INSIGHTS INTO PERSUASIVE TECHNOLOGY FOR M-LEARNING USING ACTIVITY THEORY

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ABSTRACT

In theory, educational applications that are engaging and motivating should easily persuade learners to use a mobile device for studying. Since this technology is already familiar to learners, mobile learning should be easily accessible; given a suitable m-learning application, learners could practice mathematics anytime or anywhere. LevelUp is an m-learning application, an example of educational persuasive technology that provides learners with educational content to practice mathematics exercises, it offers learners who successfully complete mathematics exercises with rewards, such as airtime or data bundles. The use of rewards is intended to persuade the learners to establish a new, sustained, learning behaviour. However, in the research reported on in this paper the learners were not attracted to and persistent in using the application. The aim of this study was, therefore, to understand the learners' perspective of the LevelUp application as a persuasive technology. This is an explanatory case study where the interpretive paradigm was used for analysis. The analysis used Fogg's Behaviour Model and Activity Theory as a way to understand this complex activity and to highlight the contradictions between LevelUp's intentions as a persuasive technology and the learners' perspective. Focus group interviews, questionnaire and observation were all used to collect data. The study contributes towards designing educational persuasive technologies that are effective and sustainable for use after school time from the learners' perspective.

KEYWORDS

Persuasive Technology, Study Behaviour, Mobile Application, Motivation, m-Learning

1. INTRODUCTION

This study focuses on a particular group of users in a particular context - learners who wait at a particular South African school, after school hours, for transport home. Some stay long after the school has closed without adult supervision, and might get into mischief. The LevelUp application, created by a group of developers that the researchers are not part of, looks for ways to influence learners similar to these to establish a behaviour to study mathematics using a mobile device application and it could be used during this waiting time. The application uses rewards of data bundles or airtime for successfully completing mathematics exercises. This is done to encourage the learners to return regularly to use the application, and to create a long-term study habit.

The designers of the LevelUp application seem to view learning on a mobile device as a simple activity. They make this assumption, in part, because learners use mobile devices continuously after school time for personal purposes and hence the technology is very familiar (Nikou & Economides 2017). Various forms of persuasion to use an application or a web site has become very common and effective. Hence, developers may assume that learners can be equally easily motivated to engage with educational applications (Yordanova 2007). There is indeed extensive research that shows that persuasive mobile technology, when implemented as recommended, has excellent potential to enhance education and to support learning environments (some recent examples are given by (Botha & Herselman 2015; Bray & Tangney 2016; Nikou & Economides 2017).

In the case of the LevelUp mobile application, using rewards to encourage the learners to study regularly was not successful. This study, therefore, aims to answer the question, 'Why were the learners not attracted to and persistent in using this persuasive technology?' The purpose of the study was to understand the learners' perspective of persuasive technology as implemented in the LevelUp application. The study aims to

contribute insights into the design of educational persuasive technology by highlighting the learners' perspective.

In order to do this, the Fogg Behaviour Model (FBM) is used to understand learner behaviour (Fogg 2003). This is supplemented by Activity Theory (AT) (Engeström 1987). FBM focuses on the behaviour of the individual, while AT assists the researcher in understanding specific relationships in a complex activity (studying the mathematics) within a social context. Focus groups, questionnaires, observation of learners' after-school behaviour and the LevelUp database were employed as data collection instruments. The paper is organised as follows: First a brief literature review is presented followed by the analysis of data using FBM. Next Activity Theory is applied which leads to the conclusion.

2. LITERATURE REVIEW

2.1 Persuasive Technology

Mobile learning is the use of mobile devices (tablets, smartphones and cell phones) for learning. A persuasive technology application is software or an information system designed to change the behaviour of the targeted group (without using coercion or deception) (Oinas-kukkonen & Harjumaa 2009). Research shows persuasive technology to be effective in encouraging the adoption of a healthy lifestyle, socially responsible driving habits, informal education, reduction in energy consumption and as a means of interactive marketing; however, it is challenging to implement (Kaptein & Kruijswijk 2016).

2.1.1 The Fogg Behaviour Model

The Fogg Behaviour Model (FBM) assists us to understand behaviours related to persuasive technology (Ng et al. 2016). FBM proposes that three elements must exist simultaneously for a behaviour to occur: motivation, ability and a trigger (Figure 1). It is however important to first identify the specific target behaviour that you are aiming to encourage.

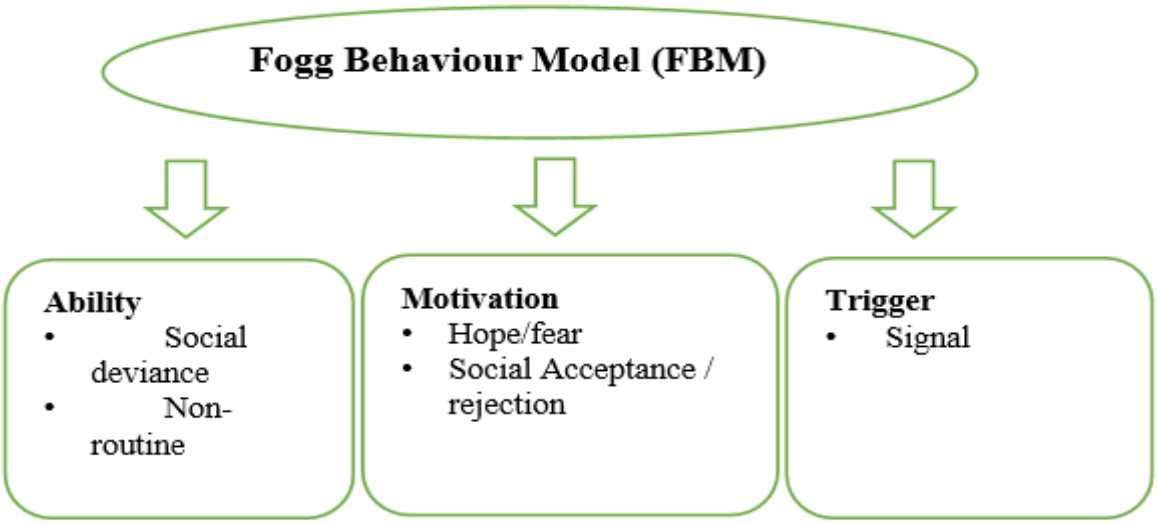

Figure 1. Elements and sub-elements of FBM (Fogg 2009; Ng et al. 2016)

Fogg (2009) also identified an eight-step process for designing persuasive technology (Figure 2). The current study is limited to the evaluation step (Step 3), that is, to finding out whether the persuasive technology effectively encourages the target behaviour; according to FBM, hindrances could be lack of motivation, ability or a well-timed trigger. In this case, the immediate targeted behaviour is the sustained use of the application and not the more complex behaviour of learning mathematics although the application's overall goal is the more complex one.

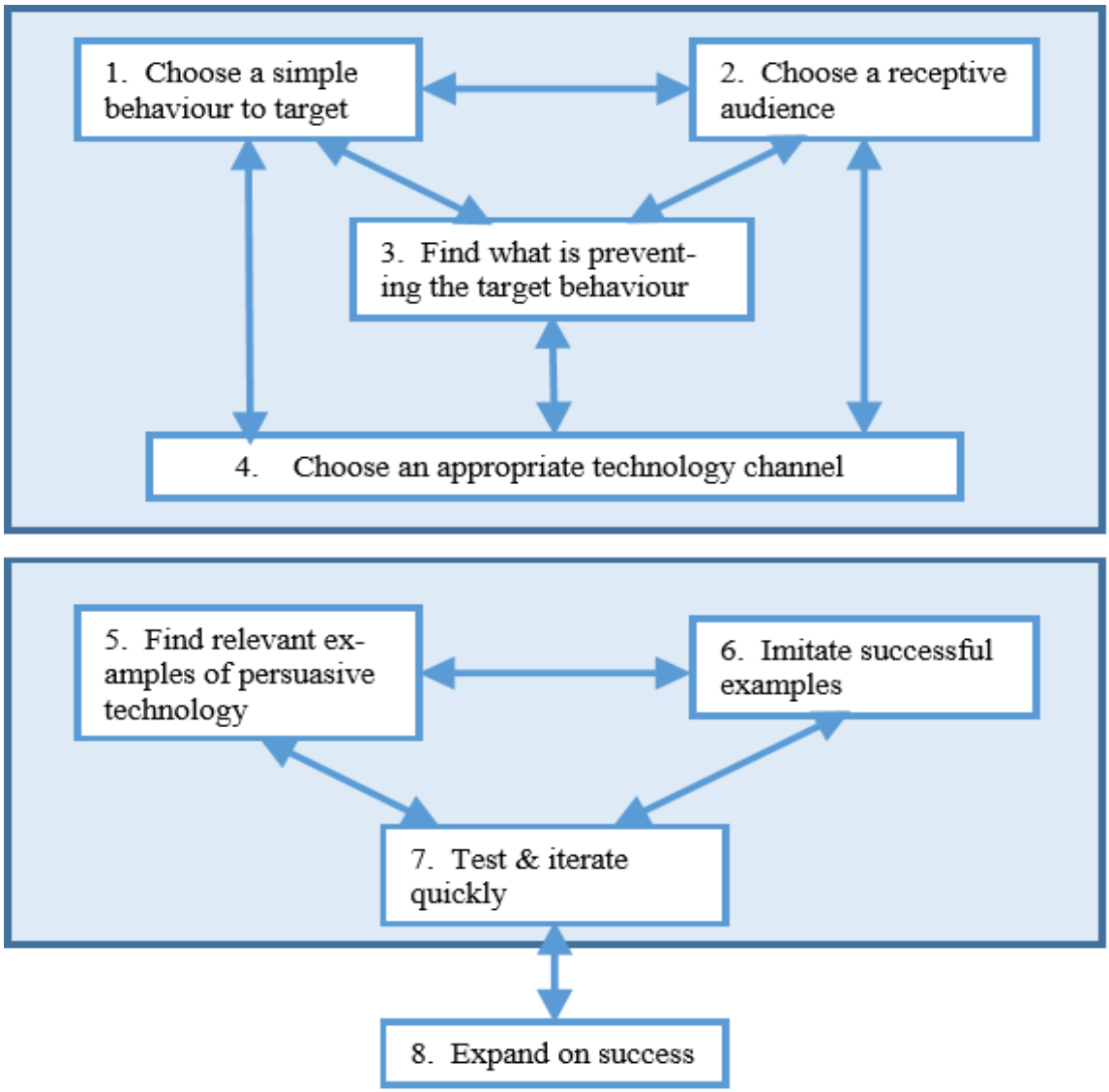

Figure 2. The eight-step process for designing persuasive technology (Fogg 2009)

It is an ongoing concern that developers' attempts to design persuasive technology fail (Fogg 2009). In the South African educational context, Botha & Herselman (2015) report that there is a noticeable failure of ICT in education initiatives and this requires further investigation and research.

2.2 Activity Theory

The major advantage of using Activity Theory (AT) to understand a mobile learning environment is that it emphasizes that learning is an activity, situated in a virtual space and socially mediated, but using tools. Persuasive technology design often does not take complexity sufficiently into consideration (Mintz & Aagaard 2012) and hence AT is a valuable theory. In the case reported on here, it is used to understand the complex environment and context and to highlight contradictions between different stakeholders (in this case the developers and the learners) as reflected in their activities.

In AT, an individual activity is explained as an activity system, which is the basic unit of analysis. The activity system has an object that is shared by a group of people or a community. The activity then, using tools such as computers and mobile devices, transforms that object into an outcome (Hardman 2005). Figure 3, depicts an activity system and shows the relationships between the subject (the person undertaking the

activity), tools, object, community, rules and the division of labour (these are the six nodes or elements) (Engeström 1987). An activity is seen as a systemic whole because all the elements are linked. During the activity, the object often changes and manifests itself in different ways.

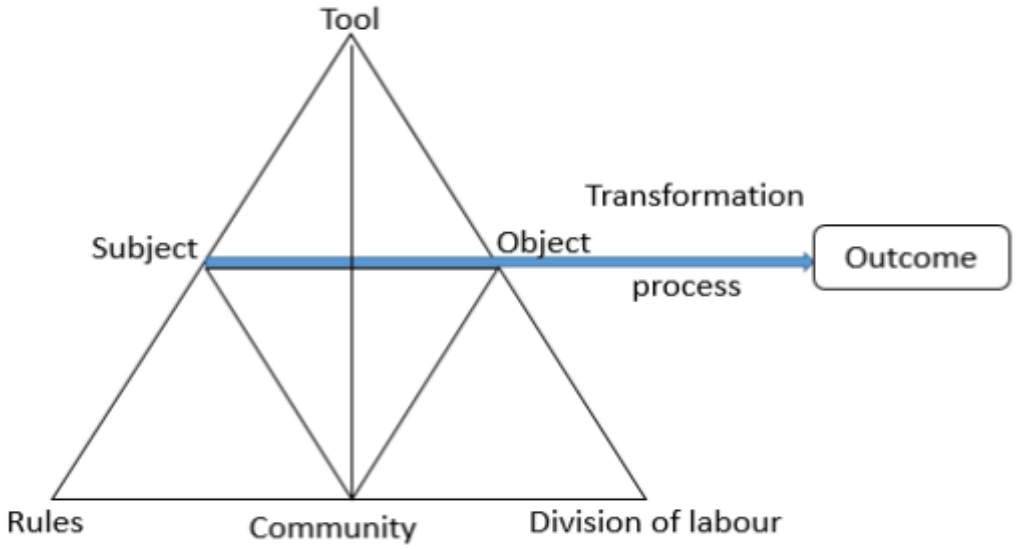

Figure 3. An Activity System (Engeström 1987)

3. METHODOLOGY

This is an explanatory case study where the interpretive paradigm was used for analysis. The interpretation was supported by two theories (FMB and AT). Although the 25 learners who were using the application in this research were all from a single grade in one school, the school is not being studied. The school's authority and parents' consent was obtained before conducting the study and the learners' names were kept confidential. Focus groups, questionnaires and observation were employed to collect data. As noted in the introduction, the main research question is, 'Why were the learners not attracted to and persistent in using the LevelUp application?' The proposition is that persuasive technology as used for informal educational purposes, cannot rely solely on motivating individual learners as the activity that they are engaged in is both complex and social.

4. FINDINGS AND DISCUSSION

To answer the main question of the study, this question was divided into sub-question. Tables 1 and 2 show examples of the data collected for two of the sub-questions – but note, this is not all of the data collected. Learners expected the LevelUp application to assist them to study mathematics in a way similar to a human teacher or peer (Table 1), therefore ideally, the application should leverage the power of social influence to motivate and persuade. Table 2 shows that daily homework set at school is the learners' highest priority. Secondly, parents play an important part in motivating their children to study - there is an expectation that they should study (Table 2). While learners were aware that they would get an immediate tangible reward, they also hoped that their maths marks would improve (see Table 1). The last comment in Table 1, "I feel like people are honestly better" illustrates the importance of human interaction and social influence. Peer pressure, social comparison and group polarization are all types of influence that arise from a social (school) environment. Mobile applications, when designed to act as social actors, will leverage the social influence principle to motivate and persuade (Fogg, 2002).

Table 1. Sub-question 1.
Do you think a person or people are better than technology in encouraging you to study and why?

Learners' responses
… So when you have a study partner you'll achieve more mentally with that person compared to doing it alone, compared to technology, that's my opinion, … I think people are better because people understand they have feelings they know what we go through, they understand the stress. … I agree with her and I think that people are better you'll have a better experience with a person than with a tablet or a phone, they can't tell you what you doing wrong and whether you understand it or not the tablet doesn't really care, so a person is better, …I think a person is better because if you don't understand something a person can try and explain it in a different way whereas a tablet won't be able to, so you'll have a better understanding with a person because they can think of a way you can relate to and understand the topic that's being tested, … I think a person is better because if you actually like the person then you start to have fun with it because not only are you spending time with the person but you learning in a fun way, …I think I agree with everyone that interaction with people is better, you get either a positive or negative feel, like emojis can't really tell a person's feelings, so I think people are better I don't know about the app. If the app can give feedback as though we've done something I think it can be better, …I feel like people are honestly better, I feel like an app is kind of programmed to tell you, it isn't on a one on one level where you can actually share your frustrations an app is more programmed, it doesn't seem realistic to me

Table 2. Sub-question 2. Do you think an App like LevelUp could be designed to encourage people your age to study?

Learners' responses
…Ja it will motivate you because there are rewards and as a teenager I would want airtime to call my girlfriend or something, … With Level up why I think it will even motivate me further is the rewards system, why not study and also get short term rewards such as airtime or data bundles in the process, … We all obviously do homework first because we get it every day, … Parents and teachers wouldn't reward us because studying to them is something that we have to do but to a lot of us we not motivated enough to do things we have to do, …I think it depends on how much homework you have that day. So I go home with transport, if I have a lot of homework then I'll go home first and start my homework and then do everything else I need to do. When I don't have that much homework to do, I go home late. If the app works I'll put some time into my schedule for it if it works for me.

4.1 Data Analysis using Fogg Behaviour Model (FBM)

The three elements in the model (motivation, ability and trigger) were analysed and linked to data collected during two focus groups sessions with the learners and from the semi-structured questionnaire completed by the learners individually to test the views amongst the wider audience of the focus group participants. FMB was used to answer the main study question: 'Why were the learners not attracted to and persistent in using the LevelUp application?'

4.1.1 Element of Motivation

People are influenced to act in a certain way by different factors, for example, hope and or social acceptance or rejection (Fogg 2009; Ryan & Deci 2000).

Motivator #1: Hope is when people anticipate a positive outcome for doing something. In the case study, while learners were aware that they would get an immediate tangible reward (Table 1), they also hoped that their maths marks would improve (this is not as definite an outcome as the immediate reward).

Motivator #2: Social acceptance or rejection – during the observation sessions, all of the learners were seen standing in groups while waiting for their transport. Group formation can result in individual learners seeking social acceptance, wanting to fit in the group or a fear of being rejected (Table 1). One learner

explained that the rest of the group would consider it impolite if you were spending an extended period working on a mobile device instead of chatting in the group.

Time #3: The target behaviour requires that the learners have time available to complete the challenges every day after school. Although the learners were short of time for using LevelUp (Table 2), they were not really short of the ability to use the application; for example, they were familiar with the mobile device and had sufficient money to buy airtime or data bundles.

4.1.2 Element of Ability

The aim is to increase the users' ability. In terms of the Fogg Behaviour Model this is neither about the standard learning measure (easy-hard) of the mathematics exercises offered nor about increasing learners' skill in using the technology. It is about the convenience, schedule or feasibility to use the application.

Social Deviance and Non-Routine – LevelUp is not part of the school curriculum, this makes it difficult for the learners to fit additional Maths exercises, using the LevelUp application, into their school daily routine as it requires additional time that deviates from the normal curriculum activities (Table 2).

4.1.3 Element of Trigger

A persuasive technology must have a trigger presented at the right moment for users to recognise and respond to Fogg (2009). LevelUp uses a text notification as a trigger to remind the learners to do their daily mathematics exercises. This trigger just reminds the learner to do the daily challenges as it was assumed that they possess both the motivation and the ability to use a mobile device. The LevelUp application is leveraging the principle of convenience by attempting to present the message to the learners after school at an opportune moment.

4.2 Analysis using Activity Theory

Sub-question 2 ('Do you think an App like LevelUp could be designed to encourage people your age to study?') is a social question. Activity Theory is, therefore, used to answer this question and to analyse the studying mathematics activity using LevelUp as the unit of analysis. Activity Theory holds that an activity must be analysed in the context in which it occurs (Jonassen & Rohrer-Murphy 1999). The analysis examined the entire activity through the activity system (Figure 4). In this case, the study identifies who is engaged in the activity, the tools used and their history (which may shape the way people act and think), the social and context within which the activity system operates, the rules and norms (which may facilitate or limit the use of tools), and the community and its role through the division of labour.

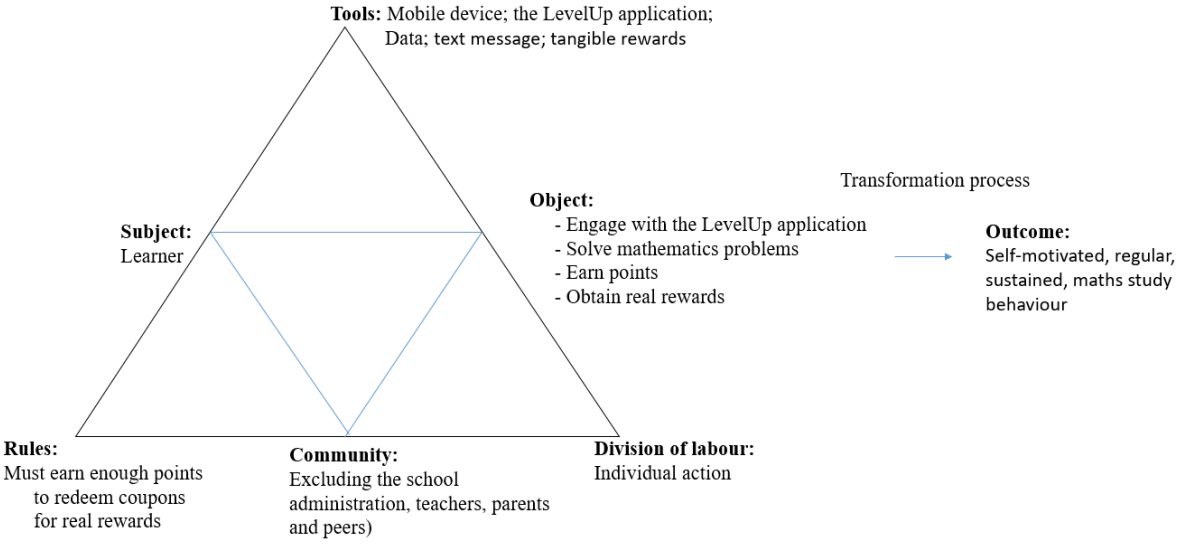

Figure 4. The Activity System for Learners using the LevelUp Application

Activity system: The activity system consists of the subject, tools, rules, community, division of labour, object and outcomes for the learners' activity of completing the LevelUp mathematics daily exercises.

Subject: The learners have been identified as individual subjects who are encouraged to participate and complete the activity, independently and voluntarily after school.

Tools: The LevelUp application is a mobile application tool used; airtime; data bundles; text message and tangible rewards.

Rules: The learners can only obtain the rewards when they have earned enough points.

Object: Although the learners indicated that their object of using a mobile device for more general reasons is convenience as it enables them to communicate, socialise with friends, and search for information and so on (Table 1), the object of the activity is very different (see Figure 4).

Outcome: This is the longer term goal where the extrinsically motivated learner becomes self-motivated. The transformation process takes the Object of the activity to this outcome.

Division of labour: The studying mathematics on a mobile device is an individual action, the application does not leverage aspects of collaboration (Figure 3).

Community: The observation shows that the school administration, teachers, parents or peers are not involved. The LevelUp application is meant to encourage learners to study outside school time.

Identifying contradictions within an activity and between different activities is an important part of analysis using AT. In the research undertaken, other activities, in particular the activity of designing the application, was also analysed. Unfortunately page limits in this paper do not allow these to be explained. The issue of contradictions is discussed therefore only in terms of the learners' activity. The objective of mobile phone activity, is understood by the learners as for communicating with friends and family, Internet surfing, but is not used for LevelUp activity, Hence there is a major contradiction between the learners' other activities and this one. Figure 3 shows only the activity of studying mathematics using a mobile device and LevelUp. So this points to a contradiction between the object of the mobile phone activity and the activity that the App supports. A further contradiction is clear from the division of labour and the community. The application is designed for individual use and hence there is no division of labour or involvement by the other people who usually motivate the learner and assist. These roles have been taken over entirely by the application (tool). However, as AT points out, activities are social.

5. CONCLUSION

The current study has illustrates that FBM and Activity Theory complement one another as a way to assess persuasive technology. Firstly, FBM was applied to understand why the learners' target behaviour would occur or not occur. The analysis of the three elements of FBM, that is, motivation, ability and trigger shows that at least one of the elements are lacking (see Section 4.1.1). This implies that the target behaviour would not occur or persist. Activity Theory was used for the in-depth analysis of the activity systems (only one activity system was discussed in this paper but in the full research others were also analysed) and enabled the study to highlight contradictions. However, Activity Theory does not explicitly talk about persuasive technology and motivation, and therefore the two theories apart could not explain the complexity of studying mathematics using the LevelUp application. This combined use of theories is expected to help the developers of persuasive technology to understand that m-Learning is a complex social activity and, therefore, that they should design systems or applications that are acceptable in the community and continuously (sustainable) used by leveraging the social support of social learning, social comparison, competition, normative influence, social facilitation and cooperation. The study contributes to use of FBM and AT to understand m-learning. Further research is required that will apply these theories after school time for learners studying mathematics.

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