school in the US through the establishment of an afterschool maker space club. Notably, observations were based on self-reported accounts; students were asked, at the conclusion of the digital fabrication process, to reflect on the series of steps they undertook and what they would opt to do differently. An analysis of their reflections revealed that though the computational thinking processes (decomposition, abstraction, algorithmic thinking, generalization/pattern recognition and evaluation) were not always linear/discrete, they were definitely evident in the students' maker activities. In essence, digital fabrication fosters computational thinking.

Other inquiries have yielded identically promising results. For instance, Trumble (2017) discovered that the digital fabrication experience improved the spatial visualization abilities of fourth and fifth grade students. This is consistent with the outcomes from studies by Katsioloudis

and Jones (2015) as well as Smith (2018). Christensen, Knezek, Darby, Den Lepcha, Jiang, Kuo and Wu (2017) also noticed value-added content mastery by way of heightened interest, engagement and peer-to-peer interactions among participants who utilized digital fabrication technology in a science camp experiment on the solar eclipse. This notion of increase in creativity and interest was also noted previously elsewhere (Shealer & Shealer, 2014; Smith, 2013).

And though the aforementioned case studies appear to congregate around mathematics education; it can be arguably held that nearly all disciplines, both STEM and non-STEM, are underpinned by some degree of mathematical thinking skills. Thus a win for math on the bridge of digital fabrication is really a win for all. That said, the purview herein certainly isn't exhaustive. Digital fabrication has been considered for other intents such as; enhancing the learning effectiveness in a medical course on anatomy (Lim, Loo, Goldie, Adams & McMenamin, 2016), narrowing the achievement gap for historically underrepresented groups e.g. African-American males (Tillman, An, Cohen, Kjellstrom & Boren, 2014), promoting inclusion for marginalized populations through customization/personalization of learning material (Jo, 2016) and as a useful pedagogical tool for the teacher (Maloy, Kommers, Malinowski & LaRoche, 2017; Novak & Wisdom, 2018).

Integrating digital fabrication into schools.

Adequate infrastructure in the form of hardware, software, a collaborative space and a maker-driven curriculum is necessary to support digital fabrication (Berry et al., 2010), in order to effectively achieve the demonstrated outcomes. Teacher and student perspectives must be considered during integration in formal learning environments. There must be cognizance of teachers' competences and students' interest in digital fabrication activities. Relatedly, the

curriculum positioning of abstract concepts in real-world applied contexts must be given due diligence, if student learning is to be prioritized

A lingering instructional concern may be how to assess non-traditional digital fabrication activities in the context of a formal educational environment. In this vein, Tillman (2011) offers using a fourth-grade algebra activity, a simple rubric for performance assessment. This progressive scale from 0 to 4 for; 0-not scorable, 1-beginner, 2-intermediate, 3-advanced, 4-master, is based on increasing demonstrated task competence.

Discussion

The role of digital fabrication in education is multifaceted. On the one hand, as evidently shown, it is pedagogically beneficial. Familiarity with digital fabrication tools and techniques from an elementary level are not only vital for achieving immediate learning outcomes but also prepares students for later life professional pursuits particularly in careers where making is elemental (Smith, 2012). On another, subtle yet salient note, it could transform pedagogy itself; anchoring an all-inclusive view of intelligence beyond standardized testing – which is centered on intellectual work (Robinson, 2015). Digital fabrication is instrumental in offering a commendable channel for learners with expressive tendencies (Tyler-Wood, 2015), this extends to students that would otherwise feel sidelined by the conventional curriculum.

On the heels of this, there is an overall need to develop more strategies for integrating digital fabrication activities into pedagogy (Tillman et al., 2014). Consequently, predating the actual introduction of the technological infrastructure in the classroom should be the more important notion of intentionality. All of the considerations (administrative, instructional, logistical etc) that go into making an environment conducive for learning must be imbued with a

maker-driven intent. A classroom for instance, should be structured such that it invites students (this is especially applicable amongst young learners), to interact physically with the surrounding learning artefacts e.g. e.g. assembling, crafting, moulding, stacking etc (Smith, 2012). Shop classes where young adults can get their hands active ought to be reinstated and the idea that skills obtained therein are only valuable for vocational programs done away with.

Digital fabrication builds upon a constructivist philosophy, marrying mind and matter with contemporary technological advancement. A progressive adoption in education implies an explicit admission that knowledge and commodity in this sense are complimentary not rivalries. Isn't this alignment of theory and practice worth pursuing? Therefore, future research ought not to dwell on the operational machinations of digital fabrication, but rather build upon the pedagogical successes recorded thus far. This will require perhaps developing more appropriate measurement instruments, uncovering empirically driven strategies to optimize its efficacy and establishing a framework for a learning theory of technology and trans-medial construction.

Conclusion

At its core, digital fabrication is basically 'high tech end-to-end making' not much unlike industrial manufacturing in the years of yore. This literature review examined the role it plays in education. Though the characteristics and applications have been documented, it is its embodiment and extension of 'making' that has been accentuated here. Digital fabrication has been shown to influence learning outcomes by situating pedagogy in real world contexts and enhancing the overall learning experience. The distinctiveness of this technology empowers students to create using a multimodal fabrication process; this emphasizes analytical and design skills that are applicable across many disciplines and beyond the classroom walls.

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Transactional Distance

Japari Ngilari

University of North Texas

Abstract

This paper investigates the transactional distance experienced among a group of medical students in the same online course. This was measured vis a vis the previous experience of each student with online learning platforms. Results showed that there was not a significant correlation between previous online learning experience and transactional distance, negating the presupposition of a positive relationship. These findings are discussed in the context of other similar studies.

The history of distance education predates the World Wide Web (WWW) contrary to popular understanding. Friedland, Hürst and Knipping (2007) reference Sir Isaac pitman, a shorthand professor, as one of the first educators to teach by correspondence in the form of letters to recipient students as far back as 1840. Institutionally, university of South Africa debuted one of the earliest offerings of correspondence courses in 1946. Thereafter, technology made its way into classrooms ushering in the WWW era. As recent as the WWW is, it took over an existing medium and changed it. It made the scope of distance education offerings broader and brought a great level of interactivity to the classroom (Friedland, Hürst & Knipping, 2007).

There has never been a time like now in which distance education has experienced an ever-increasing relevance and demand. This beckons the need to study its many facets and constitutions. Despite this nascent interest, distance education has struggled with an ability to theorise its activities as revealed by the lack of synergy in existing theories (Chen, 2001a). Some of the major ones are:

- The industrial model
- The transactional distance theory
- The theory of teaching in distance education
- The theory of reintegration of the teaching and learning acts
- And the theory of communication and learner control (Gokool-Ramdoo, 2008)

Though there isn't a unanimous consensus regarding which theory is most appropriate, the odds tipped largely in favor of the transactional distance theory by Moore(1990). Kang and Gyorke (2008) opined the lack of social variation among the learners which the theory purports to describe. Gorsky and Caspi (2005) are also among the dissenting voices arguing that the theory has no empirical and/or literary underpinnings, but is simply the philosophical culmination of an unchecked tautology. This is dispelled by the theorist,

himself Moore(1990) who admits that this work is actually informed by the work of his famed predecessor, John Dewey. These tensions are a precursor to the study that follows; first, by defining distance education as employed herein; then, chronicling its evolution into being synonymous with online learning; and finally, making the case for the empirical study of transactional distance in that context.

Distance education according to Moore(1990) is "…defined as a function of two variables called 'dialogue' and 'structure'." (p.10). He describes dialogue as the exchange of any form of discourse between teacher and student, both verbal and non-verbal whereas structure is the manner, often a logical ordering, in which the educational content/material is presented to students to facilitate learning. Although 'distance' here suggests a geographical separation, Moore had a different, more figurative approach to this definition. He posited that distance in education is not only a factor of geography but also of pedagogy. It is on this basis that transactional distance was born. "Transactional distance has been defined as barriers to students' engagement with learning in the online environment. " (Paul, Swart, Zhang & MacLeod, 2015, p. 1). Moore(1990) categorized the components of transactional distance into three; dialogue, structure and learner. The transactional distance theory implies that the greater the transactional distance, the greater the chasm between the learner and the construct(instructor, course or peers) as evidenced by the frequency of dialogue and the underlying structure.

Learning can be understood as how one comes from not knowing to retained comprehension, either as guided by self and/or an external party (Passer & Smith, 2004). These forms could be both formal and informal. Formal learning requires enrollment in a structured program, a finite duration, clear objectives and some assessment component. Informal learning on the other hand, can be any knowledge enhancing activity with full learner autonomy. It can be deduced then, that in either formal or informal learning, the

following elements are always present; a learner, an instructor and suitable content. In light of this, it then applies that the advent of the web made a significant impact on learning, one of which is morphing it into several expressions. These are, primarily;

- Online learning: formal learning in which courses are offered entirely online
- Blended Learning: formal learning in which courses are a mix of online and face-to-face instruction
- Open Learning: informal learning in which courses are offered entirely online e.g. Massive Open Online Courses (MOOC)

Today, there exists for profit institutions who only offer online courses only with no provision for physical classroom teaching. There is also a growing number of brick and mortar institutions offering distance learning through online courses. One society notable for its enthusiastic adoption of online courses is Britian, with its establishment of the Open university system (Bell & Tight, 1993). This is an accredited public university that offers up to doctoral level courses via online learning.

With popularity of online learning and a move towards this medium by several institutions of higher education, a study like this is timely. Chen (2001a) adds that there is a weakness in the empirical substantiation of distance education literature. Thus, this demand for online learning also necessitates a rationale for its empirical study. This is investigated here within the framework of the transactional distance theory. The empirical research findings indicate four dimensions of transactional distance; instructor-learner, learner-learner, learner-interface and learner-content (Chen, 2001a; Chen, 2001b; Gokool-Ramdoo, 2008; Moore, 1990; Paul et. al, 2015; Stein et. al, 2009; Zhang, 2003)

Method

Of particular interest here are two previously validated scales for measuring transactional distance in an online environment. The original scale was developed by Zhang

(2003) and the revised scale by Paul et. al(2015). The scale by Zhang(2003) had 31 survey items measuring transactional distance; 6 items for instructor-learner transactional distance, 6 items for learner-content transactional distance, 11 items for learner-instructor transactional distance and 8 items for learner-interface transactional distance. A breakdown of the instrument is provided in Appendix I. The revised scale by Paul et. al (2015) has 12 items which unilaterally measure the transactional distance, but does not account for the learner-interface transactional distance. Details of the scale are available in Appendix II

Research Design

This study focused primarily on post-secondary adult learners in a professional setting. The aim is to investigate if the learner's previous online learning experience can influence the self-reported transactional distance. The research questions are; (a) Is there a relationship between learner experience and transactional distance in online learning? (b) If any exists, what is the degree of the relationship?

The hypothesis here is that learner experience has a significant effect on transactional distance in online learning among Nigerian medical interns. Learners with substantial previous online learning experience (more than three courses) should feel less transactional distance than those with limited experience.

For the purpose of this study, the transactional interactions have been defined as:

- Learner-teacher: any academic activity between the learner and teacher that takes place online via the designated Learning Management System (LMS)
- Learner-content: any activity in which the learner either adds to the body of knowledge in the course or draws from it via the LMS
- Learner-learner: any interaction between the learner and other members of the cohort that takes place via the LMS.

Participants

Employees of a regional hospital in the capital city of one of the most populous countries in West Africa, were approached for inclusion in this study. The participants are all doctors in the first term of a two-year mandatory internship for medical school graduates. They are all enrolled in the same online study certificate course offered by the public health department of a Russell Group university in the United Kingdom. Though this course is optional, it has been observed to improve their odds of being retained after the internship. 120 students were approached to be included in this study at the start of this online course, and 70 provided consent but only 40 eventually participated in the study. 1 entry had to be dropped due to inconsistent reporting, resulting in a total of 39 responses. There were no remunerations or incentives provided for completing the survey.

Materials

The instrument involved is the 12-item Revised Scale of transactional distance by Paul et. al(2015). The first item in that scale was a reverse coded question and so for the purpose of this study only 11 items were employed as thus; questions 1-3 addressed transactional distance between student and teacher, questions 4-7 items addressed transactional distance between student and content, questions 8 to 11 addressed transactional distance between student and student (see Appendix section).

Procedure

This survey was conducted at the end of the first semester using the cross-sectional approach. It was administered via the survey collection tool survey monkey. No identifying information was collected. In addition to the validated scale, demographic information was collected about the learners' previous experience with online courses. All participants responded in a timely manner. The statistical tests performed include tests for normality, Kruskall test, correlation test and reliability analysis. The results generated follows.

Results

A descriptive test was conducted to describe the demographic information and it yielded the following results;

		Frequency	Percent
Valid	1-3 Online Courses	13	33.3
	4-7 Online Courses	16	41.0
	8+ Online Courses	10	25.6
	Total	39	100.0

Table 1.0: Previous Online Learning Experience

Table 1.0 shows that most of the students have enough experience with online learning/courses, having taken as much as 4 or more courses prior to this study.

Next, a reliability analysis was conducted which yielded a Cronbach alpha of .70 for the 11 items tested. According to Gliem and Gliem (2003), an alpha value of .70 is acceptable. No explicit validity test was conducted again here because the instrument used has been validated in prior studies with excellent validity (Paul et. al, 2015). A non-parametric test is run to identify if there are any statistical significance in the online learning experience groups using Kruskall-Wallis test (table 2.0 and 3.0).

	Online Learning Experience	N	Mean Rank
Transactional Distance	1-3 Online Courses	13	18.54
	4-7 Online Courses	16	19.75
	8+ Online Courses	10	22.30
	Total	39	

Table 2.0: Kruskall-Wallis Test - Mean of Ranks

	TD
Chi-Square	.632
df	2
Asymp. Sig.	.729

a. Kruskal Wallis Test

b. Grouping Variable: Previous Online Learning Experience

Table 3.0: Kruskall-Wallis Test - Statistics

The Kruskall-Wallis test is employed for studies in which the independent variable consists of many groups and the dependent variable is ordinal. For this study, the independent variable is the previous online learning experience which is determined by how many courses the respondent is indicated to have taken. The dependent variable is the transactional distance. The result in table 2.0 shows that there is a statistical significance in transactional distance between groups.

The next logical test to get the type of distribution the transactional distance is. This is done using tests of normality.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Transactional Distance	.082	39	.200*	.986	39	.900

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test 4.0: Test of Normality

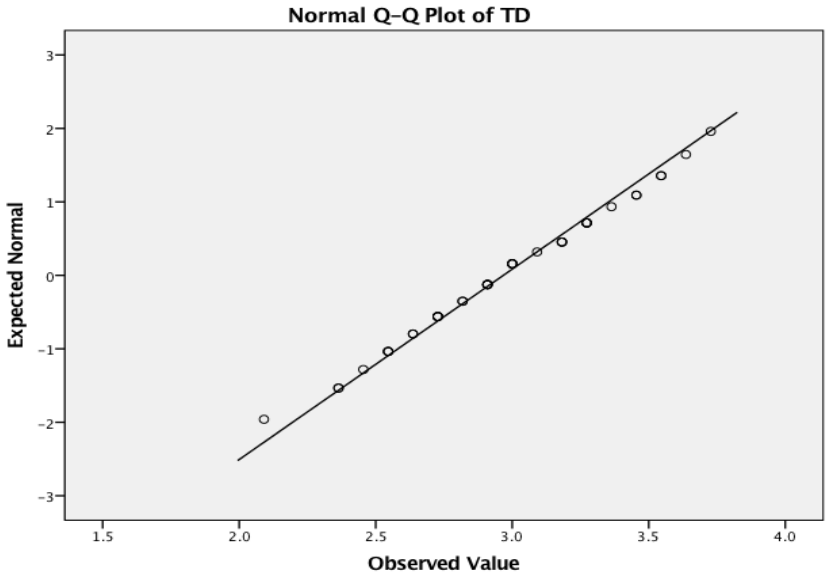

Fig 1: Graph showing a normal distribution

The Kolmogorov-Smirnov test is used for sample data of at least 2000 while the Shapiro-Wilk test is often used for small sample data as in this study. The latter has a sig value of greater than .005 which shows that the data is normal. The data plot also shows the distribution is normal. Since this is a normal distribution, it means a bivariate correlation analysis can be carried out.

			Transactional Distance	Previous Online Learning Experience
Spearman's rho	Transactional Distance	Correlation Coefficient	1.000	.125
		Sig. (2-tailed)	.	.450
		N	39	39
	Previous Online Learning Experience	Correlation Coefficient	.125	1.000
		Sig. (2-tailed)	.450	.
			39	39

Table 5.0a: Bivariate Analysis – Spearman

		Transactional Distance	Previous Online Learning Experience
Transactional Distance	Pearson Correlation	1	.160
	Sig. (2-tailed)		.332
	N	39	39
Previous Online Learning Experience	Pearson Correlation	.160	1
	Sig. (2-tailed)	.332	
	N	39	39

Table 5.0b: Bivariate Analysis - Pearson

Both the Spearman's rh0 (table 5.0a) and the Pearson's coefficient (table 5.0b) indicate a weak positive association between previous online learning experience and transactional distance for this population sample. The results address the initial research questions as thus;

(a) *Is there a relationship between learner experience and transactional distance in online learning?* For this population sample, there exists a very weak positive relationship

(b) *If any exists, what is the degree of the relationship?* The relationship is slightly more statistically significant when the scale is grouped into the three subconstructs learner-learner, learner-instructor and learner-content transactional distances than for the whole.

For these reasons, the initial hypothesis that learners with previous online learning experience will report less transactional distance is rejected.

Discussion

The apparent limitations of this study notwithstanding, the results are consistent with literature findings that the previous online learning experience does not have much impact on the overall transactional distance. In a study by Chen (2001a), a 23-item likert type questionnaire was developed to investigate what constitutes transactional distance. The variables explored were (a) the learners' skill level with the internet and (b) experience with distance education (c) peer interaction (d) support system. Much like the findings herein, even though the factor analysis on the individual variables revealed an acceptable statistical significance, the correlations were weakly positive. Chen (2001b) concluded that previous online education experience did not affect transactional distance, though, learner's internet skill had a negative correlation. Other studies however report a strong correlation of the learner-teacher and learner-interface transactional distances to the overall transactional distance. (Zhang, 2003; Paul et al, 2015).

Conclusion

Transactional distance is understood to be a psychological construct. This distance identified by the transactional distance theory exists in all educational events whether face to face or computer mediated (Chen, 2001a). In online environments, the distance is more cognizant because of the physical separation (Stein, Wanstreet & Calvin, 2009).

Summarily, the impetus for this study is summed up in this; "…the fact that nearly two decades after its development, most theorists are converging towards TDT, and moreover, their own individual theories carry elements of the TDT, appears to justify the need to explore this theory as a global one that can sustain future developments in distance education. " (Gokool-Ramdoo, 2008, p. 12)

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Appendix I

Original Scale of Transactional Distance

ST = Transactional distance between students and teacher
1 The instructor generally answers the student's questions
2 The instructor pays no attention to me
3 I receive prompt feedback from the instructor on my academic performance
4 The instructor was helpful to me
5 The instructors are available to answer my questions
6 The instructor can be turned to when I need help in the course

SC = Transactional distance between student and content
7 The content of this course is of great interest to me
8 I don't know why I have to learn this
9 The examinations in this course have challenged me to do my best work
10 This course emphasized SYNTHESIZING and organizing ideas, information, or experiences into new, more complex interpretations and relationships
11 This course emphasized MAKING JUDGEMENTS about the value of information, arguments, or methods such as examining how others gathered and incorporated data and assessing the soundness of their conclusions
12 This course emphasized APPLYING theories and concepts to practical problems or in new situations

SS = Transactional distance between students and students
13 I learned a lot from observing the interactions among the students
14 The students in this online class challenged me to do my best work
15 I get along well with my classmates
16 I feel valued by the class members in this online class
17 My classmates in this online class value my ideas and opinions very highly
18 My classmates respect me in this online class
19 I am good at working with the other students in this online class
20 I feel a sense of kindred spirit with my fellow classmates
21 The class members can be turned to when I need help in the course
22 There are students I can turn to in this online class
23 The class members are supportive of my ability to make my own decisions
SI = Transactional distance between students and interface
24 It is difficult to pay attention to the instructor in the web environment
25 I have adequate access to the web resources I need
26 The fact that I am online does not inhibit my class participation
27 An efficient system is provided for students and instructor to exchange materials
28 I am comfortable using the computer
29 I hate using the web
30 It was easy for me to use the technology involved with this online class
31 The technology used in this course is difficult to learn and use

Appendix II

Revised Scale of Transactional Distance

(with one question omitted from the original scale)

TDST = Transactional distance between students and teacher
Q1. I receive prompt feedback from the instructor on my academic performance
Q2. The instructor was helpful to me
Q3. The instructor can be turned to when I need help in the course

TDSC = Transactional distance between student and content
Q4. This course emphasized SYNTHESIZING and organizing ideas, information, or experiences into new, more complex interpretations and relationships
Q5. This course emphasized MAKING JUDGEMENTS about the value of information, arguments, or methods such as examining how others gathered and incorporated data and assessing the soundness of their conclusions
Q6. This course emphasized APPLYING theories and concepts to practical problems or in new situations

TDSS = Transactional distance between students and students
Q7. I get along well with my classmates
Q8. I feel valued by the class members in this online class
Q9. My classmates in this online class value my ideas and opinions very highly
Q10. My classmates respect me in this online class
Q11. The class members are supportive of my ability to make my own decisions

Appendix III

Survey Results from Revised Scale & Key

	POLE	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
P1	A	3	1	3	3	3	3	1	1	1	1	3
P2	A	2	2	4	2	4	2	2	2	2	2	2
P3	B	1	3	5	1	5	1	3	3	3	3	1
P4	C	2	3	1	2	4	2	4	4	4	4	2
P5	C	3	1	2	3	3	3	5	5	5	5	3
P6	A	4	2	3	4	2	4	4	4	4	4	4
P7	A	5	3	4	5	1	5	3	3	3	3	5
P8	B	4	4	5	4	2	4	2	2	2	2	4
P9	C	3	5	4	3	3	3	1	1	1	1	3
P10	A	2	4	3	2	4	2	2	2	2	2	2
P11	A	1	3	2	1	5	1	3	3	3	3	1
P12	A	2	2	1	2	1	5	1	4	4	4	2
P13	B	3	1	2	3	2	4	2	5	5	5	3
P14	C	4	2	3	4	3	3	3	4	4	4	4
P15	B	5	3	4	5	4	2	4	3	3	3	5
P16	A	4	4	5	4	5	1	5	1	1	2	4
P17	B	3	5	1	3	4	2	4	2	2	1	3
P18	C	2	4	2	2	3	3	3	3	3	2	2
P19	B	3	3	3	1	5	5	3	2	4	3	1
P20	A	4	2	4	2	4	4	4	1	5	4	2
P21	C	5	1	5	3	3	3	5	2	4	5	3
P22	B	4	2	4	2	1	2	4	3	3	4	4
P23	C	3	3	3	3	2	1	3	4	2	3	5
P24	A	2	4	2	4	3	2	2	5	1	1	4
P25	B	1	5	1	5	1	3	5	2	2	2	3
P26	C	2	4	2	4	2	1	4	3	3	3	2
P27	B	3	3	3	3	3	2	3	4	2	1	1
P28	A	4	2	4	2	4	3	2	5	3	2	2
P29	C	5	1	5	1	5	1	1	4	4	3	3
P30	B	4	2	4	2	4	2	2	3	5	4	4
P31	C	3	3	3	3	3	3	3	2	4	5	5
P32	A	2	4	2	4	2	4	4	1	3	4	4
P33	B	1	5	1	5	1	5	1	4	2	3	3
P34	B	2	4	2	4	2	4	2	5	1	2	4
P35	B	3	3	3	3	3	3	3	4	2	1	3
P36	B	4	2	4	2	4	2	4	3	3	2	2
P37	B	5	1	5	1	5	1	5	1	4	3	1
P38	B	4	2	4	2	4	2	4	2	5	4	2
P39	A	3	3	3	3	3	3	3	3	4	5	3

Key

P1 – P39: Participant Responses

Q1-Q11: Participant Questions

POLE : Previous Online Learning Experience

Numerical Responses:

1 – Strongly Disagree

2 - Disagree

3 – Neutral

4 – Agree

5 – Strongly Agree

Alphabetical Responses:

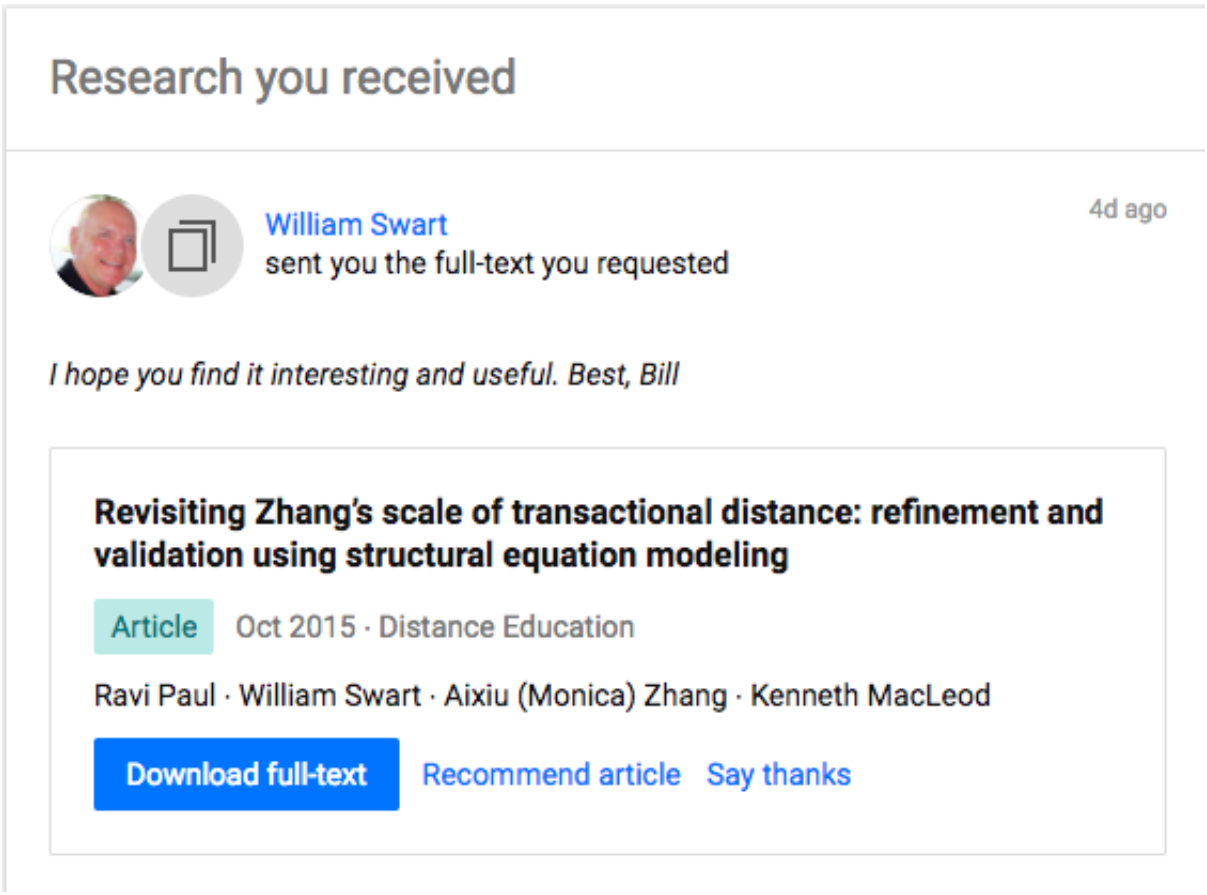
A – 1 to 3 Courses

B – 4 to 7 Courses

C – 8+ Courses

Appendix IV

Permission to Use Revised Scale from Author



Social Structures in Formal Education for the At-risk Preschooler

Japari Ngilari

University of North Texas

Abstract

Having a supporting social structure in early childhood is an important criteria for success in a formal educational setting. This qualitative case study explores a preschool program for at-risk children in a small midwestern city in North America. It is an investigation into the people and relationships that exists in the child's formal and informal learning environments. Findings show that there is a direct relationship with the quality of social support a child receives and the learning outcomes. Being socially disadvantaged can lead to a pedagogical disadvantage; this is discussed in light of its implications for educational reform.

Education has gone from being a privilege to a universally recognized human right.Thus, there is a need for equitable access to education especially for young children. The goal of early childhood education are to enhance cognitive skills, school readiness and social-emotional development (Currie, 2001). The ages of entrance into formal learning environments differ per culture and geographical setting. In North America, the age of entrance into such environments begins with the pre-k class or 'preschoolers' as they are commonly called; this is known as the 3 to 5 year old age group. This age group are mostly transitioning from primary care being provided by the parent/guardian or in a daycare setting to a somewhat structured learning environment. The years spent in preschool prepares them for entry into the kindergarten setting.

Though it is ascertained that formal education is beneficial, there is still an issue of inequitable access to such education. Additionally, where such access becomes available, the learner requires a plethora of resources to thrive within the formal learning environment. Those resources need to exist both within and outside the classroom walls. The resources include basic life necessities; food, shelter and clothing. Beyond that, being of good health (or at least having access to good healthcare), security of life and property are also of top priorities.

At-risk individuals are those who by virtue of contingent situational circumstances are devoid of access to the aforementioned resources that are otherwise commonplace in a civilized society. Children can be categorized as at-risk for a variety of reasons, namely (but not exhaustively); having a physical and/or learning disability, homelessness, poverty, diagnosed emotional or behavioral disorder, unstable family background rife with abuse, incarceration or delinquency and ethnic/language barriers.

Vygotsky, the famed social development theorist in his early work identified more broadly a categorization of the modern day 'at-risk' term. Considering the time period in which his theory was formed is apt as it mimics the current situational scope studied in this paper. According to Daniels (2009), "Vygtosky was charged with developing a state system for the education of 'pedagogically neglected' children in post-revoutionary Russia. This group included the homeless, of which there were a very large number, and those with certain categories of special need." (p. 24). He made a distinction between what he considered primary and secondary disability. The former refers to a biological impairment and the latter is due to social disadvantages. The latter is of interest in this study. Though the term social disadvantage is susceptible to a myriad of meanings and can encompass many of the at-risk factors highlighted above including an ineffective social structure. The social structure refers to the people, relationships and interactions that make up a child's learning environment. Hence, social disadvantage is the causal or correlational factors surrounding a failure to thrive within the preschooler's social structure.

This study explores the social structure that exists in the preschooler's school and home front with emphasis on the disadvantages in that structure that affect learning outcomes. At school, the teachers, assistants and administrators are investigated. On the homefront, the family dynamics are investigated. Though this is not by any means intended to be a conclusive study, it has led to some findings that are consistent with the Vygotskian sociocultural theory. The theoretical antecedents are first elaborated and subsequently, details of the actual study. An expository approach is used to narrate the findings and make informed recommendations for pedagogical practice.

Literature Review

The study of a child's learning and development has been a central theme of discourse in interdisciplinary research about education. It would be amiss to probe a study on early childhood education without reverting to some of the research and pedagogical influencers like Montessori, Dewey, Piaget and Vygotsky. Their works have laid foundations in what is now known about the development of a child socially, culturally and psychologically.

Montessori advocated that knowledge could be developed in children by allowing them to freely interact with their environment through engagement in activities that suited their developmental planes. This trifold approach covers planes of absorption, sensitization and normalization. For the preschooler (aged 3 to 5), it is characterized by the ability to easily soak up environmental information, exhibit a definitive social behavior and a dedicated application to happy work utilizing his or her own constructive energies (Montessori, 1995). This constructivist approach to learning is also shared by Dewey and Piaget; Deweys' being more a point of view or outlook on the world than Piaget's empirically grounded theory. Dewey held that humans were actively involved in the self-mastery of their world rather than being acquiescent reactionaries to their environment, evidenced for instance, in a child's instinctual curiosity. Such he believed should be leveraged in formal education (Dewey, 2013).

However, for established theories in childhood cognitive development, review of literature has traced the origins primarily to the stage theory of cognitive development and the sociocultural theory, by Jean Piaget and Lev Vygotsky respectively. For Piaget and Vygotsky, they both focused on how knowledge develops or is formed in a child, though from different perspectives. Piaget approached his study from the angle of the child acting on the environment,

in what is called a child-centered view of learning. Vygotsky's approach is from the angle of the environment acting on the individual which is known as an other-centered view of child learning.

Piaget believed that there was a connection between scientific knowledge and the psychological development of a child. Though he alluded to such knowledge constituting of sociological, psychological and epistemological elements, his studies dwelled on the latter. He charted development of an individual from a biological perspective (Brown, 1999). His developmental stage theory proposes four stages of cognitive development; the sensorimotor stage, the pre-operational stage, the concrete operational stage and the formal operational stage. The preschooler features on the early spectrum of the pre-operational stage where they have a penchant for pretense and play. This has been of practical benefit in schools as teaching practices are adopted to be cognizant of the abilities associated with a particular stage of development.

Vygotsky's sociocultural theory, which is thought to have been influenced by the lapses in Piagets, argues that innate cognitive development in children is formed in conjunction with social factors. According to Daniels (2009), "Vygotsky was particularly interested in two types of concepts: the scientific and the everyday or spontaneous. By 'scientific concepts', Vygotsky referred to concepts introduced by a teacher in school; spontaneous concepts were those that were acquired by the child outside contexts in which explicit instruction was in place." (p. 29). He presented a reciprocal relationship between the scientific and spontaneous concepts as regards a child's knowledge formation.

Though there has been discourse about the divergence of Piaget's and Vygotsky's theories in earlier interpretations, more recent studies have shown otherwise (Zaretskii, 2009). Piaget and Vygotsky agree on the concept of knowledge evolution, though unlike piaget, Vygotsky's

emphasis was on the cruciality of social interaction in such. It is thought however, in some circles that, Piaget was more aware of the link between individual and social factors in knowledge construction in a child than persistent critiques in literature might lead us to believe. "Piaget believed that knowledge construction was simultaneously social and individual and that these factors could not be separated and one made prior… Piaget differed from Vygotsky in that Vygotsky believed such separation was possible and made the social primary. They also may have differed with respect to what part of knowledge acquisition they held to be dialectical in nature. But all in all, they were very similar" (p. 63, Brown, 1999). They both also feel that learning should be in accordance with the developmental level of the child. And like Montessori and Dewey, recognize the role of play for preschoolers in a formal learning environment. With such a confluence, the premise of this research is that the role of the child by himself as well as subject to the influence of his social structure, are equally instrumental in cognitive development. This is accommodated by a term Vygotsky refers to as the Zone of Proximal Development (ZPD).

Vygotsky (1963) illustrated using the example of two children, of the same age who are at the same level in their actual development. They however solve problems at different levels with one child being able to solve problems of a much higher mental level than the other. This would translate to both children, having different ZPDs. What then is the ZPD? "The range of things children can do with the help of adults or in collaboration with them, the range of these processes, Vygotsky called the "zone of proximal development," distinguishing from the zone of actual development, within which children manage all actions independently". (p. 71, Zaretskii, 2009). If Piaget's work alludes to actual development, then Vygtosky's is proximal development.

Hence, this establishes that; (a) a preschooler can perform much more in formal learning environments active participation from adults in his existing social structure and (b) as mentioned above, there is an interdependence between concepts learned in the classroom and everyday concepts (at home).

Knowing the role the social structure in cognitive development leads to the following research questions, specifically;

For an educationally at-risk preschooler;

- What social structure exists in the school?
- How does the participation of the school structure affect learning outcomes?
- What social structure exists at home?
- How does the participation of the home structure affect learning outcomes?
- What is the relationship between the learning that occurs in school and at home?

Methodology

To investigate the social structure involved in the education of a preschooler from a low-income or otherwise socially disadvantaged environment, a qualitative approach was utilized. This method included non-participant observation and semi-structured interviews. The aim was to probe the everyday interactions that drive the educational choices of all involved stakeholders. The observation sample was purposively selected at the initial stage, from which the interviewee sample emerged.

Participants

The demography of the study is set in a midwestern city in North America with an average income of approximately $40, 000 and a population of about 20, 000 people. In this neighborhood, a non-profit federal and state funded school was selected with two campuses located within the same school district. Both sites were considered in the study.

The population sample observed were 3-5 year old preschoolers who were attending these schools. At each campus, two of such preschool classrooms were selected for observation, making a total of four classrooms. Each of the classrooms had a teacher and assistant present at the time of observations. The ratio of adult to child is one to ten and all classrooms were operating at maximum capacity. Cumulatively, eighty preschoolers were observed. In addition, this was followed by semi-structured interviews with all eight teachers/assistants and the two campus managers.

Data Collection

The data collection process began with prior approval by the school and parental consent to conduct the study in exchange for anonymity and confidentiality. There was an initial walk-through of the site and brief introduction to the interviewees. Two tools were primarily used; observation and interviews. Non-identifying information was collected about all the participants. For the preschoolers, this information includes; age, how long they've been attending the school, reported incidents (from home), history of absences (with reasons if any) and notes from their most recent home visit. For all who were interviewed, information was collected about their; role (teacher or assistant), status (employee, volunteer or intern), duration (how long they have been

working in that capacity) and work hours(how many hours they work per week). The work hours are subdivided into office hours(hours spent on teaching and administrative work) and non-office hours (overtime, uncompensated hours that go beyond what is required).

The observation approach used in this project detailed “thick” descriptions of the school’s environment, field notes and a field journal/diary. The physical environment was noted as well as the student-adult (teacher or assistant) interactions. Each site (classroom) was labelled A, B, C, D. Below is the standard observation master sheet, register and planned schedule used;

Main Site	**Subsite**	**No. students registered**
Campus #1	Class A	
	Class B	
Campus #2	Class C	
	Class D	

Table 1.0: Observation Master Sheet

Subsite: **No. Students Present:** **No. Adults Present:** **Date:** **Time In:** **Time Out:**				
ID	Task	I	A	Notes
#1	Building	needed help fitting two lego blocks	assistant demonstrates with 2 lego pieces	- student completes task - one-on-one help - the student requested for help
Key(s). I (If working independently), A (If working with Adult)				

Table 2.0: Observation Register with example

Weeks 1 -4, Class A-D			
Week 1, Class A			
Day (M/Tu/Wed/Thurs)	Date	Start Time	Completed (Y/N)
Monday		11.00am to 12.00pm	
Tuesday		11.00am to 12.00pm	
Wednesday		11.00am to 12.00pm	
Thursday		11.00am to 12.00pm	
Week 2, Class B			
Monday		11.00am to 12.00pm	
Tuesday		11.00am to 12.00pm	

Table 3.0: Planned Observation Schedule

The Observation Master Sheet in table 1.0 was filled out once at the beginning of the study. There was an Observation Register (table 2.0) for each hour of study in the Planned Observation Schedule (table 3.0). The observations were conducted at the same time everyday for four weeks. Each observation period lasted an hour, just before the children's lunchtime as shown in Table 3.0 above and each week was dedicated to a single class. Four hours of observation per class for all four classes totals sixteen hours of observation.

As a follow-up to each observation, a same day informal interview was conducted with the teacher and the assistant. The questions were open ended and covered; preschoolers performance, at home assignments, activities, interactions and the like. During the lunch time (12.00 - 12.30pm), which follows the observation hour, one adult (teacher or assistant) stayed in charge of the preschoolers as the other adult chatted for thirty minutes. Both adults alternated for the week. These chats or informal conversations occurred usually in a quiet corner within the

classroom, if the classroom was large enough or just outside the door of the classroom while the door was ajar. This was for the interviewee to able to offer help to the working adult, if necessary. By the end of each week, each adult had been interviewed twice, for thirty minutes each time. The interviews were all timed and recorded on a voice recorder. Each interviewee was identified by the file name using the format, day_date_class_role_count. For example, m_0425_a_t_1 means interview was conducted on Monday, April 25th, for the teacher in Classroom A and this is this first interview for the teacher. Role can be 't' or 'a' for teacher or assistant. Count can be '1' or '2' indicating if that is the first or second interview for that adult. By the conclusion of the data collection, each of the eight adults were interviewed for an hour each, totaling eight interview hours.

The final stage of the interview was conducted in a closed office session with each campus manager. This interview was conducted for each Friday, following the Monday to Thursday data collection at their respective campuses. The interview was open-ended to account for as much administrative information they could provide and verify some of the information from the teacher interviews. They usually started out formally before delving into more open ended questions. The administrative interviews totaled four hours, for an hour weekly per the two campus managers.

Data Analysis

Qualitative methods were used to analyze the twenty eight hours worth of data collected.The observations were collected onto excel spreadsheets. The interviews were then transcribed by a professional. The data was imported into the software NVIVO with categories

for each participant and other accompanying resource objects. Though the software provided some analysis, this was to supplement the analysis also carried out by the author. This produced the following narrative expository model that is illustrative of the theme of this study.

Results

Each classroom has twenty children, who usually live within the vicinity of the school. Some children are able to walk from the house to their schools, while others are transported by the school bus. This study did not find any student that had to commute further than the distance covered by the bus. The percentage ratio of male to female students is roughly 50:50. The teachers and teaching assistants were all female, all but one teacher who was male. The administrators were male and female. The classroom was representative of many different ethnicities in roughly equal proportions. 80% of the children will be considered as belonging to Vygotsky's secondary disability class, 10% belong to the primary disability class and the other 10% belong to neither. The preschool operates year round, Monday to Friday except for public holidays and scheduled term breaks. A typical class day begins at 8.00am and ends at 4.00pm. The children are provided with two main meals and a snack each day.

Teacher

The teachers were required to work daily from 7.00am to 5.00pm. However, they reported working even longer hours when extracurricular activities were involved. They were required to set-up class timetable, provide learning material, feed and care for the children. In addition, they also had to grade assignments and turn in reports to the campus managers.

Administrator

The campus managers were responsible for the day to day operations of the school. They had to ensure that resources required for the each school week was available such as meals and stationery. They were also responsible for overseeing that the campus was run to budget, schedule extracurriculars involving parents and liase with sister campus sites.

Parent

The parents were required to drop-off and pick up children from the bus-stop daily. They were to oversee that the child had completed school assignments, were in good health and engaged in the learning activities outside the home. They were also invited to school extracurricular activities e.g the family night on the school campus and required to host two home visits from their preschoolers teacher twice a year.

Discussion

Teaching Practices

Within the classroom the teachers had a fluid interaction with the students. They each knew their students names and often their personalities. On several occasions they were able to tell if a child was acting uncharacteristically. Children that were known for being bold for instance might act withdrawn on one day and the teachers were often good at identifying that. The teachers were found to be responsible for much more than helping children learn however. Their biggest contributions were the time and effort they put in outside the class. This was evidenced in the type of almost maternal relationship shared with their students. A child once

came into school crying and confided to the teacher that her mum was arrested the previous night. Because of the nature of their job, they have to be emotionally involved. This translates into a learning environment of trust and is reflected in class interactions. Children easily asked for help most times. The teacher support was crucial to helping the students complete the tasks.

Administrative Involvement

This program is federally and state funded; as a result, parents do not pay any tuition fees. This also means that the school administration has to run schools within a specific budget. They apply for funding each year and the amount awarded varies from year to year. There is a lot of paperwork involved as reports are prepared weekly and monthly basis. This is required for grant applications. The administrators also have to get involved in child welfare issues outside of the office to help the children stay in school. This ranged from organizing campaigns and recruiting volunteers to scheduling home visits. This showed a commitment to helping the child meet learning outcomes outside of the classroom.

Parental Involvement

Parental involvement where absent, was really absent. Sometimes children came to school hungry and weren't picked up from the bus stop. The parents failed to sign off on health checks or assignments on time. According to the interview information, extracurricular activities designed at the school to involve the parents had low turn-out. Parental involvement was highly valued and positioned to be influential to meeting learning outcomes.

Limitations

A topic of this magnitude will best be served by more field hours and perhaps a mixed methods design. It will also be beneficial to study the homefront of the preschoolers or to obtain information directly from their parents and guardians. This will mediate the bias here, as those parties get to present a first hand account. A tested observation tool and structured interview format will ensure validity of the research and its replicability by others. This will result in more definitive findings, rather than the expository approach here.

Conclusion

The findings in this study that are consistent with other similar studies found in literature (Currie, 2001). An active social structure is necessary for an at risk preschooler to thrive in the formal learning environment. It also holds that there is a direct connection between concepts learned in the classroom and outside the classroom (Daniels, 2009). For the socially disadvantaged, there is a self-pepertuating cycle that does not work well to the child's educational detriment. It is my hope that this study emphasizes primarily the role of the child's social structure in their knowledge development. Having a responsive educational system that employs feedback and conducting long-term studies for at-risk preschoolers will at the very least elicit the information necessary to make the social structure thrive.

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The Design Document for the Instructional Component of

A Custom Data Reporting Software (CDRS)

Japari Ngilari

University of North Texas

Introduction

The design of a custom data reporting software (CDRS) has been commissioned to support the electoral process within a developing community. This software is being designed to aid electoral officers in reporting the success or failure outcomes of the electoral process to a central data warehouse. It can primarily be accessed via the web although an alternative mobile based platform is provided in the case of an inadvertent access to the web based resource. The primary stakeholders are the national body responsible for conducting elections into public offices, the Independent National Electoral Commission (INEC) and external consultants providing advisory/support services, the International Foundation for Electoral Systems (IFES).

To ensure a hitch-free electoral run, supervising bodies have also asked for the training of their electoral staff to use the CDRS. This training will be conducted on a beta version of the software and is the focus of this instructional design document.

Instructional Design Considerations

Because the CDRS is going to be deployed nationally, there are certain ethical considerations that must be employed in the instructional design. It is important that learners are not taught to any great detail how to debug the software in a case where it crashes. Learners must also honor privacy concerns of the electoral public by keeping confidential whatever information is made accessible to them. Although these seem like concerns solely for the software developers, ethics will be a built in module in this training.

An envisioned constraint includes the typical bureaucracy that results from working with a national body which will require balancing sometimes conflicting stakeholder interests. Because the software the users are being trained for is currently in development, there is the likelihood, that this instructional document will be revised many times before the training is conducted. It also means that pace of the instructional design is dictated by the software development timeline.

Goals and Objectives

Due to the nature of this project, the instructional goals are multifaceted. The primary focus is of course the learners who need to demonstrate their ability to use the beta CDRS on a typical election day. However, the instructor is also implicitly compelled to deliver on performance (time, scope and budget). The supervising stakeholders are also interested in the quality of this demo training to enhance the final (non-beta version) of the CDRS and future trainings that will be rolled out en masse. Based on these, the goals are surmised below;

Goal 1.0 : Demonstrate prerequisite technological (hardware) proficiency

Objectives:

1.1. The learner should be able to set up the provided hardware

1.2. The learner should be able to troubleshoot the provided hardware

Goal 2.0: Demonstrate prerequisite technological (software) proficiency

Objectives:

2.1. The learner should be able to set up the provided software

2.2. The learner should be able to troubleshoot the provided software

Goal 3.0: Demonstrate contextual technological (hardware and software) proficiency

Objectives:

3.1. The learner should be able to use the beta CDRS to report the step-wise success/ failure outcome of the electoral process.

3.2. The learner should be able to use the beta CDRS to report the overall success or failure outcome of the electoral process.

3.3. The learner should show that they will ethically use the software, hardware and data encountered in this process.

Goal 4.0: Achieve performance proficiency

Objectives:

4.1. The instructor should be able to fit the training into the mandated 40 hours

4.2. The instructor should be able to cover all aspects of using the beta CDRS

4.3. The instructor should utilize only the available technology and resources provided

Goal 5.0: Achieve quality proficiency

Objectives:

3.1. The learner should be able to provide constructive feedback on the beta CDRS

3.2. The instructor should be able to provide constructive feedback on the beta CDRS

Scope

The referred to unit of instruction is for a training that will be given to the electoral officers who have never used the beta CDRS before. The mandated hours of instruction must not exceed 40 hours which is equivalent to a full-time work week. All of the technology and resources required for the training will be provided by the INEC and the IFES. The scope here is restricted to the initial training that will be rolled out to a group of 12 electoral officers in a laboratory setting. At the end of the training they should generally be able to demonstrate that they can use the beta CDRS software on the election day to monitor the electoral process

Learner Profile

There is a regional requirement for all students in the respective country to complete a year of civic duty training on the completion of a post-secondary degree before they can work for the government and most private institutions. This scheme is called the National Youth Service Corps (NYSC). Each year, three cycles of the scheme is conducted. Those currently active in the scheme are referred to as corpers and receive a certificate upon successful completion. The electoral officers are recruited from this active pool of corpers only. As such the learner demographic for this unit of instruction is expected to fall between 18 to 35 years of age. They represent varied academic, cultural and technical backgrounds. Though it is likely that some are technically proficient, especially those from private universities, majority will be lacking in the technical skills to use the CDRS. As a result, the instruction will target this latter majority as its audience.

Instructional Design Process

The instructional design methodology for designing the entire unit of instruction is based on the ADDIE model which covers analysis, design, development, implementation and evaluation of the instructional design document(s). Specifically for the purpose of this unit, the modified PADDIE+M model is applied to include the Planning and Maintenance stages. This is because the instructional component is for a software that is still in development. It is adequate to have a separate planning stage to accommodate correspondence with team stakeholders as to how to effectively and efficiently conduct both the software development and instructional design process concurrently. The maintenance is required for future iterations of the instructional training that will be conducted to reflect the most up to date software version at the end of beta testing.

Instructional Approach

The training will be conducted in a face-to-face, instructor to learner laboratory type setting. The instructor has a stationary central setup, with a laptop and powerpoint project displaying the instructor's screen. Each learner has a personal mobile work station with all of the technology required for the training. The instructional approach used will employ a combination of direct instruction, demonstration, learning center and role play.

Direct Instruction

Each lesson will be introduced by means of direct instruction. The instructor discusses the theoretical aspects of the lesson, explaining some of the foundational knowledge required.

Demonstration

This usually follows or supplements the direct instruction if there is a hands-on skill that the learners need to acquire. It could be demonstrated virtually or physically. The step-by-step process is demonstrated on the screen as the instructor completes the task to the viewing of the learners. For the physical exercise, the learners gather round the instructor's station to watch the demonstration and interact or ask questions.

Learning Centers

Each demonstration by the instructor requires a replication by the learners. The learning centers are the mobile work stations where learners work independently on the demonstrated task. The instructor moves away from his/her stationary central station at this point and transitions between learning centers to supervise the completion of the tasks. The idea is for the learner to first watch how the task is conducted by the instructor and then perform it on their own. The demonstration-replication process is piecemeal, as the lesson moves from one task to another.

Role Play

This is a key conclusion to each lesson as the students work in random pairs. The instructor issues a problem scenario that covers concepts learned in the current lesson. This scenario is one that is likely to occur on an election day. The pair works on a plan to address the scenario. Each learner takes a turn at the workstation with the team mate playing a supporting role, as they unveil their act to the critique of the instructor.

Instructional Approach Rationale

The instructional rationale employed is based on the principle of constructivism through the Knowledge as Tools and Situated Cognition theories. Because the of the learner profile and kind of training this instruction targets, the most suitable approach is learning by doing; doing being a direct implication of *knowing* how, what, when and how to do or undo. This comes from knowledge as tools theory which proposes that the functions of a tool are best understood within the context of its use. Additionally, this learning by doing must occur in an environment that is as authentic as possible as advocated by theory of situated cognition. Therefore, this unit of instruction employs Goal Based Scenario model which is traditionally associated with the aforementioned theories.

[*Task] go*als are integral to every aspect of human behavior (Schank, 1993). The use of word 'goals' here might cause some ambiguity but it it is important to note that "the *instructional* goals are distinct from the *task* goals (called the *mission*) which are set within some activity (called the *context*)" (Naidu et al., 2000). The learning by doing approach identifies tasks, goals for each task, and the activity or context in which that goal can be met. Within the scope of this project, this favors the adoption of a Goal Based Scenario (GBS) Model. "The intent of a GBS is to provide motivation, a sense of accomplishment, a support system and a focus on skills…" (p. 453, Schank, 1993)

The idea of goal based scenarios is that learners are able to do research, role-play and collaborate in order to achieve the learning outcomes (Naidu, Ip, & Linser, 2000). The design architecture is therefore made up of setting goals, role-playing, online web-based communication/collaboration and lectures/tutorials. Goals are recognized to be both intrinsically

and extrinsically motivating for the learners. Role-playing allows the learners to act on predefined responsibilities mimicking what they would encounter in the real world. It doesn't matter if it is simulated in situ or virtually. The web acts as a support framework to make other additional resources available to both the students and lecturer. This will be supported by leveraging the traditional face to face lectures and tutorials. GBS necessitates the need for an instructor to be physically present, which in this project's environment is critical, at least initially, because the learner demographic are assumed to be lacking in technological skills, access to technology and have no experience in particular with this software being deployed. The instructors presence will provide a real time communication framework favored by cognitive apprenticeship.

According to Schank (1993), a fear of failure in learning begins to precipitate at about age 6, which is when the natural goals associated with learning (which is learning for learning sake or learning to know) are then replaced by superficial goals like getting good grades or pleasing instructors. This is why it is important to incorporate the GBS principle of creating an environment that allows the learner to fail safely (Naidu et al., 2000). This means that the learners will experience more freedom in learning which is especially important for the novice technology learners in this project.

Learning-by-doing can be dangerous, expensive and fail to provide relevant cases (Schank,1993). This danger can be in form of physical harm to themselves or the environment. In this project, precautions will be taken to simulate as much of the learning as possible before the election day. If required, a retraining will be conducted periodically until a satisfactory outcome is met. The otherwise adverse effect of this is causing critical errors or reports to be

issued during a real election, which is unacceptable. The time and cost expenses of the GBS however cannot be averted without compromising on the quality of the training. Finally, it is plausible that no relevant information will be obtained from demo settings that can be used as cases in future iterations of the instruction. The following then surmises the justification for this training; “The goal of effective training must be to simulate as well as possible the total experience an employee needs in as intense, danger-free, inexpensive, and timely fashion as possible” (p. 436, Schank, 1993)

Learning Resources and Activities

The following shows the resources that will be provided for and after the training.

Learning Resources

The learning resources that will be available to the learners during the training are;

- A Laptop
- A Wi-fi modem with internet connection
- A mobile phone
- All hardware manuals
- Instructional material from the instructor
- Charging Outlets

Some learning resources that will be available to the learners outside the live training are;

- The CDRS user guide from the software development team
- A recorded instructional video of the instructor going through the training
- A help menu integrated into the CDRS that describes how to perform basic functions

Learning Activities

Based on the background information presented about this training, the table 1.0 below shows a mapping of the learning objectives to the learning activities for the learner. It addresses Goals 1. 0 to 3.0, Objectives 1.1 to 3.1 from the Goals and Objectives Section.

Learning Objectives	Learning Activities
1.1. The learner should be able to set up the provided hardware	a) Ensuring the devices are charged and/or plugged to suitable power outlet b) Starting up the devices c) Connecting to the devices to the internet d) Connecting multiple devices together e) Shutting down the devices appropriately
1.2. The learner should be able to troubleshoot the provided hardware	a) Resetting the modem b) Resetting the mobile phone c) Resetting the laptop
2.1. The learner should be able to set up the provided software	a) Updating the modem, mobile and laptop operating system versions to the most recent b) Installing the beta CDRS from various sources(CD ROM, USB drive, internet) c) Running the CDRS program
2.2. The learner should be able to troubleshoot the provided software	a) Backing up data on the CDRS b) Repairing or resetting the CDRS c) Reporting a software error d) Using the CDRS help menu
3.1 The learner should be able to use the beta CDRS to report the step-wise success or failure outcome of the electoral process.	a) Identifying each step in a typical electoral process b) Entering success outcome in the CDRS if criteria for each step has been met c) Entering failure outcome in CDRS with justification
3.2. The learner should be able to use the beta CDRS to report the overall success or failure outcome of the electoral process.	a) Submitting a form addressing the overall outcome at the end of the electoral process
3.3. The learner should show that they will ethically use the software, hardware and data encountered in this process.	a) Reading and consenting to an Ethical License Software Agreement b) Submitting personal login information to indicate consent

Table 1.0: Learning Objective to Activity Mapping

Objectives 4.2 and 4.3 of Goal 4.0 are indirectly addressed by the creation of table 1.0 which ensures that learning activities make use of only learning resources provided by the INEC and the IFES. There is no requirement for the learners to acquire supplementary material. The learning activities column also addresses all the functionalities available in the beta CDRS. Objective 4.1 (Goal 4.0) which covers instructional hours has been elaborated upon in table 2.0.

Lesson Day	Lesson Time	Learning Objectives	Instructional Hours	
Monday	8.30am - 9.30am	1.1	Direct Instruction	1 Hour(s)
	9.30am - 10.30am		Demonstration	1 Hour(s)
	10.30am - 11.30am		Learning Center	1 Hour(s)
	11.30am - 12.30pm		Role Play	1 Hour(s)
	1.30pm - 2.30pm	1.2	Direct Instruction	1 Hour(s)
	2.30pm - 3.30pm		Demonstration	1 Hour(s)
	3.30pm - 4.30pm		Learning Center	1 Hour(s)
	4.30pm - 5.30pm		Role Play	1 Hour(s)
Tuesday	8.30am - 12.30pm	2.1	Direct Instruction	1 Hour(s)
	9.30am - 10.30am		Demonstration	1 Hour(s)
	10.30am - 11.30am		Learning Center	1 Hour(s)
	11.30am - 12.30pm		Role Play	1 Hour(s)
	1.30pm - 5.30pm	2.2	Direct Instruction	1 Hour(s)
	2.30pm - 3.30pm		Demonstration	1 Hour(s)
	3.30pm - 4.30pm		Learning Center	1 Hour(s)
	4.30pm - 5.30pm		Role Play	1 Hour(s)
Wednesday	8.30am - 10.30am	3.1	Direct Instruction	2 Hour(s)
	10.30am - 12.30pm		Demonstration	2 Hour(s)
	1.30pm - 3.30pm		Learning Center	2 Hour(s)
	3.30pm - 5.30pm		Role Play	2 Hour(s)

Lesson Day	Lesson Time	Learning Objectives	Instructional Hours	
Thursday	8.30am - 10.30am	3.2	Direct Instruction	2 Hour(s)
	10.30am - 12.30pm		Demonstration	2 Hour(s)
	1.30pm - 3.30pm		Learning Center	2 Hour(s)
	3.30pm - 5.30pm		Role Play	2 Hour(s)
Friday	8.30am - 10.30am	3.3	Direct Instruction	2 Hour(s)
	10.30am - 12.30pm		Demonstration	2 Hour(s)
	1.30pm - 3.30pm		Learning Center	2 Hour(s)
	3.30pm - 5.30pm		Role Play	2 Hour(s)
Total				40 Hours

Table 2.0 Learning Objectives to Instructional Hours Mapping

Assessment and Evaluation

Formative Assessment

Formative assessments will be based on the learning center and role play tasks issued by the instructor. Each learning center task is directly mapped to a learning activity from table 1.0. A learning center task is assessed by completing the associated learning activity and receiving a direct verbal feedback from the instructor. Each role play task is directly mapped to a learning objective. A pair of students complete a scenario issued by the instructor. A role play task will require the learner to be an actor (working directly with the software or hardware technology) and a supporting actor. A grade of a Pass (P) or Do-Over-Until-Pass(DP) is assigned to the learner's role as an actor. To receive a P grade for a role play task, the actor role must be completed successfully on the first or second trial of the task. A DP is awarded otherwise. To qualify for the final examination (summative assessment) at the end of the instruction, the learner

needs to have a P grade in at least 50% of the formative assessments. Otherwise a retraining is recommended.

Summative Assessment

Summative assessment will be by the means of a final demonstration project in a one-one setting with the instructor. In this project, an entire simulation of an election day electoral process will be carried out between the learner and someone else acting as a voter. The voter will act according to a script provided by the instructor but unknown to the learner. The learner will be graded on their ability to complete each task successfully and within the set time frame. Their summative performance will dictate whether they need to be retrained or selected for the real elections. Their selection for the real elections is score based, priority is given to those with the higher percentages.

The grading scale is as thus;

- 0 - 33% : Learner requires retraining and does not demonstrate a real grasp of the CDRS
- 34 - 67% : Learner is somewhat comfortable with the CDRS but is advised to retake the summative assessment at a later date for a better score.
- 68 - 100% : Learner is a good choice for election day use of the CDRS.

Evaluation

The evaluation addresses Goal 5.0 (Objectives 5.1 and 5.2). At the end of the training, the instructor and the learner complete respective surveys on the quality of the beta CDRS based on questions prepared by the software development team.

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Japari Ngilari

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LTEC 6240 – Artificial Intelligence Applications

Common Sense in Artificially Intelligent Applications: The Culture of Technological Silence

Abstract

Artificial Intelligence (AI) is fast growing domain that is gaining momentum for its applications in contemporary society. An essential component of AI is the extent to which it each it is able to typify what is often thought of as abilities peculiar to humankind. To this extent, common sense becomes an important criterion if that representation is to be true to reality. This paper presents a working definition of common sense, in both the lay and scientific sense. It follows on to establish the role of common sense in AI applications with explicit focus on cultural implications. A detailed proposal of hypothetical AI application, *Silence Of The Apps (SOTA)*, that focuses on the culture of technological silence in classroom settings surmises the discussions.

Keywords: artificial intelligence, common sense, educational technology, culture

Towards a Working Definition of Common Sense

The basis for what constitutes common sense amongst a group often differs for a variety of reasons. These differences could stem from the individual e.g. age and experience, or outwardly from the individual's environment. For instance, what may be expected as common sense for a three-year-old is vastly different than that of a thirty-three-year-old. If common sense were quantifiable, the adult here will be said to be in possession of more of it than the child, *ceteris paribus.* And even for adults of the same age group, there could be marked differences in the quality of their experiences that could affect the type of knowledge they consider to be common sense. Thus, one person's compendium of knowledge cannot be said to be exactly equivalent to another. It also cannot be said to be exhaustive, comprehensive or representative of all human common sense (Geanakoplos, 1992).

In lay terms, common sense is the ability to express sound judgment about situations and present a consequential course of action. However, there is a perceived difference between this understanding of common sense and that which has come to be accepted in Artificial Intelligence (AI) literature (Anacleto, Lieberman, Tsutsumi, Neris, Carvalho, Espinosa, Godoi, & Zem-Mascarenhas, 2006). According to McCarthy (1989), also known as the father of Artificial Intelligence; "common-sense knowledge includes the basic facts about events (including actions) and their effects, facts about knowledge and how it is obtained, facts about beliefs and desires" (pp 1). This includes but is not limited to; public events, facts about human nature and observed habitual human behavior (Geanakoplos, 1992).

These events, facts and behaviors have underpinnings that are not immediately apparent. Considerations such as the frame of reference, innate bias and motivation from which the common sense is generated are undecidedly ambiguous (Geanakoplos, 1992). This

posits a limitation for AI which seeks to transmit such common sense onto machines. To make this transmission plausible, a formalization of the scope and process is required;

- scope: common sense of a group of people is quite vast and as Geanakoplos (1992) puts it, is "a potentially infinite chain of reasoning about knowledge" (pp 255).
- process: this reasoning also extends beyond the self, such that "an AI system will have to reason about what it and others can and cannot do." (pp 13, McCarthy, 1989)

A reductionist approach is adopted in this formalization. Firstly, it is impossible to map out an infinite scope of human common sense. So, the scope of the AI system or application must be bounded. And secondly, there is a great deal of agency in the process by which humans express common sense. Some of this must also be conceded in AI applications, in favor of exact probabilities. The goal of AI is more modest in this light, it becomes to exhibit in applications the *'intelligence'*, not banality of human common sense. The result is artificially intelligent applications that are derivative of approximations of reality or as McCarthy (1989) puts it; approximate partial theories.

Application of Common Sense Knowledge in AI

One aspect of human reality of interest here is the environment. Humans acquire common sense through their daily interactions with their environment (Anacleto, Lieberman, Tsutsumi, Neris, Carvalho, Espinosa, Godoi, & Zem-Mascarenhas, 2006). "In different situations, different kinds of events are common knowledge, and with different consequences" (pp 256, Geanakoplos, 1992). As previously mentioned, what is considered common sense then will differ from community to community. Such common sense, Geertz (1975) argues, is a cultural system in and of itself. Culture here is taken to mean an organized communal experience. Since AI is also largely experiential, it would be made even more useful by incorporating common sense aspects of culture. Anacleto et al.(2006) outlines a three-fold approach for doing this. They are:

Developing Systems Considering Cultural differences

This means that from the onset, the role of culture (e.g., symbols and colors) in the development process of AI applications should be considered. In China, for instance, it is common knowledge that red is a sacred color. It will be inappropriate to trivially use this color in an interface. Generally, creating AI applications that reflect peculiar cultural norms improves its appeal and usability of the interfaces to its intended group of users.

Developing Systems Which Consider Cultural Differences

Further, when the applications are deployed, preferences should become more personalized with increased utilization. This will improve the quality of engagement with the user; he/she will have a sense that application '*understands'* him/her. Some aspects of this have been implemented in web-based applications which customize the information presented to the user by location. For instance, some international news sites use the visitors' IP address to display regional headlines first, on their home pages.

Developing systems which facilitate communication between people showing cultural differences

In addition to the above, the third dimension of interaction between cultures requires exploration in AI. For AI applications in multicultural contexts, one must factor how people of the different cultures will interact with the same application. One example of such in action, is having a translation button on a web page that allows users to viewers to switch between different languages. Singh (2002) agrees that "diversity is the secret to success. It is not so much a matter of choosing between such representations as it is a matter of finding way for them to work together in one system "(pp 5-6).

Application Proposal for Silence Of The Apps (SOTA)

It is not uncommon to find various forms of technology at use in classroom settings. This is often in the form of mobile phones, tablets and personal laptops. As much as they

could be beneficial and even required in some classes, they have the tendency to be a distraction. A study of a real-time classroom in a university setting by Wood, Zivcakova, Gentile, Archer, De Pasquale, and Nosko (2012) found the group of students with access to web-enabled devices to be very likely to engage in off-task activities involving social media and instant messaging. This group when compared to the control group which had no access to any form of technology, consistently underperformed. The consensus here is that technological distractions are detrimental to learning. In classes where technology is not required, the instructor is at liberty to ban them. But even the ban has its limits. It could apply to larger devices like laptops or tablets; however, a more ubiquitous general-purpose device like a mobile phone might pose a challenge.

Campbell (2006) notes that a primary problem of mobile phones in the classroom shared by both instructor and students alike is the incessant ringing. Consider that it may take several seconds for the student to find the phone if it is lodged away in a bag/backpack. It may take even more time to unlock the phone if it requires an access code and then finally reject the call. Having this happen to a handful of students is one class session is highly probable, even from first-hand experience. This presents the basis for the proposed application. SOTA for smartphones will be intelligently aware without being prompted by the student that class is in session and it will set the phone on silent for the duration of the class. When the class is over, it returns the phone to the default sound state. This is consistent with the of classroom culture technological silence necessary for optimal learning.

Features of SOTA Application

This section details the SOTA application and its' implementation.

Source

This application will be downloadable via a webpage. The user can select the model of his/her mobile phone in the list of options available and click the download button. If the

user does not know this information, an *'I don't know'* option is available which automatically detects the Operating System (OS) of the user's phone. This step is necessary to ensure that the application is specifically suited for each device. Next, the user can agree to the terms and conditions, then click the download button to download. The terms and conditions will reveal the kind of user data that will be accessed for the application to work properly.

Installation

When the download is complete, the user will be shown a simple welcome screen where he/she can choose a calendar option to be used with the application. The calendar should contain information about the student's classes, such as exact location and time. The options available are either the phone's own calendar or a synced external calendar such as Google/Outlook. If the user selects the latter, the application will require a user name and password that is required to access that calendar. If the user selects the phone's own calendar, he/she will need to allow the application access from the phone's settings. Once this step is completed correctly, the application automatically syncs with the chosen calendar.

Features

To use the application, it should be launched from the phone dashboard. A simple large button will be displayed in the middle of the SOTA home screen if the previous steps have been completed. The click of this button activates the 'on' or 'off' states indicated by a green or red color respectively. In the 'on' state, the application will automatically set the phone on silent for the duration of the events that have been preset on the calendar. In the off state, the phone will remain in its default sound state.

Example

For a student A, who has a class from 8:00am to 10:00am every Monday, this event should already be set in the selected calendar. This application will put the phone on silent

every Monday at 8am; no additional prompt from the student is necessary. Once it is 10am, the sound on the phone returns to default state. There is also no limit on the number of events allowed. As far as an event is preset in the calendar, the application uses the start time of the event to transition the phone into silent mode and the end time to transitions it out of that silent mode. This is especially usefully for students who are constantly on the move, from classes to labs, seminars, workshops etc.

Conclusion

In this paper, a view of common sense in artificial intelligence is presented with respect to AI applications being cognizant of culture. A proposed educational technology application, SOTA, imbibes this by addressing the culture of technological silence required in a classroom setting. SOTA uses time as a measure of awareness of the student's environment. This addresses McCarthy's (1989) primary AI concern that "for concreteness,… a robot ***[phone application]***… must act in the same world as people and perform tasks that people give it" (pp 13).

There is a second, more potent concern, chiefly, as it pertains common sense; "What view shall we build into the robot ***[phone application]*** about its own abilities, i.e. how shall we make it reason about what it can and cannot do?" (McCarthy, 1989). SOTA can be made more intelligent by utilizing the phone's GPS location services as thus;

- SOTA will transition the phone into silence only if the phone's current time and location is the same as the preset event's time and location.
- SOTA will use the current location of the phone to calculate the travel time to the classroom. If the above student A is 40 minutes away, SOTA will automatically notify the student at 7.20am for an Estimated Time of Arrival (ETA) in class of 8.00am. This ETA is always adjusted based on proximity to the class and other user specified preferences.

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Task Three: Analysis of an Educational Macro-system Using Banathy's Motion-Picture Model

LTEC 6250: Educational Systems Theory, Analysis and Planning

Japari Ngilari

Department of Learning Technologies

University of North Texas

Abstract

This paper details the analysis of an educational macro-system as a follow-up to a prior analysis of its associated sub-components; the meso-system and micro-system. It employs the use of the process lens: the motion-picture model to analyze a school district in subsaharan Africa with specific emphasis on K-12 education. First, there is a background detailing the geopolitical nature of the country as it contextualizes the actual macro-system. Next, specific details of the system is discussed. This is succeeded by an analysis using the motion-picture framework, as the system goes through a mandated policy implementation. Three models are generated based on the subject of the system, the input, transformation and output models. It concludes with a discussion based on an evidence-based evaluation of the system.

Introduction

The series of analysis up till this point began with a preschooler known as Jack Doe (JD), who was the microsystem using the systems model (Ngilari, 2016a). In the follow up to that, there was a functions-process model examination of his meso-system which was defined to be his immediate learning environments, limited to the formal setting (school) and informal setting (home). The key actors in that environment were the parent, babysitter, classroom teacher and best friend (Ngilari, 2016b). Herein lies the concluding part of the series which employs Banathys motion-picture lens to examine the macro-system. The macro-system is the school district in which JDs preschool is located, consisting of several schools, offices, places of worship, business centers and families. The focus here is on the educationally affiliated institutions.

Background

This gives more insight on the general geopolitical environment in which this macro-system exists, and provides a canvas on which to subsequently paint the specific picture of the key system entity in the macro-system.

Nigeria is located in West africa and a very populous country. It has 36 states and the federal capital territory. It is a combination of urban and rural areas, with the latter outweighing the former. Physically, it is composed of many of african descent. There aren't many racially diverse groups, though intertribal tensions can run high among some classes of people. Because there are so many tribes (250+), there has been a federal law enacted referred to as the 'Federal Character Code' (FCC) that encourages fair ethnic representation especially of minority groups

in all public spheres (government, civil service, educational institutions, military and so on). As it applies to educational institutions, specifically public schools are required to be FCC compliant (Afigbo, 1989). They implement this using a quota system that enables prospective students to be considered on the basis of their demographic background (including ethnicity and gender).

Nigeria was colonized by the British Empire and gained its independence in 1960. This is noteworthy because the colonial influence still holds in the field of education especially (Fafunwa, 1991). Some of the oldest and most prestigious schools in the country are those established by the British. English is the lingua franca. Outside of that, there are three primary languagees (Igbo, Hausa and Yoruba). Though these languages aren't used in official communiqué, they are required to be taught in public schools starting at the elementary stages. Each student must study one (Davis & Kalu-Nwiwu, 2001). Preschools where available are exempt. More recently, there has been effort to introduce foreign languages as well, specifically French and Arabic. Though the latter has been controversial because of the perceived idea of religious motives or undertones (Sirajudeen & Adebisi, 2012).

In general, it is safe to say that Nigeria is a pretty religious country; though there are few millennials that are comfortable identifying publicly as atheists and agnostic (Hackett, 2011). The latter point is made for a few reasons; it is simply expected that one must have a mode of worship and religion is considered demographic information. The three main religions practiced are; Christianity and Islam (which are the most dominant and have actually equal representation), and Traditional religion which is the minority and mostly practiced in rural areas (Hackett, 1988). Religion like the aforementioned factors has its impact on education as well; christian religious and islamic religious studies are required subjects in all public schools. They are

examined in the national Secondary School Certificate Examinations (which in the United States is the equivalent of a high school diploma). All students must identify as one of the two. It is also common to see religious institutions having their own particular private schools, as it is the current trend. This could debatably be traced back to the pre-independence era in which some of the British christian missionaries were thought to have made establishing schools a priority (Fafunwa, 1991; Hackett, 1988; Hackett, 2011). Since their route was from the southern part of the country towards the north, that might also account for the general marked higher concentration of schools in the former as opposed to the latter.

Though subcultures have their own eschewed norms, there are ties that cut across the board. Respect for instance is vocally advocated; respect for the elderly especially. There are gender-related connotations as well; women are expected to be submissive to men. The educational ties associated with this are salient (Nduka, 1964). It is considered for instance, unsightly for a younger party to challenge an older party in intellectual discourse even if the younger is factually right. This has been carried over into classrooms as well; students hesitate to call out a teacher or question authority, even in the case of unethical conduct. It makes classrooms in public schools a predominantly instructor-centered environment, with almost a dictatorial flavor to it. Gender-wise, males are purported to be intellectually superior to females; sometimes outrightly so (Obasi, 1997). In the exams written to get into high school from elementary, or university from high school, it is not uncommon to see gender-based cut-off marks. The cutoff marks for males are usually higher than for the females . Also, the Nigerian senate recently rejected a gender equality bill (covering aspects of education and equal pay for women); which lends credence to the following point on government influence (Payton, 2016).

There are two primary political parties which do not necessarily have distinct ideologies; it is not uncommon to see a contestant move from one party to the other several times in his/her political career. Nevertheless, this seamlessness of transition devoid of personal consequences does not translate into public policy formulation. A change in government comes with an overhaul of the previous governments policies, programs, key appointments and any existing frameworks. Because a typical tenure is four years, this radical change exhibits a chameleon-like effect on education in a variety of ways (Fafunwa, 1991; Nduka, 1964). Top education stakeholders may shift attention from regular operations to trying to get in good with the new government. The already limited resources are spent unnecessarily to fix what isn't broken. Additionally, four years is too short a time to observe any notable impact of already implemented programs. This focus on short-term rather than long-term educational goals is not in the interest of a typical student who would be spending at least 16 years in pursuit of formal education.

Context

The macro-system has inherited traits of the larger geopolitical environment in which it is situated but has a few peculiarities of its own that makes a marked contrast against the bigger picture. District 234 is a school district unit that serves the 1.2 million inhabitants of the capital city of Nigeria. This represents 1% or less of the country's population (National Population Commission, 2007). There are 12 schools in this district, 3 public schools and 9 private schools to meet the education needs of the community from preschool through to high school. Within this system, schools are classified as either comprehensive or non-comprehensive. The comprehensive term means that a school has provisions from preschool all the way to high

school. This is typical of all public schools in the country and is also the case in District 234. Private schools however, can serve a particular grade set if they choose; preschool, kindergarten, primary or secondary school only. Of the 9 private schools in the district, none are comprehensive; 7 serve preschool through to elementary and the other 2 are boarding secondary schools.

This district has the lowest school to person ratio compared to other parts of the country. The standards of living here are also the highest, possibly associated with it being the seat of the government. The private schools in this area are quite technologically advanced, with some providing wireless connectivity on school grounds and tablets to each student. These luxuries also come with a high price tag; the basic tuition for a preschooler starts at a rate equivalent to three times the tuition of a public high school student. Private schools in general are exempt from some of the policies mandatory for public school regarding being FCC compliant and have more independence in operations since they do not collect government funding (Afigbo, 1989).

Analysis

This section introduces the process lens: motion-picture model by Banathy(1992) and applies it to examine District 234 as it undergoes the implementation a national policy. The process lens is another tool used to analyze educational systems that promises to be more extensive than the systems-environment model and functions-structure model. While the others are particularly adequate for capturing a static system, essentially the snapshot of a system at a particular point in time; the process lens employed here will capture the drama of human interactions inherent with educational activity systems (Banathy, 1992). To mitigate the

overwhelm of analyzing a dynamic system, Banathy(1992) advocates specificity as thus: "… within the class of educational systems, we can consider a specific operational system of education in a specific functional context" (p.104). On that note the focus of the analysis is narrowed to a singular function.

In 2016, the Nigerian government and educational regulatory bodies put forward a directive that requires all students from elementary through to high school to compulsorily study French; tertiary students are exempt. This is in line with its aim of making French the official second language to increase the country's global economic prospects; especially in international trade with African francophone countries and their European allies (Omoniyi, 2003). Up until this point, French was offered only as an elective in schools. This directive is examined here with the potential implications it has in District 234 and by extension the entire educational landscape of the country in its imminent enactment. The choice of the process-lens is vital for this as it captures the complex interactions that may occur between the different sub-systems in the district (Banathy, 1992).

The following analysis of the macro-system begins by selecting the main entity which will be subject of the system. Using the model provided by Banathy(1992), there are three components to the analysis; input, transformation and output.

Input

The first step is to identify the interactions in this system and select those applicable to the French Language Adoption (FLA) policy. The result implies that communication in this district is mostly top-down and outside-in. What this means is that the influence is greatest from

the parties above and outside of the district in the national organizational hierarchy. According to Banathy(1992); “Depending on the nature of the input and the means of assessment available, a judgment of value (to the system) can be qualitative and quantitative… information input that represents systems-relevant environmental changes is qualitatively valued…Resource inputs, such as financing are quantifiable. The outcome of the identification process is a designation of systems-relevant input.” (p. 109). As it applies to the inputs for the FLA policy, they are by and large qualitatively geopolitical (and apply just as described in the *background* section).

Transformation

The transformation stage is a series of operations that will take all of the geopolitical input into the district and channel them into getting schools within to comply with FLA. This will involve production (identifying the operations), facilitation (applying the operational strategy) and guidance (gauging the strategy’s effectiveness). The district has decided to conduct awareness meetings with all school heads explaining what the FLA is and how it will affect them. It has then provided an adoption timeline to be followed. The motivational strategy here is implied to be extrinsic. Banathy(1992) states that; “this kind of motivation works in coercionive systems in which compliance is expected, where the vision is espoused from the top down, expecting people to “buy-into” it or at least accept it.” (p. 151). The follow-up entails periodical audits to each of the participating schools through out the year.

Output

This covers the tangible deliverables (output) of FLA as well as the intangible deliverables (outcomes). The output is recorded as thus; termly test scores of all students in the French classes and compulsory enrollment in the SSCE exams. The outcome is having professionally fluent bilingual students (in English and French) at tertiary institutions, although there isn't a clear mechanism on how this will be measured as of yet or how it connects to the overall economic goal of making French the second official language.

Discussion

The model in figure 1.0 (see Appendix) shows the current FLA model process with the overall goal of making French the second official language. This model visually depicts some of the current weaknesses of the macro-system background and the context in which it functions. First, the inputs in the model flow from the top to the bottom, showing that the decisions are made from the qualitative assessment of geopolitical influences. This tendency towards imposition has consequences on the transformation process; rather than having willing compliance from within the district, push back should be expected. This is due to the key stakeholders within the district feeling excluded from the decision making process. Additionally, there is no correlation between the direct outputs and the intended outcome of this process.

To remedy this, an improved model is proposed where there is a balance of inputs into the system. The qualitative geopolitical inputs should be supplemented by quantitative inputs (test scores, enrollment records, teacher profiles, school capacity, funding, resource allocation and so on) from within the district. This will make FLA an informed and inclusive process,

improve the production strategy and encourage intrinsic motivation via acquiescent key stakeholder buy-in. It will also create a cyclical rather than top-down information model, where the macro-system is able to self-regulate with the feedback obtained from the district. Finally, there needs to be a connection between the direct outputs and indirect outcome. This can be established by downsizing the scope of the outcome and altering the narrative from an economic to learner-centered point of view.

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Appendix

Model

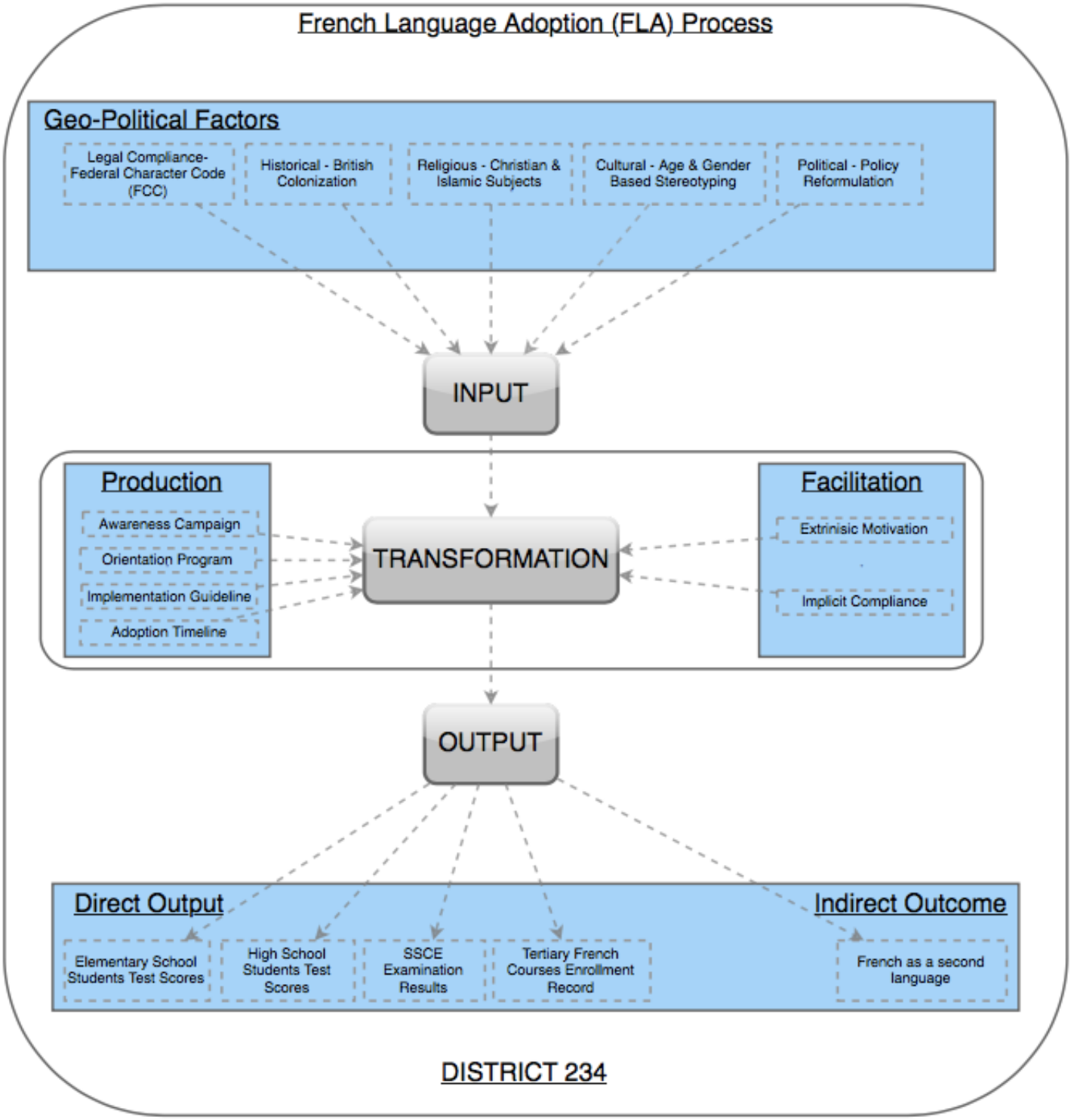

Figure 1.0: Model of the FLA Adoption in District 234

Vlogging to Learn

Japari Ngilari

University of North Texa

Abstract

Of the emerging social media trends, blogging has generated substantial interest for its suitability to pedagogy. This paper preliminarily explores the rise of a blogging sub-genre, video blogging (colloquially referred to as vlogging). The focal emphasis is on what it constitutes, how it differs from traditional blogging, its relevance in educational settings and an optimistic evaluation of it nascency.

Keywords: Vlogging, Pedagogy, Learning

Blogging is usually referred to as a journal entry or any other such documentation of personal opinions, thoughts and experiences of the writer shared in a public medium (Farmer, Yue & Brooks, 2008). By this expansive definition; this means it could encompass many forms of social media such as Facebook status updates, Instagram picture grids and Twitter's 140 character feeds. The scope employed here however is with regards to the traditional creation of niche content in a chronological fashion, specifically for broadcasting to an audience. Of interest is a sub-genre called vlogging.

So what exactly is vlogging? It is essentially blogging but in a video format. It ranges from the equivalent of a soliloquy to an entire staged cinematic production about an area of interest. The pervasive theme is audiovisual documentation and no topic is off limits (Snelson, 2015). A quick search on YouTube, arguably the largest user generated video repository on the web, reveals that people vlog about everything and anything. Up until recently, vlogging has received the least mention of web-based publishing. But with Google's acquisition of YouTube and the growing appreciation of social currency, it seems vlogging is here to stay (Gao, Tian, Huang, & Yang, 2010). Consider this study obtained from Romania, that highlights the pervasiveness of vlogging; per " official figures, 6.5 million monthly users visit YouTube looking for videos about cooking, sports, news or product reviews" (Bacescu, 2017).These users search for content to stay informed amongst other reasons. It wouldn't be a stretch to imply this is synonymous with learning.

Learning can be understood as how one comes from not knowing to retained comprehension, either as guided by self and/or an external party (Passer & Smith, 2004). These forms could be both formal and informal. Formal learning requires enrollment in a structured program, a finite duration, clear objectives and some assessment component. Informal learning on the other hand, can be any knowledge enhancing activity e.g. reading a book, visiting a museum, watching a film. It can be deduced then, that in either formal or

informal learning, the following elements are always present; a learner, an instructor and suitable content.

In light of this, it then applies that the advent of the web made a significant impact on learning. Of the learning elements aforementioned, content for instance can be represented in a myriad of forms online. Hypermedia is the most engaging form which captures sound, motion and text all at once (Nielsen, 1990). The web also provides the ability to publish content in an instant. And web users can respond to this content in real time. Vlogging harnesses these web-enabled capabilities in a way that is influential to learning.

Video as a tool of learning isn't novel; it is a development that preceded the web era. Some of the earliest educational television programs were on air as far back as the 1930's, around the same time colored TVs became commercially available (Novak, 2012). Most of those videos however were intentionally produced for the mass market and often backed by corporate sponsors. Though a laudable effort, there was an inherent limit in variety. The playing field is much different with vlogging now, the masses are the creators, curators and consumers of their content. Anyone with a camera enabled device and web access can be a vlogger (Snelson, 2015). In a sense, this is knowledge crowdsourcing and can be tied to theoretical underpinnings in socio-constructivism.

Vlogging can be integrated into pedagogy, here are a few examples how. In the role of the learner as vlogger, these are the contexts in which it would apply. To;

- document field experience assignments.
- provide commentary on live events of interest.
- record reflections on assigned reading

And in the role of the instructor as vlogger, to;

- record lecture videos about the topics being studied in class
- broadcast conferences or live demos as needed

- answer students' frequently asked questions.

Research shows that blogging increases "student interest and ownership in learning" and provides "opportunities for diverse perspectives." (p 124, Farmer, Yue & Brooks, 2008). For vlogging in particular, an easily identifiable benefit is learner engagement (Bacescu, 2017); video is a welcome alternative to the traditional lecture. Another benefit is peer-to-peer instruction; students can participate in the social construction of knowledge. By collaborating on videos or sharing videos with each other, learners can create a community of practice outside the classroom. A community keeps them accountable and encourages them to engage in public discourse about the topic at hand. Vlogging is also ideal for learners who find it difficult to communicate succinctly via text; video assignments give them the opportunity to be a) creative and b) hone their presentation skills. Lange (2015) concurs that "… video is an important medium for self-expression" (p 302).

For the instructor, the humdrum of grading is somewhat eased by the experience of watching video assignments as opposed to reading tons of term papers (Hung, 2011). Additionally, since most instructors teach the same basic courses repeatedly, they can create a series of well-edited vlogs addressing each area of the course content. The effect is manifold; (a)having the vlogs as a playlist online will allow students anytime access outside the classroom to study and revise as needed, (b) students can also ask specific questions in the comment section of each vlog about parts they did not understand, e.g 'at 4:03, what did that image mean?' (c) other members of the community can answer these questions, outside the instructor (d) instructor has more avenues to collaborate with other subject matter experts (e) videos can convey a high level of instructor engagement if they are recorded at a time of peak enthusiasm, because instructor engagement and enthusiasm wanes from the monotony of long-term lecturing (f) classes can still be conducted using prerecorded material if the instructor has to be away due to unforeseen circumstances.

There are pitfalls to vlogging; most concern authorship and content creation. E.g. who owns the copyright to the videos? How is intellectual property maintained? What consent must be obtained to record other participants? There is also the sheer amount of effort required to edit and upload the videos. Higher quality videos must be filmed in optimal lighting conditions with background noise correction. This requires some technical know-how and high equipment costs that potential vloggers might find off putting. Videos files are large, so bandwidth and storage accommodations need to be made. Because sharing publicly is essential to vlogging, there are privacy concerns. Lange (2015) is one of those affected and attributes her resistance to upbringing; "I grew up in an informationally-conservative household, in which I was taught the power of information and the need to guard one's privacy as much as possible" (p. 298).

The mass adoption of vlogging has potential pedagogical implications. In a study by Bacescu (2017) on institutional interest, it was discovered that most schools have resource (cost, human capital) constraints that limit the acquisition of media equipment and training for users. Some adopters have reported technical difficulties to be their primary challenge (Hung, 2011) though others say it helped them "gain new digital literacies" (p 302, Lange, 2015). In the wider academic realm, knowledge dissemination via video is tricky; specifically indexing, searching and attribution (Gao et. al, 2010).

Vlogging could be used in online, face-to-face or hybrid programs as a supplement to other learning activities. A broad empirical evaluation of vlogging efficacy in learning is unfeasible due to the scarcity of literature, though much exists about its forerunner, blogging. The few documented studies on vlogging have been in the language learning domain (Hung, 2011). Hence, the prospects and pitfalls cited herein have primarily been deduced from the intersection of hypermedia and social media use in education. According to (Snelson, 2015), "additional research is warranted to gain a deeper understanding of this practice and its

implications for …educators and school administrators" (p. 336). The YouTube usage statistics, active enrollments in Massive Open Online Courses (MOOCs) and increasing ubiquity of mobile video-recording technologies are indicators that the future of vlogging is promising (see appendix). Future work in this area could look at theoretical frameworks for the evaluation of video content by gleaning successful cases in the applications of netnography (Kozinets, 2006) and critical cine-ethnography (Warren & Gratch, 2016).

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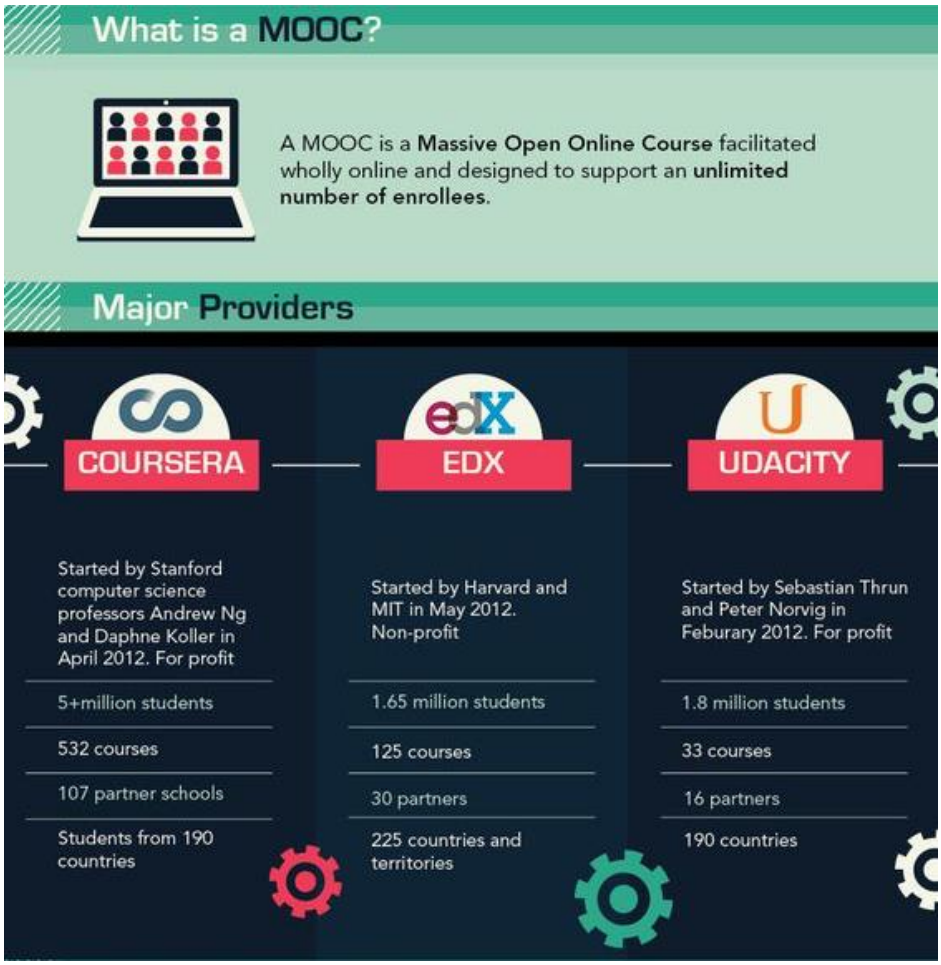
Appendix



(Source: http://ideas.ted.com/moocs-by-the-numbers-where-are-we-now/)

(Source: http://www.designinfographics.com/social-media-infographics/youtube-statistics)

Grant Application: Early Childhood STEM Interactive Technology Education (ECSITE) Project

Japari Ngilari

University of North Texas

Project Summary
Early Childhood STEM Interactive Technology Education (ECSITE)

Overview. The Early Childhood STEM Interactive Technology Education (ECSITE) project seeks to use interactive software to educate pre-school children (ages 3 to 5) about STEM oriented subjects using spatial concepts. In this "fun" project for preschoolers, a Spatial Intelligence Package (SIP) will be developed for preschoolers and available to them via the web on the ECSITE web page. SIP will be developed in the first year, during which consent for research will be solicited as well as other research planning efforts. In the second year of the project, SIP will be administered to 20 preschoolers over 12 weekends mimicking a regular academic term. Their performance skills will be tested at various stages; at the beginning, halfway through the session (after 6 weeks) and at the end (at 12 weeks), to monitor their progress. This project aims to develop in children spatial intelligence skills which is useful for a STEM future. By strengthening spatial skills, children's performance in STEM concepts will be increased. SIP provides a visual heavy yet friendly atmosphere for leisure learning in children. Easy enough to find natural interest, yet engaging enough to stimulate learning.

Intellectual Merit. SIP will provide an avenue for which children can mindfully use technology to supplement their classroom education in their leisure time. Alternatively, it is a good entry tool for children who are not enrolled in typical preschool programs (are homeschooled). It confirms academic material by drawing on proposed curriculum concepts that preschoolers should learn before entry into K-12. It will also provide a diagnostic comparison model to confirm relationships between time spent on SIP and performance improvement. There is currently an underrepresentation of populations from developing countries, especially females, in global STEM disciplines. This is driven by many factors, one of which is knowledge inaccessibility. This two-year project will demonstrate that STEM education can be introduced as early as the preschool years, and spatial intelligence is a good avenue to do that. There have been studies tracing success in spatial intelligence to success in STEM disciplines. Since this study will be carried outside the USA, it will also demonstrate that these success traits are universal and without cognizance of socio-cultural factors.

Broader Impact. Other forms of media such as text books, toys and cartoons have been used to stimulate learning in young children. SIP will harness the *pedagogical content* in books, the *manipulable fun* of toys and *audio-visual properties* of the cartoons to provide an *exciting* introduction to STEM. The software could also be expanded to more advanced spatial skills, math and related skills that will be useful to the preschooler in later education. One way to know what a child likes, what a child is good at, is by exposing him or her to these skills in the earliest and least intimidating setting possible. This kind of immersive learning can develop a propensity for excellence in later life in STEM related disciplines.The formative model of this project allows an introspective and niche study into early childhood education. By using current tab devices, it encourages the creative use of technology for education in a conscientious way. It is expected that the children will be more enthusiastic about learning and will understand learning not just as an activity that occurs in the classroom but is non-geographically situated.

B. Project Narrative

a. Significance

They are into legos and play dough, or maybe cartoons and tea parties. The perks of being a child, rife with such wonder and curiosity. Their litany of questions rivals an attorney's. At ages three to five years, the child is cognitively a sponge, absorbing all and sundry knowledge. This is a prime time to expound upon the child's spectrum of intellectual abilities or *multiple intelligences*.

Robert Gardner first put forward the theory of multiple intelligences in his 1983 book, *Frames of Mind*. The theory holds that human intelligence isn't measured by a single quotient but rather differentiated into seven distinct groups that capture more broadly the range of human potential (Gardner, 1983). These groups are, namely;

- visual-spatial : space, imagery
- verbal-linguistic : words, language
- logical-mathematical : abstraction, numbers
- bodily-kinesthetic: fine and gross motor skills
- musical: rhythm and sound
- interpersonal: socialization
- intrapersonal: introspection

ECSITE (Early Childhood STEM Interactive Technology Education) considers these intelligences as pathways to scholastic achievement in STEM disciplines. It aims to use technology to develop these pathways in preschoolers. The focus here in this project is on just one of these pathways, visual-spatial. This grant seeks to develop a Spatial Intelligence Package (SIP) suitable for preschoolers. SIP will be a four module package, with each module addressing each of the four areas of spatial intelligence put forward by the National Science Foundation (NSF) funded Spatial Intelligence and Learning Center (SILC). The areas of spatial intelligence, in no particular order are; Intrinsic-Static, Intrinsic-Dynamic, Extrinsic-Static and Extrinsic-Dynamic (Newcombe & Shipley, 2015).

Intrinsic-Static

This refers to the unchanging properties of the objects that identifies them as belonging to particular groups e.g. their size, pattern, shape etc. An activity in this category will be solving puzzles with cues from a picture template

Intrinsic-Dynamic

These are the manipulable properties of objects without altering their original dimensions e.g. folding along a diagonal, rolling a ball, rotation of a circle. Lego is a well-known tool with intrinsic-dynamic properties. It allows children to build a wide variety of structures .

Extrinsic-Static

These are the unchanging properties of the objects that differentiates them spatially from other objects e.g. taller than, wider than, near, far etc. Toys that depict these properties are often miniature replicas of real world spatial structures. An example is a barbie doll house, a map of the globe, a three dimensional maze

Extrinsic-Dynamic

This refers to the complete motion of objects in a scenic environment e.g. animation. Items in this group combine all of the other properties. Building a train track for instance will belong here as will motion-sensitive games like the Nintendo Wii.

The proposed timeline of ECSITE project will begin with research planning and software development efforts. This will be succeeded by the actual implementation of the software and in-house testing to make sure it is error-free. The pilot group of twenty parents and their preschoolers will then undergo a twelve week study session, during which the preschoolers will be subjected to a series of basic concepts assessments. From this overview, it can be concluded that the project will concurrently run two streams, that of academic-research oriented activities as well as operations-production activities. In the sections that follow, more information is detailed about the project's phases.

Phase One : Initiation (At 0 – 6 months)

The first phase of the project signifies the commencement of the ECSITE project. In this stage, the idea is developed more fully of what should be accomplished by the end of the project. This involves writing a proposal, soliciting financing, feasibility studies and expected results.

The deliverables at the end of this project are:

- **SIP**, a working open source software application available to selected accounts via a website. This application is an educational effort towards familiarizing preschoolers with spatial concepts via on screen objects that can be manipulated digitally. It will use a storytelling, fun, adventurous approach with elements assimilated from their real life formal and informal play-learning environments
- A **technical report** that documents the processes and progresses encountered from the beginning to end of this project, addressing if the objectives were met, problems encountered, results and insights for future work of this nature

Phase Two: Development (At 6 – 12 Months)

The development phase of this project will require acquiring personnel, setting up the physical environments for the project, soliciting co-operation from project partners and personnel, setting up a logical structure, selecting the research population and basically, setting up the foundation for the project to succeed. This phase lays emphasis on the operations-production streams of activities; at its core is the development of SIP until it is ready to ship. The software development process involves;

- Software Analysis: produce a working plan of elements that SIP should contain based on ethnographic and pedagogic information collected in *Phase One: Initiation*
- Software Design: generate sketches, mockups and a digital prototype showing SIP's visual interface
- Software Coding: combine the analytic and design information into a working web application by the programmers
- Software Testing: ensure that SIP is fully functional and error-free
- Software Integration: deploying the application to the web and providing access via authenticated accounts

Phase Three: Execution (At 12 – 18 Months)

This phase will dwell on the academic-research stream of activities. The pilot group of twenty preschoolers are selected with consent from the participating parents. The participants will be required to be at the training center three times during the twelve week study session in this phase; the orientation, intermission and conclusion.

During the orientation, the iPads are distributed to preschoolers and accounts are created for SIP access on the ECSITE webpage. The parents are taught the iPad basics; how to charge it, turn it on or off, connect to the internet, launch the browser and access the SIP app (including the user guide, help menu, FAQ section). The children are given their first assessment based on Boehm's Test of Basic Concepts: Preschool Version (Boehm, 1986). Both parents and children are shown how to interact with SIP and allowed to explore until they express familiarity with the application. They are allowed to use SIP at home for the following twelve weeks. For the purpose of the project, these are the usage limitations;

- SIP will only allow one account per user and one user per household.
- SIP will collect non-identifying demographic information and diagnostic usage data
- SIP will be available only during the weekends (12:00am Saturday to 11:59pm Sunday)
- SIP account access will be valid for only twelve weeks

The intermission period offers an avenue to reconnect with the project team and address any ongoing concerns at the training center. This will be between the sixth and seventh week of the session The same Boehm's test is administered at this time and once more during the conclusion after the twelfth week. The participants can also opt to provide information about their session experience and recommendations for improvement.

Phase Four: Synthesis (At 18 – 24 Months)

The synthesis phase requires making sense of all of the information that has been captured (ethnographic, pedagogic, diagnostic) at the end of the study. In this phase, the technical report which has been slowly built up from the previous phases is finalized.

PROJECT TIMELINE

The project is expected to take place over the course of two calendar years, between the first of January, two thousand and seventeen to the thirty-first of December, two thousand and eighteen. The proposed timeline of previously detailed activities is shown below;

Phases	Activities	Duration
Phase I: Initiation	Project Definition	January - June 2017
Phase II: Development	Research Planning	July 2017
	Software Development Process	

	Analysis	August 2017
	Design	September 2017
	Coding	October 2017
	Testing	November 2017
	Integration	December 2017
	Research Implementation	January - June 2018
	Study Session (SS)	
Phase III: Execution	SS : Orientation	April 2018
	SS: Intermission	May 2018
	SS: Conclusion	June 2018
Phase IV: Synthesis	Project Evaluation	June - August 2018

INTELLECTUAL MERIT

There have been several discussions in literature regarding the propriety of children and adolescents' utilization of pervasive technology such as personal computers and mobile devices. Contemporary studies have dimmed that discussion by showing that when used conscientiously, technology can be beneficial to children (Yelland, 2005). Therefore, future research should steer the debate from *what* these benefits are towards the *how*. *How can children, in this case, preschoolers further assimilate these benefits? How do these benefits accrue longitudinally? How will these benefits impact the practice of early childhood education?*

In an ideal world, all children will be able to access the technological and pedagogical benefits but due to several limitations both internally (with respect to the child in particular) and externally (with respect to the child's circumstances), this hasn't been so. For example, mathematical aptitude for all ages, early childhood notwithstanding, is a seemingly plausible goal. However, those with economic and social disadvantages are handicapped by knowledge inaccessibility stemming from early childhood(Cross, Woods, & Schweingruber, 2009). Additionally, some gender-performance correlations were discovered during a spatial skills assessment with the males outperforming the females (Hill, Corbett & St Rose, 2010). Though these correlations were not apparent in early childhood, they peak dominantly at about age 10 – 18, and continue well into later years (Johnson & Meade, 1987). A similar phenomenon exists in STEM professional practice with an underrepresentation of females (Hill et al., 2010).

According to Diezmann and Watters (2000), also ascertained by Wai, Lubinski and Benbow (2009), spatial skills can reliably predict the pursuit of and performance in STEM disciplines. For this reason, SIP can be viewed as an early stage technological intervention for the aforementioned less than ideal prognosis. The outlook is promising based on empirical evidence. Consider this study of 41 children aged 3 to 6 by Couse and Chen (2010). They observed that despite initial technical difficulties, these preschoolers had a keen interest in tablet devices that increased with age and persistent usage. Similarly, Newcombe (2010) noted that children "showed substantial improvements in spatial skill from a wide variety of interventions, including academic coursework, task-specific practice, and playing computer games that require spatial thinking..." (p. 31).

Szechter and Liben (2004) videotaped parents reading a children's story book *zoom,* filled with predominant spatial language and representations such as maps and photographs, to their children. The children were then tested on their ability to complete two related tasks to the book just read; it included ordering objects in sequence and pairing similar objects that were randomly dispersed, one from the other.When the data was coded and analyzed, there was a peculiar link between measures and performance of spatial-graphic dimensions.

BROADER IMPACTS

The reviewed literature above gives credence to the elements of the SIP software. The impacts are addressed three-fold:

How will the preschoolers assimilate the benefits of SIP?

SIP will utilize rich imagery in it's design. The application will incorporate familiar objects from the children's real world environment; homes and classrooms. Using storytelling and adventure to teach children mathematics has proven to be effective (Casey, Kersh & Young, 2004).

A study by Clements and Sarama (2002) shows that "Children who use practice software about ten minutes a day increase their scores on achievement tests." Through the initial orientation and subsequent practice with SIP over twelve weeks, the preschoolers' familiarity of the application will increase as will their technological and pedagogic competencies.

How will the benefits of SIP accrue over time?

This is really more a question of numbers. SIP has a component that will collect diagnostic usage data. When this data is matrixed with demographic information and scores from the Boehm's test, it will provide descriptive insight. This quantitative approach comes on the heels of a related study that had success using qualitative measures of spatial performance (Szechter and Liben, 2004).

SIP's diagnostic tool is also a built-in incentive to experiment with a larger pool of participants and across other multiple intelligences' pathways.

How will SIP benefit the practice of early childhood education?

Casey, Nuttall and Pezaris (2001) believe that intervention introduced early enough children will diminish the gender inequality in later scholarship performance. As a learning tool, programs like SIP have also aided the comprehension of spatial concepts (Clements & Sarama, 2002; Newcombe, 2010).

Thus, if SIP is at the very least, minimally beneficial, gender-performance correlations on the spatial aspects of the Boehms' test should be negligible. This will champion a gender-neutral approach to nurturing spatial skills in early childhood settings and consequently perhaps, increased female interest STEM disciplines.

b. Method

The SIP academic-research stream will use a descriptive-quantitative design. Twenty preschoolers and twenty parents or guardians will participate in a twelve week long study session during which they will interact in their homes with the SIP application via mobile web-enabled tablets. These preschoolers will be selected at random from a single private school in the capital city of Nigeria, Abuja. This school provides education to about four hundred students from preschool through to senior high school. The preschoolers will be accessed prior to, during and after the session.

Research questions

1. Does the performance on SIP improve with usage?

SIP has a feedback component that automatically collects usage data for each account such as login time, performance on various levels/modules of the application, frequency of use and the like. This also looks at the diagnostic data collected from the web every weekend as the children interact with the application. It looks at time spent on the application as well as their results on the four domains of spatial intelligence.

2. Does the performance on spatial tasks in the Boehm's test improve over time?

This compares the scores from the three continuous assessments administered. It will look at the intermittent and gross changes in performance.

3. Is there a relationship between the performance on SIP and performance on the Boehm's test?

The data collected from research questions *1* and *2* above are examined for correlation.

4. Is SIP a beneficial tool for improving spatial and basic concepts skills?

Descriptive insight will be deduced from the outcomes of research questions *1*, *2* and *3* above as well as feedback from the participants.

Rationale for method

Boehm's Test (1986) is a validated instrument for collecting information on preschool readiness. Using this ensures emphasis on reliability and validity of the data.

SIP provides a tool to automatically collect diagnostic and usage information. This ensures accuracy in measurement as well as objectivity where, otherwise, self-reporting will be biased or observation, cumbersome.

c. Personnel

The following members of the team have the pre-requisite programming and research experience for a dual-streamed project of this nature.

Japari Ngilari (Lead PI)

Japari is a doctoral student in learning technologies at the University of North Texas. She also works as as an instructor in the department of computer science and software engineering at a private university in her home country and site of the project, the capital city of Nigeria, Abuja. She has both Bachelor and Master of Science degrees in software engineering from the American University of Nigeria and University of Manchester, United Kingdom, respectively. She has worked in various capacities as developer and project manager in the technology industry prior to her foray into academia. Because of her backgrounds in programming and research, she will be able to effectively spearhead this project. She has published papers in peer-reviewed local and international conferences on the subject of technology use. Her interest in this project is driven by a gap observed in a recent research project. She observed the limited number of publications on early childhood education in Africa, especially regarding technology use. Outside of corporate studies, empirical research was lacking. A project like this could fuel literary discourse. Her involvement will provide an avenue for collaborative undertakings with other researchers and industry professionals. She has a 50% involvement in this project.

Agbor Aln (Co-PI)

Agbor is the Co-PI on this project. He is currently a senior developer and project lead with the renowned software company, Google. He is also a founding member of the team behind the Google for Education initiative. In his capacities, he is chiefly concerned with designing interactive software and improving the web user experience for children. He has Bachelor of Science degree in Psychology and Early Childhood Studies. He obtained his Master of Science degree in Logic, Computation and Methodology from Carnegie Mellon University's Department of Philosophy. He is a Google ambassador to Africa and has successfully liased several educational technology projects in the continent on behalf of the company. In his spare time, he runs a popular educational technology blog under a pseudonym. He gets at least 120, 000 visits from all over the globe to his blog every month. His academic foundation with children is much needed in this project as well as his technical writing experience and industry connections. He has a 25% involvement involvement in this project.

Kivi Alex (Programmer)

Kivi Alex is a programmer on this project. He will be responsible, alongside Salana Vanara for all aspects of the Software Development process as supervised by the Lead PI, Japari. Kivi is a freelance programmer and has developed several open source applications. He has also worked previously with the Co-PI, Agbor, on a website that provides teaching materials for elementary school teachers in Nigeria where he currently resides. He has a 12.5% involvement in this project.

Salana Vanara (Programmer)

Salana Vanara's background was originally in finance, with a Bachelor of Science degree in International Accounting from the University of Suffolk, United Kingdom. She is self-taught as a programmer, taking part-time classes at the University of Manchester while she managed the department of sponsorships and scholarships at the same institution. She now owns her own higher education software development company SalVan Systems Limited while consulting on several projects for the Nigerian government. She also organizes an annual technology startup conference that has hosted prominent guest speakers such as Bill Gates and Mark Zuckerberg. She has a 12.5% involvement in this project.

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