Project-Based Teaching for Information Technology Students in Africa: A Case Report

Ngatchu Damen Nyinkeu
Catholic University Institute of Buea, Cameroon
Clive Tsuma Katiba
The ICT University
Ngatchu Henry
University of Buea, Cameroon

The conversation on reforms in higher education is perpetual and even more relevant in the twenty-first century. The effects of our rapid changing technological society on the educational landscape calls for a rethinking of the teaching-learning processes, irrespective of geographical barriers or discipline of studies. Using a qualitative methodology, this paper presents the experiences gotten from implementing a project based course for information technology students in a private University in Sub-Saharan Africa. Data from three batches of students, who participated in the course, were collected, transcribed and analyzed. The Technological Pedagogical Content Knowledge (TPACK) framework was adopted for the studies and the findings are in some cases, similar with those from different parts of the world. The uniqueness of the challenges with implementing project based courses in Africa are uttered.

Keywords: project-based teaching, information technology, tutored project, Sub-Saharan Africa (SSA), Technological Pedagogical Content Knowledge (TPACK)

INTRODUCTION

The phrases "project-based teaching" and "project-based learning" are often used interchangeably in scholarly literature. In either case, they both involve creating and managing the pedagogic process around a task or set of tasks or a project. Proponents of project-based teaching and learning agree on the fact that it enhances gain in learner's achievement (Hung et al., 2012; Gökhan baş 2011; Junco et al., 2010), their problem solving capabilities (Hofer et al., 2005; Greene et al., 2012; Schul, 2012; Hartsell, 2013),

Ngatchu Nyinkeu is Assistant Lecturer at Catholic Univwersity Institute of Buea, Cameroon. Clive Katiba is Lecturer at the ICT University in Los Angeles. Ngatchu Henry is Assistant Lecturer at University of Buea, Cameron. Ngatchu Nyinkeu can be reached at ngatchu@cuib-cameroon.net

their ability to work in groups (Neo et al., 2013) as well as their understanding and appreciation of subject matter (Manfra et al., 2006; Moti et al., 2006; Hartsell, 2013) and related skills(Ahmet Kılınç 2010; Hofer et al., 2005). Integrating technologies into the teaching-learning process particularly when a project-based approach is taken poses some challenges to learners (McKenney et al., 2011; Torrez, 2010; Tamim, 2013) and teachers (Manfra et al., 2006; Schul, 2012; Gachago et al., 2013) alike. Hofer and Owings-Swan (2005) have called upon researcher and practitioners worldwide to share their findings, techniques, successes and challenges in a bid to harness the connection between technology, pedagogy and content.

Most studies found in scholarly literature and relating to project-based learning where carried out in technologically advanced counties and have focused on training teachers to use project-based learning approach in their classrooms (Moti et al., 2006; Torrez, 2010; Dabner et al., 2012). A good number of studies (Greene et al., 2012; Torrez, 2010; Manfraet al., 2006) have made an initial assumption that student's technological know-how is sufficient for the course; only to discover that it is not ubiquitous (Hofer et al., 2005).

This paper reports a case study of project-based teaching, carried out in a sophomore level course at a private higher educational institution in Sub-Saharan Africa (SSA), precisely in Cameroon. The course is designed to give Information Technology (IT) students the opportunity to deliver concrete IT projects under the supervision of a tutor. The study uses Technological Pedagogical Content Knowledge (TPACK) as its theoretical framework to communicate the findings, techniques, successes and challenges related to integrating technology, pedagogy and content in Africa.

LITERATURE REVIEW

Gökhan baş (2011) administered an academic achievement test and used an attitude scale to measure attitude towards English Language Lessons for sixty, 9th–grade high school students. He found that the experimental group of students participating in project-based learning had better post-test results than the control group of students. The experimental group also showed better attitude towards English Language which indicate some benefits of a project-based learning on students' academic achievements.

Furthermore, Hung et al. (2012) found that digital storytelling could effectively enhance learning achievement of students over conventional project-based learning approach to storytelling. In their quasi-experiment, a control group of students experienced participated in conventional project-based learning approach to storytelling while the experimental group used a software. Interview with the experimental group revealed that the project-based digital storytelling approach not only enhanced the students' learning achievement and problem-solving competence, but also improved their learning attitude and motivation. The findings from Gökhan baş (2011) and Hung et al. (2012) show that project-based learning positively influences learners' achievement and having a technological add-on makes it better.

There is a growing literature on project-based learning and teaching that reports cases of students using various technological tools to complete course projects. Hartsell (2013) shares a case of the effectiveness of using digital movies as a form of reflection in a graduate instructional design course. Greene et al. (2012) investigate the perceived value of videos created by accounting and marketing student as a tool for enhancing the students' learning-experience. Schul, (2012) explores the intentions and practices of an experienced teacher with integrating desktop documentary-making into History classroom. These studies reveal that taking a project-based approach to teaching and learning greatly enhances learners' problem solving capabilities and ability to work in groups.

Neo et al. (2013) measured the perception of forty-two sophomore students in a Malaysian University after their participation in a multimedia course. The course required students to create an interactive website using multimedia elements such as Adobe Flash, Photoshop, Illustrator and Dreamweaver. In agreement with students' comments, their findings show that the students learned how to work in groups and about group responsibilities and commitments. Students were also found to be more independent in their learning process and saw their teachers as facilitators to keep them motivated and engaged.

Literature also holds that students have expressed greater appreciation of project-based learning over other traditional approaches to teaching and learning. Moti et al.,(2006) analyzed qualitative data from ninety-two student-teachers who participated in a course designed to help them design project-based learning environments. Most of the students-teachers indicated that they would attempt to integrate project-based learning approach in their teaching and appreciated the relevance and appropriateness of the approach. Student participants from Hartsell's (2013) study equally preferred creating videos to demonstrate their understanding of instructional design models and learning theories as opposed to writing a paper at the end of the course. Students generally have a high regard for video creation exercises (Greene et al., 2012) as it offers deeper, more engaging, active and experiential learning. Project-based learning does not only create a "wow-effect" but insinuates a change is mindset as well. The results from Kılınç's (2010) study suggest that project-based learning environment caused positive changes in the behaviors of student-teachers, regarding environmental protection.

Literature also sheds some light on the challenges faced by learners and teachers with project-based teaching and learning. These challenges have been associated with the technological platforms and the software tools (Torrez, 2010) used. Tamim (2013) suggests that some of the difficulties with project-based learning are related to students' ability to adjust to a new style of learning. Schul (2012) found that focusing the students' compositional efforts in preparing scripts for video project is a very challenging exercise. McKenney et al. (2011) highlighted the misalignment between current curriculum and textbooks with the objectives of integrating technology in education as an obstacle. The concept of the "invisible learning spaces" as cited in Gachago et al., (2013) which describes students' predominant use of some technologies that are not easily accessible for lecturers can also be seen as a challenge to integrating technology in the teaching-learning process.

Manfra et al., (2006) investigated the approach used by two teachers to integrate student-created digital documentaries into their social studies classrooms. They found that the teachers' pedagogical aim dominated what they planned to teach and what they actually taught while technology and course content were relegated to the background. Their paper showed that the pedagogic aim drives the teacher to either become a manager of the content, directing students towards knowing the content or act as a facilitator, enhancing students' understanding of the content. However, Schul (2012) hold that a technologically driven approach to teaching was more difficult than the approach traditionally used by teachers.

In conclusion, it is evident from literature that project-based teaching has some positive impact on learners' academic achievement and improves on their problem solving competence and ability to work in teams. Most authors (Greene et al., 2012; Torrez, 2010; Manfraet al., 2006; Hofer et al., 2005;) have emphasized the limitations of their findings to particular settings and subject areas. There is a general appeal to investigate and share findings, techniques, successes and challenges from different parts of the world and in different subject areas.

THEORETICAL FRAMEWORK

The Technological Pedagogical Content Knowledge (TPACK) refers to the synthesized form of knowledge for the purpose of integrating educational technology into classroom teaching and learning (Chai et al., 2013). It asserts that the intersection between pedagogical, technological and content knowledge defines the context within which the integration of technology into the teaching-learning process can be examined (Chai et al., 2013; Koehler et al., 2013). This intersection therefore create seven dimensions within which the teaching-learning process can be examined. Chai et al., (2013) attempts to define these dimensions of TPACK following a systematic review of seventy-five journal articles. Their definitions are as follows: (1) Technological Knowledge (TK) – Knowledge about how to use ICT hardware and software and associated peripherals; (2) Pedagogical Knowledge (PK) – Knowledge about the students' learning, instructional methods, different educational theories, and learning assessment to teach a subject matter without references towards content; (3) Content Knowledge (CK) – Knowledge of the subject matter without consideration about teaching the subject matter; (4) Pedagogical Content Knowledge (PCK) Knowledge of representing content knowledge and adopting pedagogical strategies to make the specific content/topic more understandable for the learners; (5) Technological Pedagogical Knowledge (TPK) – Knowledge of the existence and specifications of various technologies to enable teaching approaches without reference towards subject matter and (6) Technological Content Knowledge – Knowledge about how to use technology to represent/research and create the content in different ways without consideration about teaching. All the studies reported in Chai et al., (2013) where carried out in Europe, the Mediterranean and Asia Pacific regions, with 95% of them employing a constructivist-oriented pedagogy with project-based learning and using predominantly TPACK framework. Therefore, in tandem with other scholars, we chose TPACK to guide our study and pose the following research questions:

1. What learning conceptions do Information Technology (IT) students have when participating on a project-based course?
2. How do IT students think participating in a project-based course influences their learning attitudes?
3. What are some of the challenges with implementing project-based courses in Africa?

METHODS

This paper reports a study that covers three batches of students who participated in a project-based course, titled "Tutored Projects" during their sophomore year in the University. According to the students' handbook, the course is designed to drill students on what it takes to deliver an IT-project. At the end of the course, the students are assessed based on their contributions of the project, as well as their end of course write-ups and presentations.

PARTICIPANTS

The participants of this study were exhaustively selected from the students in the University. That is, all those who had participated in the Tutored Projects course, were included in the study. Ten students from the 2012/2013 batch, currently in their senior year; Fourteen in 2013/2014 batch, currently in their junior year and thirteen in 2014/2015 batch. A total of thirty-seven students participated in the study, among whom were seven female and thirty male.

PROCEDURES

Cumulatively, for the three batches of students in this study, the course required them to participate in a departmental project and to use their technological skills to make meaningful and innovative contributions to the project. The project is titled "The Cameroon Hymnal Project" and aims at producing digital content from a Catholic hymn book popularly used in Cameroon. During the course, the students used various computing hardware (Desktops, Laptops, Tablets, Mobile phone, Digital Cameras, Dictaphones, Scanners and Printers); software (Presentation Software, Word processors, Spread Sheets, 3D Page Flip, Adobe Software Suit, Sony Vegas Pro, Movie Maker, Note-Worthy Composer, Android SDK, Visual Studio and Apache-MySQL-PhP packages) as well as the Internet. Some students had prior knowledge and experiences with these tools while others had to develop and enhance their skill-sets during the course. Throughout the years, the students have developed a wide variety of artifacts related to the project. These include: ebooks, 3D flip pdf files, Desktop Applications, Mobile Apps, Websites, Databases, Social Media pages, Video Clips, mp3 and midi files for the melody of some hymns. The experiences of the students, their evaluations of the course and the challenges they faced while participating in the course are documented in the end-of-course write-ups and archived in the University.

DATA COLLECTION

The data that is analyzed and discussed in this paper comes from the students' project write-ups and their end-of-course presentations. These presentations where videotaped by some members of the audience and these videos have been transcribed as part of the data for this study. The primary requirement for the course was a 25-page write-up and a power point presentation. Although the students had different ways of structuring their write-ups, they are generally divided into four main sections: the preliminary pages; the introductory section; the Procedure and closing sections. The preliminary pages include separate pages for a signed declaration; A dedication statement; An acknowledgment statement; About the author; The table of Content and a list of acronyms. The introductory section constituted the abstract, a background to the project, the specific objective of the student's work and its relevance. In the procedure section, the students describe the tools which they used, how they used them, the advantages and disadvantages of these tools as well as a work schedule time map. The challenges faced, future perspectives, recommendations and conclusions are discussed in the closing section. In most cases, the power-point presentations files contained key elements from the write-ups and in some cases, detail excepts.

Authorizations and students ethical clearance was obtained from the Research Ethics Committee of the institution where the research was carried out and an embedded analysis (Yin, 2003) of various forms of digital data was performed. The transcribed videos, together with the write-ups and the power-point texts were used for textual analysis. The next section discusses the findings following the research questions and uses pseudo-names of the participants for privacy reasons.

FINDINGS AND DISCUSSIONS

WHAT LEARNING CONCEPTIONS DO INFORMATION TECHNOLOGY (IT) STUDENTS HAVE WHEN PARTICIPATING ON A PROJECT-BASED COURSE?

In the project write-ups which the students submitted at the end of the course, almost all of them stated objectives which were either general or personal. The learning

conceptions which IT students have when participating on a project-based course gravitates more around skills acquisitions and being part of something significant. For most of the students, to participate in the project was a primary objective. Other objectives which the students stated were: "To see how I can motivate myself to the limit"; "To develop / add new skills to my portfolio"; "To contribute [to] the project"; "To acquire presentation and task planning skills"; "To motivate others"; "To assess my level of seriousness and challenge myself".

The students saw the course as a forum for them to engage with the realities faced by information technologists and to develop an understanding of this reality. One of the girls in the first batch of students, Kelly, said during her presentations "… Actually if this course was not given to us, I could not sit down to come up with this … I could be think that I want to do something but for me to realize it would be very difficult.... ". Her classmate, Peter, in his own presentation said "… we always complained that we never had a lot of practice, a lot of practical sessions and from this course … , I can realize that this is actually the practical session, this is what we have been asking for and it was actually given to us … ". One of the girls from the second batch of students, Mary, said "My motivation [for participating in the project] was to learn professional life, ... how to manage a project, … going out of the theory, going more practical". Her classmate, Gerald, said "… We were able to put theory into practice; The fact that we were leaving school to go and work outside... I think … group work was my motivation". Rose from the same batch said "… My motivations were my classmates, to start with because seeing them moving ahead and me behind … [encouraged] me to do more. [Also,] the senior students … were also a good source of motivation. ... the teaching process was a good one … though it wasn't as I thought it would be, but it was very good because … He [the teacher] didn't just come and do all the job, work, for us, he just gave us points … for us to go and continue". Two boys, Jean and Conrad from the third batch of students said "… it is a good course because actually it puts students in an environment of a project. (Conrad) … It's my very first time of doing such a course because as it says, it is a project, … we have to find our own way on how to carry it on, Nobody is there to teach us, just a mentor, just someone to supervise us. So it is a good course, it is something innovative (Jean)".

The findings reveal that, by participating in a project-based course, students see the learning process as journey they have to embark on with the support of their friends, teachers and different resources. They create for themselves, the notion that they have to work harder to acquire the relevant professional and technical skills in order to deliver their projects. Being part of an ongoing project made the students to give more value to their contributions and drove them to work even harder. They take full responsibility for the outcome of their work while appreciating the support of their peers and mentors.

The findings also insinuate a significant distinction in the teaching process, particularly for the course under investigation. A probable way forward, to consider for further research would be to look into the teaching process for project-based courses.

HOW DO IT STUDENTS THINK PARTICIPATING IN A PROJECT-BASED COURSE INFLUENCES THEIR LEARNING ATTITUDES?

Generally, after participating in a project-based course, students' attitude towards learning on their own and learning beyond the course significantly improves. In the end-of-course presentations for the first batch of students, most of them stated additions and upgrades, which they hope to carry out in the future. John said "… In the future, I will make … this App ... to go cross-platform. It is very easy for me now... ". Peter stated that "… in future, I will really love to continue on this project because the product is not yet

complete … " while Kelly, towards the end of her presentation added "...I look forward to completing my [project]...". Matthew in his presentation described how he learned to create e-books by himself when he said "I had it in mind that I needed to create an e-book and I would do what ever it takes to create an e-book so I went through the Internet, searched and luckily for me I got Sigil [an e-pub editor]… So I had to go through the manual, read it through over and over … ". Jean from the third batch of students shares a similar experience when he said "The project helped me in particular to know how to research; because, nobody taught me anything, I had to go on my own and look for things that would help me".

Paul from the second batch of students said "… throughout we were working on a plan and if there is one thing I have learned from the whole course is how to plan my work … through doing my project, I learned how to plan". Gerald said "… It helped me a lot, first in terms of self-confidence and completion of task. I gained a lot of self-confidence during the tutored project [course] and gaining self-confidence can help you a lot especially in industrial milieu or even in school and [in] studies, to perform better And also I would say tutored project … has really boost[ed] my morals and I'm able to work over hours". Sandra added "… I learned to be disciplined, from there I learned that it is not all the time that you would be having somebody behind you to, like, follow you up; do this at this particular time. … So it made me to be disciplined". A vivid picture of how project-based teaching influences students' learning attitude is captured in a recount by Andrew, between him and his course instructor. "… A clash I had with the lecturer; Not a physical confrontation, not a fight … on the day we were selecting the individual project … He [the course Instructor] proposed two difficult projects. One that I can remember was the Search Engine Optimization project … He [the Instrctor] had to bet that nobody would be able to do the project and I stood up and said. 'Sir I want to do the project'. He said, 'Personally … I know you will not do the project' So I said 'Sir, I will challenge myself by doing the project' …".

All thirty-seven students in this study expressed their appreciation for an improvement in their time management skills. Twelve weeks was the allotted time for students to complete their task, produce a write-up of what they have done and present their work in front of an independent panel. Most of the students, in their end-of-course write-ups and power-point slides, associated their successful participation in the course to their improved ability to manage their time. Matthew for instance wrote "Skills acquired: Time management; Collaboration; Word Processing; Producing an eBook (ePub)..." while Kelly noted how she successfully managed her time in the following excepts "...Disconnected Myself from Unnecessary activities like watching movies, taking a walk and idle discussions...". Hillary from the second batch of students wrote "The project is laborious yet fascinating. [I] acquire new skills and knowledge ... I wish I could have the opportunity to continue working on the project after validating the course".

The findings show that by participating in a project-based course, students are driven to build a knowledge seeking attitude towards learning and a willingness to continue working on projects even beyond the course. The course influences students to develop a craving for knowledge and skills and they actually apply themselves in the learning process. The students thereof gain ownership of their newly acquired knowledge and skills and are able and willing to put their know-how into practice even beyond the settings of the project-based course.

WHAT ARE SOME OF THE CHALLENGES WITH IMPLEMENTING PROJECT-BASED COURSES IN AFRICA?

The comment from the orchestrator during an end-of-course presentation, speaks volume about some of the challenges with implementing project-based courses in Africa.

While Peter, from the first batch of students was presenting his work, the orchestrator of the presentation session said, "… Excuse for that, we have just had a power failure …". One could also observe, in the video, some distortion in Peter's composure as he tries to carry-on without his power point slides. Although project-based courses do not necessarily require electricity to be implemented, frequent power outages are one of the unimaginable technological realities of Africa. This makes implementing project-based courses in Africa very challenging especially in the discipline of Information Technology. Some of the challenges which the students identified include: "Lack of technical competence"; "Lack of domain specific competence"; "Lack of appropriate equipment"; "Lack of Appropriate IT Infrastructure" and obviously the "Lack of sufficient time".

A good number of the tasks that were assigned to the students required them to be skilled with software tools such as word processing software, e-book creator software, JavaScript and other computer programming environments. Although knowledge of these tools was seen as ubiquitous to both students and teachers, they realized that using the tools productively could be challenging. Jean from the third batch of students said "... Challenging because it is just when the project was introduced that I got to study database... So, at the very early state of the project, it was difficult, it was very challenging...". In some cases, the software tools were specific to certain aspects of the project; like in creating Musical Instrument Digital Interface (midi) files from Sol-fa and stave notations. In such scenarios, learning how to use the new tool was challenging for some students. Some students did part of their work at home and on their laptops which were exposed to viruses and malwares. The challenges of Internet connectivity and low access bandwidth was persistent and together with the frequent power outages gave the project a stand-alone, offline characteristics. This is reflected in Paul's comment "... It was a project worth doing … But what is unfortunate is that I haven't seen it being implemented out of school … I would … recommend that it is … given out, let people use it rather than keeping it in school …".

It is obvious that some challenges from the findings are intrinsic to the geographical environment while others such as assuming that technological know-how is omnipresent have been observed by other researcher (Hofer et al., 2005). In addition, even where the technological know-how was found in excess, this study reveals that putting this know-how into productive participation in a project-based course posed a different set of challenges. However, the presence of challenges only give room for improvement and growth.

IMPLICATIONS AND CONCLUSIONS

The synthesized form of knowledge experienced in the teaching-learning process in this study offers a rich context for the study of how technology, pedagogy and content interact with each other. Given that the students in the study were technologist in training, creates some reference point for the exploration of other categories of students. Their zeal and passion for technology obviously played a role in their disposition to the course content. Certainly, the disposition of non-technologist towards using technology for courses would be interestingly different and insightful. The project-based pedagogic approach in this study anchored on a technology-intensive project and the multiplicity of tasks partly account for the diverse experiences shared by the students. The study therefore contributes in deepening our understanding of the various dimensions of the Technological Pedagogical Content Knowledge (TPACK) framework.

The learning conceptions of acquiring skills in the context of professional life, which Information Technology students have, when participating in a project-based course is a plausible one particularly for students in higher education. It equips students with the

mindset needed for their life after University and catapults them to greater professional careers and aspirations even while in school. The choice of the project and the motivation for involving students into the project all conspire to spur up the observed learning conceptions which the students developed. Although this seem to have been successful for IT students, it is obvious that different disciplines might need to look at this differently. There is also a need for empirical research linking participation on a project-based course and students' learning conceptions.

Project-based teaching significantly and positively influences students' attitude towards learning on their own and learning beyond the course. This can be associated to the fact that the students were able to get a realistic view of their efforts, from the remarks of the panel which graded their presentations; the appraisals from the audience and most especially from the values which they gave to their original contributions towards a life project. The worth of such appreciations, to the students' educational development is enormous and overshadows the grade found on the student's result slip.

Besides the infrastructural and other challenges, teaching with technology, especially new technology, is characterized by a set of challenges which students must overcome in order to have learned. The pen is a complex technology which has been around for ages and the ability to use it has always been considered as ubiquitous. However, by observing primary schools kids in Cameroon, it becomes obvious that the use of even the most rudimentary tool should not be taken for granted.

In conclusion, this paper shares, with the academic community, the experiences of implementing project-based teaching for information Technology students in Sub Saharan Africa, particularly in Cameroon. The findings, discussion and implications presented are localized and may not necessarily apply in other geographical settings, even in Africa. The study urges researchers to look at different subject areas, different course projects and different infrastructural settings. It also calls for a review of the teaching styles and methods used by instructors of project-based courses. Project-based teaching and learning seems to be taking higher education in the twenty-first century back to Africa's original form of education – Apprenticeship.

REFERENCES

Baş, G. (2011). Investigating the effects of project-based learning on students' academic achievement and attitudes towards english lesson. Retrieved from http://www.tojned.net/volume/volume01-issue04.pdf#page=8

Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2013). A review of technological pedagogical content knowledge. *Journal of Educational Technology & Society*, *16*(2), 31–51.

Chenail, R. J. (2011). YouTube as a qualitative research asset: Reviewing user generated videos as learning resources. *The Qualitative Report*, *16*(1), 229–235.

Dabner, N., Davis, N., & Zaka, P. (2012). Authentic project-based design of professional development for teachers studying online and blended teaching. *Contemporary Issues in Technology and Teacher Education*, *12*(1), 71–114.

Frank, M., & Barzilai, A. (2006). Project-based technology: Instructional strategy for developing technological literacy. Retrieved from http://scholar.lib.vt.edu/ejournals /JTE/v18n1/frank

Gachago, D., Ivala, E., Backhouse, J., Bosman, J. P., Bozalek, V., & Ng'ambi, D. (2013). Towards a shared understanding of emerging technologies: experiences in a collaborative research project in South Africa. *The African Journal of Information Systems*, *5*(3), 4.

Greene, H., & Crespi, C. (2012). The value of student created videos in the college classroom–an exploratory study in marketing and accounting. *International Journal of Arts and Sciences*, *5*(1), 273–283.

Hartsell, T. (2013). The effectiveness of using digital movies as a form of reflection. *Journal of Educational Technology Development & Exchange*, *6*(1). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&autht ype=crawler&jrnl=19418027&AN=94433935&h=Pr%2FKv1a0ym59QE7ZfHxLjAg 1myw8Mi4Srdph3oMhlQMfTwmy5Uktwlf1NRhBoQQ2lCAAc%2F%2BTveFe8r2y %2F3Inog%3D%3D&crl=c

Hofer, M., & Owings-Swan, K. (2005). Digital moviemaking—the harmonization of technology, pedagogy and content. *International Journal of Technology in Teaching and Learning*, *1*(2), 102–110.

Hung, C.-M., Hwang, G.-J., & Huang, I. (2012). A project-based digital storytelling approach for improving students' learning motivation, problem-solving competence and learning achievement. *Journal of Educational Technology & Society*, *15*(4), 368– 379.

Junco, R., Heiberger, G., & Loken, E. (2011). The effect of Twitter on college student engagement and grades: Twitter and student engagement. *Journal of Computer Assisted Learning*, *27*(2), 119–132. http://doi.org/10.1111/j.1365-2729.2010.00387.x

Kilinç, A. (2010). Can project-based learning close the gap? Turkish student teachers and proenvironmental behaviours. *International Journal of Environmental and Science Education*, *5*(4), 495–509.

Koehler, J. M., & Mishra, P. (2009). What is technological pedagogical content knowledge? Contemporary Issues in Technology and Teacher Education, 9(1), 60-70.

Koehler, J.M., Mishra, P., and Cain, W. (2013) What Is Technological Pedagogical Content Knowledge (TPACK)? Journal of Education Volume 193, Number 3, 2013

Kurzel, F., Rath, M., & others. (2007). *Project based learning and learning environments*. Citeseer. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi= 10.1.1.381.8612&rep=rep1&type=pdf

Lane, S. D., & Lewis, T. N. (2013). The "Digital Divide," social media, and education-related outcomes. *The Online Journal of New Horizons in Education*, *3*(2), 39–50.

Manfra, M. M., & Hammond T. C. (2006). Teachers' instructional choices with student-created digital documentaries: Case studies. Journal of Research on Technology in Education. (JRTE) 41(2), 223–245

McKenney, S., & Voogt, J. (2011). Facilitating digital video production in the language arts curriculum. *Australasian Journal of Educational Technology*, *27*(4), 709–726.

Neo, M., Neo, K. T.-K., & Lim, S. T.-L. (2013). Designing a web-based multimedia learning environment with laurillard's conversational framework: An investigation on instructional relationships. *Turkish Online Journal of Educational Technology-TOJET*, *12*(3), 39–50.

Schul, J. E. (2012). Toward a community of learners: integrating desktop documentary making in a general secondary history classroom. *International Journal of Technology in Teaching and Learning*, *8*(1), 44–62.

Tamim, S. R., & Grant, M. M. (2013). Definitions and uses: Case study of teachers implementing project-based learning. *Interdisciplinary Journal of Problem-Based Learning*, *7*(2). http://doi.org/10.7771/1541-5015.1323

Torrez, C. A. (2010). Because I was curious": Oral histories and Web 2.0 in elementary social studies methods." *International Journal of Technology in Teaching and Learning*, *6*(2), 146–156.