A Lecturer's Perception of the Adoption of the Inverted Classroom or Flipped Method of Curriculum Delivery in a Hydrology Course, in a Resource Poor University of Technology

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Abstract: The core business of any higher education institution (HEI) is to provide quality learning to its students by facilitating deep learning. More often than not, this goal is not fully achieved in most HEIs globally. This is in part due to over-reliance on the lecture method of delivering instruction, a method which is not particularly an effective medium for promoting deep learning. The delivery of instruction in Civil Engineering at a University of Technology, South Africa, is predominantly via the lecture method. As a result, an alternative method of delivering curriculum in this field maybe needed in order to improve student learning. Informed by a modified technology acceptance model, this paper presents a lecturer's perceptions on the adoption and benefits of the inverted classroom method (ICM) of delivering instruction in a hydrology course, in the Civil Engineering field. A qualitative approach of collecting data was used and the data consisted of recordings of an in-depth interview with the lecturer and a workshop facilitated by the lecturer to introduce the ICM to 11 lecturers from various disciplines in the university. Data analysis was done deductively whereby relevant data were mapped to the constructs given in the conceptual framework. Some key findings were that the lecturer implemented the ICM due to his self-efficacy, technological self-efficacy and perceived usefulness of the ICM of curriculum delivery. The study also highlights the challenges experienced in, and effective ways of implementation, of the ICM of curriculum delivery at the university. Findings of this study will give insights and ideas on the adoption and benefits of the ICM of curriculum delivery in an engineering field at the university and also in other resource-poor contexts, particularly in the African continent, where there is limited research and use of the ICM for instruction.

Keywords: inverted classroom or flipped method of curriculum delivery, technology acceptance model, the lecture method of curriculum delivery, teacher self-efficacy, technological self-efficacy

1. Introduction

The main business of any higher education institution (HEI) is to provide quality learning to its students, which can be facilitated by deep learning. More often than not, this goal is not fully achieved in most HEIs globally. This is in part due to over-reliance on the lecture method of delivering instruction, a method which is not particularly an effective medium for promoting deep learning (Johnson et al. 1991; Bates & Galloway 2012).

Drawing from a modified technology acceptance model (Chigona et al. 2012), this paper presents a lecturer's perceptions on the adoption and benefits of ICM of delivering instruction in a hydrology course, in the Civil Engineering field, at a University of Technology, South Africa. The study was guided by the following questions:

- What factors influenced the lecturer's adoption of the ICM of curriculum delivery?
- What was the lecturer's perceived benefits of implementing ICM to himself and his students?

Some key findings were that the lecturer implemented the ICM due to his self-efficacy, technological self-efficacy and perceived usefulness of the ICM of curriculum delivery.

2. Literature review

Teaching and learning in higher education Institutions

Most teaching in higher education is by the lecture method (Bates & Galloway 2012; Koller 2011), with the main emphasis being on coverage of content (Strayer 2007). Johnson et al. (1991) reports on several studies that show lectures are a relatively ineffective way of promoting learning (see also Bates & Galloway 2012). In the lectures, students are introduced to the materials or concepts, process the information, solve problems and practice with the course concepts and reach conclusions outside of the class (McDaniel & Caverly 2010; Talbert 2012). In Engineering education, Nguyen and Toto (2009) and Lord and Camacho (2007) report that majority of the classrooms still rely on the lecture model of delivery of course content. While this format has

been effective, in practice, we still find significant problems with pacing of instruction and the fact that the most difficult tasks students have to perform generally appear in the work they do outside of class (homework), on their own and separated from the instructor's help (Nguyen & Toto 2009; Talbert 2012).

To improve on student learning, HEIs needs to use pedagogical approaches which promote deep student learning and thus, students' high performance. One of these pedagogical approaches is the 'Inverted classroom method' (ICM) (Gannod et al.2008; Koller 2011), a term coined by a group of economic professors in Miami University (Ohio) (Lage et al. 2000). In the schooling sector, the ICM is often known as the 'flipped classroom, a term coined by Bergmann (2011), a high school Chemistry teacher. The ICM of curriculum delivery uses technology to 'flip' or 'invert' the traditional lecture model (Strayer 2007). The method moves the lecture outside the classroom via technology and moves homework and practice with concepts inside the classroom via learning activities. The primary elements of the ICM are online lecture materials, in audio/video format, that students can access on demand, and a classroom environment that is conducive to working with peers and the lecturer, problem solving and answering questions (Demetry 2010; Gannod et al. 2008; Lage et al. 2000; McDaniel & Caverly 2010; Nguyen & Toto 2009; Strayer 2007). Hence, online materials are used to provide the first introduction to course topics and classroom time is used to process the information and solve problems. According to Lage at el. (2000), the inverted classroom environment is not a new idea and Gardner (2012:2) argues that, "the modern version of inverted class, which is characterized by online videos, is already over a decade old". However, the method is new to many faculty and in recent times, has received increased attention.

An advantage of the ICM are the out-of-class activities, which include students watching online videos introducing course concepts, showing examples, giving quizzes or exercises and modeling problem solving process (Doering & Mu 2010; Talbert 2012). By using videos this way, students who would have found the lecture pace slow are able to work quickly through material that they already know and delve into more interesting and challenging problems (Koller 2011). Students who would have struggled with concepts can access the course materials when they are ready to learn, and at anytime of the day and are able to rewind and watch tricky segments many times (Gannod et al.2008; Gardner 2012; Strayer 2007). Students can also pause and reflect on the lecture materials when needed (Talbert 2012).

By watching the videos out of class, students arrive in class prepared to practice the ideas to which they've already been exposed. An assignment over the material is given and student work in groups. The students are involved in active and peer learning, while the lecturer walks around, observing their work and offering appropriate assistance. Students who struggle with the concepts benefit from the instructors time, time that the instructor spends identifying the particular and individual sources of a student's confusion, hence promoting personalized instruction. The faster students may also serve as peer mentors (Gannod et al. 2008; Koller 2012; McDaniel & Caverly 2010; Strayer 2007) for the other students in the class, this would mean the slower students have more help available to learn the concepts. The faster students might achieve the deeper understanding that comes from explaining a concept to someone else. This might also mitigate the risk in self-paced learning where a student quickly crams through material, but isn't engaged with it for a long enough time for long-term retention.

The ICM is criticized for assuming that every student has access to technology (computer, smartphone or tablet) and Internet connectivity (Gardner 2012), an unrealistic expectation especially in developing countries, like South Africa. For the method to work well for instructional delivery, majority of the students must engage with the online materials before class, a scenario that is highly unlikely without developing an enforcement mechanism. Furthermore, developing inverted classroom materials is labor intensive and time consuming (Bates & Galloway 2012; Talbert 2012), for lecturers who are expected to teach as well as do research. However, ICM is still useful despite the criticisms.

Even with this potential to promote effective learning, there are few research studies that specifically investigate the ICM globally (Strayer 2007), and particularly [in Africa].This paper presents a lecturer's perceptions on the adoption and benefits of ICM of delivering instruction in a hydrology course, in the civil Engineering field, at a University of Technology, South Africa.

3. Course details

The hydrology course is a third year module within the Water Engineering subject 3 and contributes 50% of marks towards the subject. The water Engineering 3 subject contributes towards the attainment of a national diploma in Civil Engineering. It is a compulsory one semester course taught in the second semester, with two-one- hour lectures per week. The course is aimed at imparting the principles and practices of engineering hydrology through the use of examples and calculations. The lecture method of curriculum delivery is used to teach course content, supplemented by student interaction with information through home work, lab session, project and discussions out of class to make meaning of the course content. The course was co-taught by two lecturers.

Inverted classroom method was not implemented in the delivery of the entire course but on selected topics of the course. The selected topics were: introduction to hydrology; meteorological data; evaporation and transpiration; and infiltration and percolation. The lecturer implemented the ICM by providing basic materials on course content to students via online videos (using a shared drive on the institutional intranet for long videos and drop-box for short videos as access systems), short documents on the course website and continuously encouraging the students to engage with the materials through a closed Facebook group. Links from drop box were also posted in the Facebook group. Students were supposed to engage with the online materials at home in preparation for the class. In class, students worked in groups with more complex questions on the course content, with the lecturer assisting and guiding them when needed and students helping each other.

4. Theoretical framework

The paper draws on a modified technology acceptance model (TAM) (Chigona et al. 2012), to investigate and understand a lecturer's perceptions on the adoption and benefits of ICM of delivering instruction in a hydrology course, in the Civil Engineering field. Although this model's focus is on technology acceptance, we felt that it would be suitable for understanding the adoption of ICM since the method relies heavily on technology. The adapted TAM framework (see figure 1) was developed by integrating two constructs (technological self-efficacy and teacher self efficacy) onto Davis's (1989) original model (see figure 2), which stipulates that individuals accept and use a new technology if they perceive it to be useful and easy to use which both determine an individual's intention to use of the innovation. According to McDonald and Siegall (1992), technological self-efficacy is "the belief in one's ability to successfully perform a technologically sophisticated new task". An example of technological self-efficacy is an individual's perception of his or her ability to use computers in the accomplishment of a task rather than reflecting a simple component skill (Compeau & Higgins 1995). Research show that technological self-efficacy influences perceived usefulness and perceived ease of use of a technology (Chigona et al. 2012; Skoretz 2011). On the other hand, teacher's efficacy is defined as the teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tscannen-Moran & Hoy 2001:1).

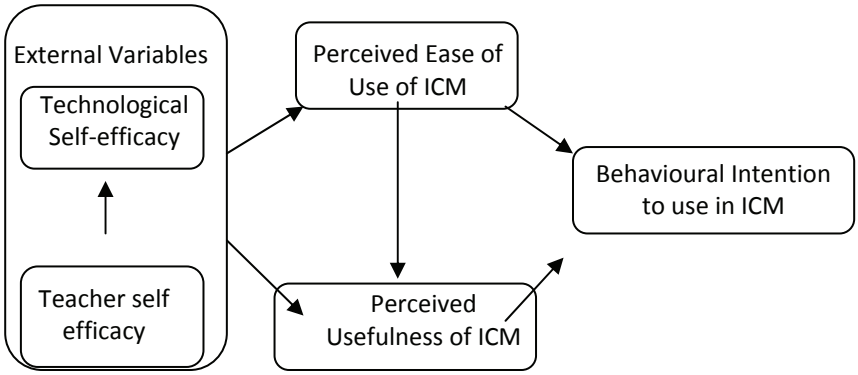

Figure 1: Conceptual framework adapted from Davis' original TAM Model (Chigona et al. 2012)

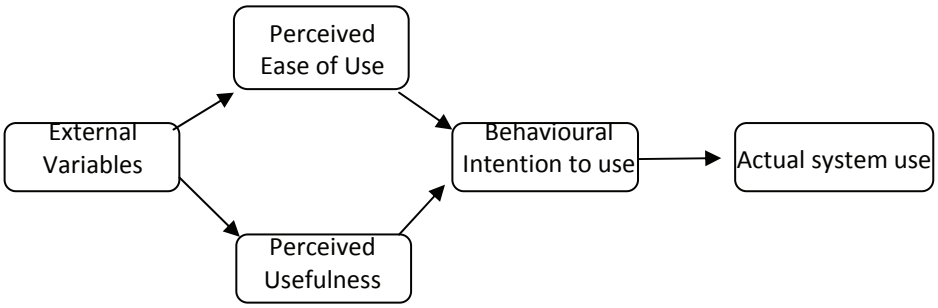

Figure 2: Technology acceptance model (Davis 1989)

Perceived usefulness is "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989), while perceived ease-of-use is "the degree to which a person believes that using a particular system would be free from effort" (Davis 1989).

5. Methodology

A qualitative approach was employed in this study with an aim of understanding a lecturer's perceptions on the adoption and benefits of ICM of delivering instruction in a hydrology course, in the Civil Engineering field. This approach was suitable for the study because of its strength in investigating experiences as they are ' lived' or 'felt' or 'undergone' by the participants (Sherman & Webb 1988).

5.1 Context and participants

The main participant in this study is an Engineering lecturer (The first lecturer to use ICM of curriculum delivery at the university), who implemented the ICM of curriculum delivery in a hydrology class in 2012 and offered a training workshop to 11 lecturers on ICM in November 2012. Thus, a purposive sampling was used (Neuman 1997). He was chosen because he had rich information gained through practice (Patton 1990) and was thought to be likely to reflect on the complexity of implementing the ICM in a resource–poor institution like this university.

5.2 Data collection

A qualitative approach of collecting data was used. Data consisted of recordings of an in-depth interview with the lecturer and a workshop facilitated by the lecturer to introduce the ICM to 11 lecturers from various disciplines in the university.

5.3 Data analysis

Data was analysed using the adapted TAM Framework constructs. The constructs were: technological self-efficacy; teacher self efficacy; perceived usefulness of the ICM; and perceived ease of use of the ICM (see figure 2). Analysis was done deductively whereby relevant data were mapped to the constructs given in the conceptual framework. The researchers in this study acknowledge that findings of this study are not generalisable, but offer valuable insights, which others interested in the implementation of the ICM of curriculum delivery could draw from.

Consent to participate in the study was sought and the purpose of the study was explained to the lecturer. Interview and workshop transcripts were available for the lecturer to scrutinize. Anonymity and confidentiality was adhered to as promised to the lecturer. Ethical clearance was given by Fundani ethics committee.

6. Results and discussion

The paper reports on a lecturer's perceptions on the adoption and benefits ICM of delivering instruction in a hydrology course, in the civil Engineering field, at University of Technology, South Africa. Findings and discussion are presented under the following categories.

- Technological self-efficacy
- Teacher Self efficacy

- Perceived usefulness of the ICM
- Perceived ease of use of the ICM

6.1 Technological self-efficacy

According to Compeau & Higgins (1995), an example of technological self-efficacy is an individual's perception of his or her ability to use computers in the accomplishment of a task rather than reflecting A simple component skill. Inverted classroom method relies heavily on technology, but most faculty at this university, like elsewhere, have not learned their subject content with these technologies and hence do not have essential experiences in learning with these technologies nor have they been prepared to teach their content with these new and emerging technologies (Niess 2011). However, the lecturer in this study implemented ICM partly because he possessed technological self-efficacy:

> *…although I've studied Engineering I also come from a very strong IT background …I did three year Software Diploma and I've always been interested in technology. I think I'm not scared of technology. I find it sometimes a stumbling block for lecturers to get because they are a little bit scared of technology and ...for me it is second nature.*

From the above results, it can be inferred that lecturers' technological self-efficacy influence their decisions to adopt ICM of curriculum delivery, due to the methods reliance on technology for delivering course materials outside the classroom (Strayer 2007). Technological self-efficacy is needed in order for a lecturer to be able to source or develop the online materials.

6.2 Teacher self efficacy

The ICM of curriculum delivery, uses technology to 'flip' or 'invert' the traditional lecture model (Strayer 2007) by moving the lecture outside the classroom via technology and homework and practice with concepts inside the classroom via learning activities. To change from delivering instruction using the lecture method, a method which dominates most teaching in HE globally (Bates & Galloway 2012; Koller 2011), the lecturers need to have self-efficacy (lecturers' "judgment of his or her capabilities to bring about the desired outcomes of students engagement and learning" (Tscannen-Moran & Hoy 2001:1). Lecturers' who have positive self-efficacy will feel confident to include new pedagogical approaches in their classroom. In this study, the lecturer seemed confident enough to teach using the ICM. The lecturer's self-efficacy to teach with ICM is demonstrated in the following quotes:

> *…I had a particular problem this year that they gave me …two hour slots after lunch two days, consecutive days. So the students arrived tired, struggled to concentrate… So I thought you know I cannot use normal techniques here, it's not going to work, you know because they'll fall asleep … Now if I can get them involved, I can hear them talking and engaging, I feel that's a great way of stimulating conversation and learning more…*

> *…I've lectured a lot of subjects over many years and it does get boring doing the same thing over and over and it's probably my biggest motivation …I'm looking for things that makes it not only interesting for the student but start making it interesting for me because it's my job … Making things exciting but it's nice and that's why some lecturers are also actually buying in on it because it brings back some excitement in their teaching …*

The above findings show that this lecturer had very high levels of self-efficacy as he was able to reflect on his own teaching methods (lecture method) and the context of teaching (lecture time slots at lunch time when students are tired) and how it impacted on students learning (students not concentrating). He was also able to come up with ways of changing his teaching and student learning, which included the decision to adopt the ICM in order to be able to actively engage students in learning. He also adopted the method to make his work more enjoyable and exciting. The lecturer's self–efficacy was also shown by the fact that he was confident enough to facilitate a staff training workshop on the ICM at the university.

6.3 Perceived usefulness of the ICM

It is commonsense that many faculty would adopt a new pedagogical approach when the approach is perceived to help improve the teaching and learning process. According to Davis (1989) perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job. The lecturer

in this study believed that the ICM of curriculum delivery was useful for facilitating deep learning and enhancing his job, as evidenced in the following quotes:

> *…the things I did right was the whole idea of giving the material beforehand, basic material and then coming to class and then carry on with a little bit more advanced examples… questions that require cognitive engagement, when I'm there to prompt them and help them and they help each other obviously. They help each other actually a lot. Sometimes they don't even want the lecturer to give them help... what happens in normal classrooms is the lecturer stands up and …does basic examples and then he tells students' to go back do homework and the homework is then more advanced…*

> *… it [ICM] enriched my job because I'm unfortunately in the situation that I will probably be stuck as a lecturer … till I retire. So I have to make my life interesting. I have to enrich my own life and I have to use new methods. And it definitely did … I'm getting some exposure, meeting some new people…and I'm making new contacts all the time now…*

6.4 Perceived ease of use of the ICM

The perceived ease–of-use of an innovation is "the degree to which a person believes that using a particular system would be free from effort" (Davis 1989). The way lecturers perceive how ease the ICM is to use in the classroom influence their decision to adopt the method for their teaching or not. In this study, the lecturer indicated that the method was useful for enhancing deep student learning and his job, but expressed that the method was not ease to use because it was labor intensive and time consuming to make the online materials and that one needed to motivate students to ensure that they engaged with course materials at home.

> *I don't think it's easy because it takes a lot of preparation… you have to prepare new material where you could have just stuck with the old, … it takes time to make little videos and editing it. …to actually shoot the video it takes probably four/five times as long to edit it…*

> *I believe that this inverted classroom needs to go hand in hand with a good communication tool because if you want to give students stuff to do outside the classroom there needs to be constant communication… I think a major problem would be just to let the student be and when he comes to class again then he says well I didn't understand what I was supposed to do or whatever…. I set up Facebook …for the subject and I had all 50 students actually in the group and it was a closed group… we had constant questions from students, posting of things that's happening, go look on the shared drive for this thing and do that. So the instructions didn't only take place in the classroom, the communication went right through the week.*

These results are similar to findings by Bates and Galloway (2012) and Talbert (2012). According to the lecturer, a mind shift on how one teaches is needed to embrace the ICM and constant communication with students is required to ensure that students engage with course materials outside the classroom. The lecturer also reported that at the university it was not ease to use the ICM because of contextual and social issues, as he explained in the following quotes:

> *…let's say two lecturers lecture the same subject we have to agree on the assessment. Now this deeper learning that took place might not be assessed because we're back to the old way of let's say we taught in class and we have to assess those basic things. So maybe if a paper was set with more higher level questions it would have come out more clearly. But I must say my class did way better than the other group but I can't say it was because of the inverted…*

> *…I don't know about other places but you can come and look at our classrooms. They're terrible …I want to show a little video of something … using a data projector, I don't have sound, then you could hardly see because there's no way I can make the classroom a bit darker. It's very noisy and it's uncomfortable…*

> *… what is happening because our facilities are so poor, if I have to go to class and use technology there, I bought myself a trolley. In the trolley I put my laptop, data projector, my two speakers, my extension cord... Now I trolley this to the classroom…tea time I would go fifteen minutes before the time …and set up my things. And then of course at lunchtime when we stop I have to take down all this lot again – put it in my trolley and off I go back. Now that in itself is really a big stumbling block for anyone who wants to implement this because it's really too much hassle.*

The above findings show that co-teaching a course, poor classroom conditions, and lack of technology and technical support in the use of technology in teaching and learning may hinder lecturers' use of the ICM at the university. The provision of good teaching facilities and technical support in the use of technology would make lecturers find the ICM easy to use.

7. Conclusion

Findings of the study show that the lecturer perceived the use of the ICM of curriculum delivery significant for promoting deep learning and enhancing job satisfaction. Through this method, the lecturer managed to create a learning environment which encouraged student participation in class (both for slow and high aptitude students); independent learning; high students-student interaction with the course content; student -contents interaction and student-lecturer interaction, characteristics of teaching and learning which promote deep learning (Anderson 2003). Additionally, results indicate that lecturers' adoption of the ICM is to some extent affected by lecturers' technological self-efficacy coupled with teacher self efficacy, as the lecturer in this study adopted the method partly due to his self efficacy and technological self-efficacy. Because of the labor intensity and time needed to produce online materials, and the contextual and social issues at the university, the lecturer perceived the adoption of the ICM not easy.

Findings of the study also demonstrated that it is important for lecturers to try innovative pedagogical approaches because it demonstrates to the students that the lecturers are trying to help them learn, which may improve their motivation.

> *…I think students are becoming more and more technology savvy…If you look at the response of students [on the use of ICM] they're actually fine with you trying these type of things and they do enjoy it because that's what they are using everyday [technology]*
>
> *We are also convinced that an institution that aspires to greatness and innovation has to be open to support a wide variety of pedagogical approaches, of which ICM is one.*

Further in-depth research will be done to examine students' perceptions on the use of the ICM for their instruction in this course.

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Biographies

Conference Chair

Professor Christine Winberg is the Director of the Fundani Centre for Higher Education Development at the Cape Peninsula University of Technology in Cape Town, South Africa. The Fundani Centre is responsible for enhancing teaching, learning, and educational research at the institution. Her work involves academic development, policy work, and programme evaluation. She is also the project leader of the Work-integrated Learning Research Unit, which is supported by the South African National Research Foundation. Her research focus is professional and vocational education and technical communication. Previously she lectured in applied linguistics and language education in South Africa and in Sweden. She is chairperson of the South African Association for Applied Linguistics.

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Keynote Speakers

Professor Andy Bytheway. Following a career in the systems and software industry, Andy Bytheway took up an academic post at the Cranfield School of Management in the UK, first as Lecturer and then as Research Fellow. There he pioneered commercially-funded Information Systems research and he taught on the Cranfield MBA programmes in the UK and Singapore. He emigrated to South Africa in 1998, where he took up the Old Mutual Chair in Information Systems at the University of the Western Cape His specific interest in the management of information technology in education arose from a two-year research partnership with the Cape Technikon, which investigated the role of information technology in Higher Education. On his retirement he continued to work at CPUT as Adjunct Professor of Information Management, supervising masters and doctoral research and assisting with funded research projects

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Mini Track Chairs

Khalid Alshahraniis a lecturer at King Fahad Naval Academy in Saudi Arabia. His research interest includes understanding eLearning in Higher Education from sociocultural perspectives adopting Activity Theory as a theoretical perspective. He is also interested in how eLearning and Distance Learning programs can enhance teaching and learning especially English as a Foreign Language (EFL).

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