Influence of Mobile Learning Discourse on Human Agency: A Critical Discourse Analysis Perspective

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Abstract: One of the challenges facing higher education (HE) in South Africa is to increase the number of science and engineering graduates. At the core of these disciplines is mathematics. Thus, the problem is that poorly prepared students find it difficult to succeed in university mathematics. This paper argues that the use of mobile phones has potential to enhance student engagement with mathematics learning resources. The study involved forty-nine first year students who had previously failed mathematics and therefore suffered from low self-esteem. Critical Discourse Analysis (CDA) is used to understand ways of empowering students and uncover the inter-relationship between text, interactions, and context. The paper concludes that the use of anonymous Short Message Services (SMS) fostered student engagement with mathematics and may have contributed to student's improved academic performance.

Keywords: short message services (SMS), higher education, mathematics education, critical discourse analysis (CDA)

1. Introduction

South African tertiary institutions are under pressure from the government to dramatically increase the number of graduates in the fields of science and engineering (du Toit and Roodt, 2009). The Facing the Facts study (NACI & DST, 2004) warned that well-trained, effective scientists, engineers and technologists are critical to the country's future. Doubling the numbers of graduating engineers seems to be the medium-term target but at least a ten-fold increase in professional engineers would be needed for South Africa to have ratios of engineers to population comparable to leading countries such as the USA (Creamer Media's Engineering News Online, 6 March 2009).

There are two clear ways to achieve the goal of graduating more students without lowering standards: by admitting more students, and by improving teaching and learning conditions so that more students are able to meet the standards for qualification (i.e. increasing throughput). These easily-stated objectives have been the subject of much research, particularly regarding teaching and learning. Since pass rates for first year mathematics continue to be lower than desirable, it seems that there is a need to find additional ways to engage students whose learning needs are not being met by current practices.

Apart from increasing the number of science and engineering graduates, a second reason for introducing changes to first-year mathematics relates to the position of mathematics modules within broader degree programmes. It has been argued that for engineering qualifications to be relevant to the 21st century, non-technical topics should be included, such as communication skills, ethics, professionalism and leadership (Galloway, 2008). Assuming that it will be some time before degree programmes extend by a year to give formal space to these topics, it would be beneficial to use every opportunity throughout the current degree programme to develop these 'soft' skills. Innovations that require students to develop communication skills in all modules may help to achieve these additional learning objectives.

2. Background

Much research has been done on the identifying and addressing the possible reasons for low throughput rates at universities. These include student-centered difficulties with adjusting to university life e.g. living away from home, forming study groups, language difficulties, time management, (Beard, Clegg & Smith, 2005; Bell, McGrane, Gunderson & Anderson, 2010), and lecturer-centered issues, such as unrealistic expectations from lecturers, boring lectures, unfair assessment practices, an overloaded curriculum (Blight, 2000; Stansfield, McLellan & Connolly, 2004). For mathematics courses, the 'mathematics problem' of many students arriving poorly prepared for tertiary studies has been well-documented (e.g. Hawkes & Savage, 2000). Unsurprisingly, first year courses typically

have the highest failure rates (Chrissman Ishler &Upcraft, 2005: 28; Eiselen, 2006). Our thesis is that the systemic challenges facing HE in general and mathematics education in particular have the potential to be addressed if focus is shifted from broad contextual challenges to enhancing engagement with learning resources. This paper focuses on students' interaction and the resulting dynamic generations of text. To this end, Critical Discourse Analysis is used to frame the study.

2.1 Critical discourse analysis (CDA)

The three dimensions of CDA, text, interaction and social action, provided a conceptual framework for this study. According to Fairclough (1992:10) every discourse instance has three dimensions: it is a spoken or written language *text*; it is an *interaction* between people, involving processes of producing and interpreting the text; it is part of a piece of *social action* – and in some cases virtually the whole of it. CDA is particularly significant in this work because of its isolation of text, interaction and social action. According to Fairclough, text is an outcome of human interaction. The *modus operandi* of human interaction is that the social conditions that govern both the production and interpretation of text are oblivious to the interacting human agents. It can be inferred from the statement that mathematical problems are text and lack of student confidence or low self-esteem is oblivious to the process of interpreting and solving the problems. It follows from this argument that the quest for Universities to create more rigorous, immersive, and differentiated learning environments (Franklin, 2011) is insufficient if the conditions for students to become active learners individually are not created. We view learning mathematics as a cognitive activity which therefore happens at an individual level. The use of mobile phones, especially augmenting mobile interactions with anonymity, has potential to increase confidence and enhance student learning.

In Figure 1, we depict the three dimensions of CDA. Fairclough (1992) uses the terms description, interpretation and explanation to move from text to the social context and vice versa. While we have used Fairclough's Discourse Analysis three-dimension framework, we particularly sought to distinguish between "what is said in the text to what can be said from the text" (Ricoeur, 1981:93) and focused on the former. To this end, our goal is not to analyse and report on the details of the text messages but rather to limit our discussion to the meaning of what the text helps us understand.

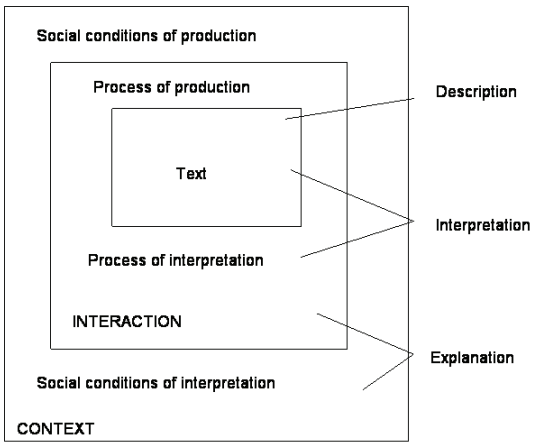

Figure 1: Discourse as text, interaction and context (Fairclough, 1989:25)

Short Message Services (SMS) in a Learning Management System (LMS)

Most university students fall into the group described by Selwyn (2003) as young people who experience time and space differently because of mobile technology. The SMS tool of the LMS allows students to send text messages from their mobile phone to the LMS. The sender has an option to restrict the message to users with particular roles e.g. site owners, participants or support. Alternatively a sender may paste a list of mobile numbers into the tool. The messages can also be scheduled to go out at a later date and time. Mobile phones are personal devices owned by learners and it is therefore important to give learners a choice to unsubscribe should they no longer wish to receive messages on their handsets. The LMS provides an option for users to unsubscribe. Another important consideration is that the mobile numbers are not matched to the user's name. The purpose

of the SMS tool is to push messages from the LMS to students' handset. Messages sent from the SMS tool cannot be responded to.

Unlike the SMS tool, the Question & Answer tool (Q&A tool) is a bidirectional tool (sends out messages and receives messages). The Q&A tool allows users to send questions to the course site anonymously (only the message is published and not the author's name or the mobile phone number). The purpose of anonymity is to ensure a safe environment for learners to express themselves without feeling suppressed or silenced.

The main advantage of mobile phones is the 'always connectedness' they provide, regardless of the changing context of users. This connectedness provides a user with freedom to choose when to use the device. In making a voice call, for example, the caller and the one being called (the callee) should both have their mobile phones switched on. This means there is a convergence of time though space and the physical distance between the caller and the callee is theoretically immaterial. In the absence of a way of knowing whether the callee is available to receive a call, such as is the case with social presence indicators in Instant Messaging software, there is no guarantee that the calls will be successful. However, to the extent that SMS is asynchronous, the receiver does not need to have the device switched on to receive a message, as messages to a switched off mobile device are held in a queue at the Short Message Control Centre (SMCC). The SMCC is responsible for delivery of the message as soon as the device is switched on. SMS is more likely to reach the intended target audience (students) than email. Needless to say, an increasing number of young people rarely read emails and should an email be sent to them, the sender is expected to send a follow-up SMS alerting them to check their email boxes.

The anonymous Q&A can also be used for obtaining feedback from learners. The integration of anonymity with the privacy of a mobile device allows users to feel safe and confident to be expressive on both content and administrative issues of the course. Teaching adult learners is like teaching colleagues and it is sometimes difficult to give honest feedback especially if such feedback is negative. The use of anonymous SMS empowers learners to give honest feedback. It is no longer necessary to wait until the end of the module to get feedback from learners and because feedback is timely it can be used to benefit the current cohort of learners. This is particularly important in block release modules because the contact time with learners is short and there is no time to defer decisions. Learners spend most of the time studying in isolation during the pre and post contact time so the time spent together with learners needs to be optimized. Mobile phones are used to capture the views of the learners about course content and can also be used to reinforce important points of the learning activity.

Mobile-Mediated Interaction

Mobile phones enable socially networked collaborative learning. This type of learning involves creating a task that encourages cooperation, interactivity and social engagement. The task, which requires use of mobile phones, is pedagogically grounded in teaching critical reading skills, interrogation of a reading or collaborative thinking. For example, in a course called E9999[1] , a task or reading is assigned a number e.g. 111. The users are required to contribute either in the form of a response to a question or a comment on a presented idea. Working independently, each learner is asked to use their mobile phones and text their contribution. In practice, the educator will create a topic by texting a short code e.g. prefix a message with a course code, E9999, followed by a text, for example, *E9999 Welcome 2 mobile learning.* The tool assigns the task a number, for example, 111. Learners are given the number 111 and asked to post their comments to that specified code. Learners might post: *E9999-111 + we r explorn & pushn boundries*

E9999-111 + g8 but y don't we c this? The '+' tells that tool to append the message to task 111.

This tool extends the limitations of the 160 characters of the SMS as it allows a user to add to the message. It is an effective way of gathering student opinions on an issue or contribution or feedback etc. In one of the uses of the tool a task was created which required students to decide how they wanted the class to spend a Friday afternoon and to motive why. In a space of 10 minutes, student views were gathered beamed to the class for all to see. All contributions were anonymised though

[1] E9999 is not the real course code

students could see their individual views. A decision was immediately reached and the contributions served as a record of the process. In order to ensure that every student's voice was heard, a task was created, assigned a number and invited contributions from the students. Other uses included use of the tool to get feedback from students on their learning.

Case Study Description

The participants were first year mathematics students who were repeating a module they had failed the previous semester. Participants (n=49) were thus familiar with the material and needed enhanced engagement with the learning resources to ensure understanding. As a consequence of previous failure, participants had low self-esteem and were likely to have low confidence. It was therefore envisaged that an anonymous interaction would empower participants to engage more, and openly expose misconceptions that could lead to improved learning and increase chances of passing.

3. Methodology

Participants were introduced to the Q&A tool that was part of a LMS. The Q&A tool has both a web and SMS feature. The strategy was to introduce participants in a lab session so that the tool could later be used independently outside the campus environment. During a face-to-face session, the researcher requested participants to indicate their mobile network providers. To ensure that no students were excluded from participating on the basis of financial constraints, attempts were made to purchase R10 of SMS credit for each student. However, a once-off purchase of this amount was not possible by any of the three mobile service providers in South Africa. It was also difficult to purchase a once-off SMS credit for a student on a mobile phone contract. The idea of sponsoring SMS credit was therefore abandoned. Many students indicated that they preferred to access the LMS via computers on campus or via laptops in their residence rooms rather than via their mobile phones.

The researcher setup the communication rules which was that the use of Q&A was to be educational in the context of the curriculum. Users of the tool could either ask a question or respond to posted questions. Table 1 depicts some of the questions anonymously posted.

Table 1: Some of the Q&A questions with number of answers and frequency of views

Question ID	Question	Answers	Views
9256	how do you do question 38.c intergration by parts(the big weird S Is the interggral sign) i get it up to hre = 0.5x2arctanx -0.5S x2/1+x2 dx . i dnt get how you get S 1- 1/1+x2 please explain this step	2 (3.8%)	3 (1%)
9035	What is the angle between the hour hand and the minute hand when your wrist watch says quarter past three?	4 (7.7%)	11 (3%)
9023	What can you say about average rates of change?	12 (23%)	83 (19%)
9021	Question 80 in the workbook asks for an estimate of ln 1.2 and ln 0.8. How do you know what point to use to find the equation of the straight tangent line?	6 (11.5%)	108 (25%)
9020	Physicists often just use x as an approximation to sinx. Are they mad?	24 (46%)	158 (37%)
8875	Why are radians preferred to degrees?	4 (8%)	68 (16%)
	Total	52	431

The question with the least number of answers was 9256 with only 3 hits (views). The posting is significant in that the student begins by explaining what s/he has done and the point where help is required. This suggests that the author is confident to 'expose' their (mis)understanding. This confidence could be attributed to the anonymous interaction. The question that attracted most responses (46%) and views (37%) was 9020 about whether Physicists were mad to use x instead of sinx (See Table 2). The question was phrased such that it had some element of humor while remaining educational.

Table 2: Physicists mad or not

Q9020: Physicists often just use x as an approximation to sinx. Are they mad?
2011-08-31 09:03 It may help to find a linear approximation to sinx at a suitable point. 2011-08-31 09:08 no,they are not mad because the derivative at x is equal to 1,ant that of sinx is cosx and cosx at x=0 the approximation is 1 but this approximation is only applicable when x=0 2011-08-31 09:10 The linear approximation of sinx is the product of x and cosine of x, which is y = xcosx 2011-08-31 09:11 no they are not mad, x is a good approximation to sinx for x = 0, but it does not seem to be like that for other x values 2011-08-31 09:12 nope theyre not mad:) f(x)= sinx f '(x)= cosx f ' (x)= cos(0) so, m=1 y-o=1(x-0) y=x :D 2011-08-31 09:19 no, they are not mad cos th derevative of sin x is cos x which equals 1 at x=0,and derevative of x=1>>>they are rght

Another question that had several responses (23%) was Q9023. With 83 (19%) views, it was the second most looked up question (See Table 3).

Table 3: Rate of change question

Q9023: What can you say about average rates of change?
2011-08-31 09:54 The change in the value of a quantity divided by the elapsed time. For a function, this is the change in the y-value divided by the change in the x-value for two distinct points on the graph 2011-08-31 09:30 its finding the average of a quantity that is changing with time,for instace VELOCITY. 2011-08-31 09:30 Its sumthn whch has to do with finding a gradient from da initial point to da ending point 2011-08-31 09:32 y-y1/x-x1 5 2011-08-31 09:33 1st deriv =vel. and 2nd deriv = acceleration

The Virtual Noticeboard was also created where hints to assignment questions were placed to be retrieved using SMS on demand. Table 4 shows the hints to questions 4, 5, 8 and 10. The purpose of the Virtual Noticeboard was to provide students opportunities to attempt to answer questions without assistance and to allow students to decide when to access and retrieve help.

Table 4: Virtual noticeboard

Short hints are available for Q4, 5, 8 and 10 from the trigonometry exercises on page 44 of the 3rd term notes. To access them, sms the following to 31957. (Standard sms rates apply.) Question 4: sms **A 9155** Question 5: sms **A 9156** Question 8: sms **A 9158** Question 10: sms **A 9157**

The hint to question 8 was with respect to the following problem.

8. Verify the following identities
[To verify an identity you need to show that the left hand side (LHS) is equal to the RHS for all x. **Do not assume** that the two sides are equal, this is what you have to **prove**.]

i) $\frac{\cot x - \tan x}{\sin x \cos x} = \csc^2 x - \sec^2 x$

ii) $\frac{\cot x}{1 - \sin x} = \sec x(\csc x + 1)$

iii) $2\sin^2 \frac{\theta}{2} = \frac{\sec\theta - 1}{\sec\theta}$

Figure 2: Example of question for which a hint was placed on the Virtual Noticeboard

Hint ID	Description	Hint
9155	2011-09-29 09:45 Trig question 5 hint	Convert angles to x, then convert other ratios to sinx and cosx
9156	2011-09-29 09:45 Trig question 5 hint	Separately get LHS and RHS in terms of sin(theta) and cos(theta). Use an identity on LHS to get two terms
9157	2011-09-29 09:51 Trig question 10 hint	cos(a+b)=cos(a)cos(b)-sin(a)sin(b) and sin(a+b)=sin(a)cos(b)+cos(a)sin(b). Get RHS ito sin and cos then make denominator one term
9158	2011-09-29 09:58 Trig question 8(iii) hint	For (iii) sin^2(x/2)=(1-cosx)/2

4. Observations

A humorous but offensive posting by one student in the lab session got part of the class laughing and the educators' attempt to immediately delete the posting failed, setting up some discomfort in the class. While students are expected to take control of their learning, the educators need to take control of the learning environment. Some postings by students had an immediate effect on pedagogy. For example, a student requesting more information on a topic the educator had previously explained, led to further explanations in different ways. Such feedback could be gained in any class setting but the anonymity of the Q&A forum seemed to make giving and receiving such feedback easier because of the lack of social/psychological barriers, such as causing embarrassment. While real-time anonymous feedback was of benefit to students, it had implications for the educator who needed to be prepared to adjust the teaching to address unanticipated outcomes. This form of feedback had an impact on the teaching practice of mathematics.

Although the LMS was institutionally adopted, only a few students owned Notebooks and had access to Internet at home to have access to the LMS beyond campus. Despite the fact that the majority of students had mobile phones, the LMS was not accessible on most student mobile phones unless on Smart phones. The use of SMS as an interface to the LMS had varied outcomes. For some students, anonymous communication empowered them to ask questions and / or to comment on other students' postings, yet others found that the cost of the SMS was an inhibition.

Anonymous responses meant that the lecturer could not give individualised feedback for particular misconceptions, as might be possible in small group tutorials. Explanations addressed to the whole class could be boring for students not sharing the misconceptions. The advantage of using an online forum over answering questions verbally was that a record of questions and answers was saved for students to review at a later date if necessary.

One of the options of consideration is the reverse billing so as to absorb the costs for incoming SMS. However, there is no reverse billing in South Africa. The alternative would be to have a toll free number for educational uses. Such educational numbers could take the form similar to call me e.g. ***999#31975#.** The integration of the mobile learning into the mainstream will require that issues of cost be addressed and integration of students' mobile phones and institutional LMS become seamless.

5. Discussion

The influence of mobile learning discourse on human agency is depicted in Figure 3. In the teaching and learning of mathematics, human agents are educators and students, both with complementary roles. Pressures on HE influence the production or design of the science and engineering programmes. Although these pressures are oblivious at a pedagogical level, they are important indicators of the success of HEI in this regard. Many students for whom the curriculum is designed are inadequately prepared for HE, and consequently perform poorly.

The human agency is exercised at interaction level. The educator designs the learning tasks, appropriates technological tools such as the LMS and mobile devices, and invites students to engage with the learning resources. The interactions were structured to foster confidence. Technologies already in the hands of students, the mobile phones, and the competence of using the devices were exploited to enhance interaction with mathematics resources. The educator posted questions (text) and invited students to engage with the problems and post responses. Students also posted questions. The educator also posted hints to assignment questions.

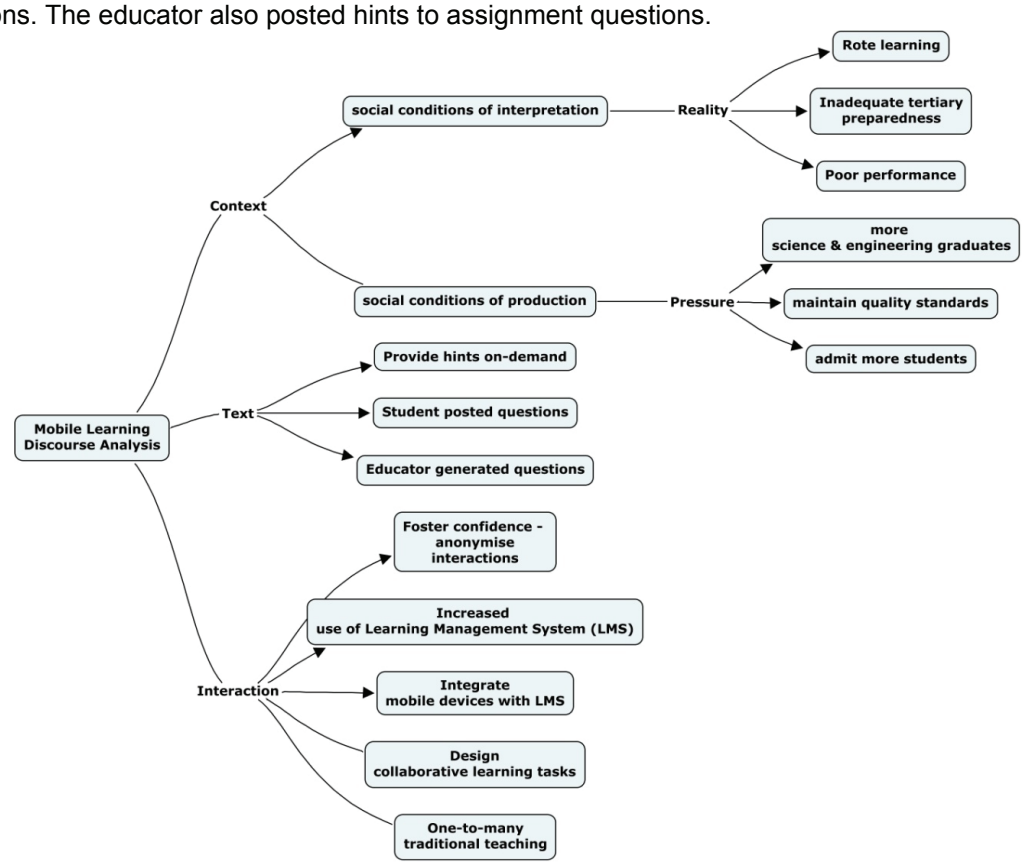

Figure 3: Mobile learning discourse analysis

6. Conclusion

Our thesis was that the systemic challenges facing HE in general and mathematics education in particular have the potential to be addressed if focus is shifted from broad contextual challenges to enhancing engagement with learning resources. Through the lens of Critical Discourse Analysis, this paper examined students' interaction and the resulting dynamic generations of text using anonymous SMS provisions through a LMS. The anonymous SMS tool did appear to foster student engagement with mathematics and may have contributed to student's improved engagement with mathematics, resulting in better academic performance. The anonymity provided through the LMS may be particularly beneficial to students experiencing low self-esteem, such as students repeating a module or who school background has not adequately prepared them for tertiary studies.

Future studies could investigate whether the use of technology in the mathematics class resulted in improved motivation towards mathematics studies. This can be done through interviews and a focus group.

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