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Modelling the impact of study behaviours on academic performance to inform the design of a persuasive system

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ABSTRACT

Information technology is deeply ingrained in most aspects of everyday life and can be designed to influence users to behave in a certain way. Influencing students to improve their study behaviour would be a useful application of this technology. As a preamble to the design of a persuasive system for learning, we collected data to identify the study behaviours of students and recent alumni. We then developed two models to measure which behaviours have the most significant impact on learning performance. Current students reported more foundational behaviours whereas alumni demonstrated more higher-order thinking traits.

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1. Introduction

People often behave in suboptimal and non-rational ways [38]. To address this problem, many researchers have investigated the potential of information technology (IT) to persuade individuals to improve their behaviours in various ways and contexts [13]. Due to the growing computational power of IT, and its continued spread throughout business and society, this technology offers great potential for such work. The process of using computer systems to persuade has been referred to as “Captology” (Computers As Persuasive Technology) or, more generally, “persuasive technology” or “persuasive systems” [13].

Persuasive technology can be applied to education, specifically to address poor study behaviour. For example, many students seek to improve their grades by developing study plans so they can keep up to date with their work, yet they may struggle to maintain their schedule; this is where persuasive technology might be of assistance. As with general behaviour, study behaviour can be complex to measure because it is composed of many elements and influenced by many factors [27].

The goal of this research is to identify the most significant study strategies and behaviours that enhance academic performance, which can then be used to inform the design of persuasive systems to improve student learning that is automated and scalable.

Understanding the learning environment and the behaviours exhibited within it by students is an important first step in planning the design of system features as *consistency* with the user’s view is key to developing a persuasive systems design. That is, a persuasive system should generally align with users’ behavioural expectations. We devised the following research question to obtain a picture of the current landscape of student behaviour in relation to learning performance:

- Which study behaviours have the greatest impact on academic performance?

To answer this question, we first review the existing literature on behaviour and persuasive design and then discuss instruments designed to measure study strategies and learning motivation. Next, we present the results of a survey of students about their study experiences, from which we then develop several models that explain which behaviours and strategies have the most significant impact on learning performance.

2. Background

2.1. Behaviour change

As persuasive systems are aimed at influencing behaviour, it is important to understand the main theories related to behaviour change. One such model is the Transtheoretical Model for behavioural change, also known as the Stages of Change model. The premise of this model is that the process of behaviour change can be broken down into the following discrete stages:

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(1) pre-contemplation, (2) contemplation, (3) preparation, (4) action, (5) maintenance, and (6) termination [30]. In the first stage, the individual has no desire to change until they reach stage 2, in which they are actively considering a change. In stages 3 and 4, the individual has decided to adopt a new behaviour by planning how to enact the change and then performing the new behaviour. Stage 5 involves the individual continuing the new behaviour, despite the temptation to relapse into the old one. Finally, in stage 6, the individual has completely let go of the undesirable old behaviour and adopted the new behaviour. Transition through the stages is traditionally time-based, with each stage usually lasting approximately six months.

The idea of behaviour change as broken down into time-based stages has been questioned. Considering that human behaviour is often irrational and unpredictable, it is difficult to accept that behaviour is a definite linear process with a permanent end result. The idea of permanent termination of an undesired behaviour is also disputed as people often terminate an undesirable behaviour only to relapse after a long period of time [37]. The SNAP model was devised to better address the reality of human behaviour and overcome the limitations of the Stages of Change model [38]. SNAP is an acronym for “Staying the old behaviour”, “New behaviour engagement”, “Attempting to change” and “Planning to change”. This model views behaviour as a never-ending series of states, such that one can progress through any of the four states at any time and in any direction.

Although the Stages of Change and SNAP theories describe how behaviour functions as a process, they do not prescribe how to change behaviour. This is a clear distinction between persuasive design theories and behavioural theories. Furthermore, it is important to note that, although different, these two types of theories do not compete with one another, but are complementary. Models such as SNAP may help to better understand and utilise persuasive design. For example, it is implied that once you have persuaded an individual, that behaviour will become permanent. Yet persuasive system design may not lead to permanent adoption of a behaviour, but instead continual triggers (as per the SNAP concept of states of behaviour) will be needed to ensure long-term behaviour change.

2.2. Persuasive systems

The process whereby technology can be designed to influence human behaviour can be defined as following three main phases: (1) understanding the key issues behind persuasive technology, (2) analysing the persuasion context, and (3) designing the system qualities. Collectively, this process defines the Persuasive Systems Design (PSD) framework [26]. The first phase is based on aligning the system the seven key postulates that underpin the design of persuasive systems:

1. Information technology is never neutral.
2. People like their views about the world to be organised and consistent.
3. Direct and indirect routes are key persuasion strategies.
4. Persuasion is often incremental.
5. Persuasion through persuasive systems should always be open.
6. Persuasive systems should aim at unobtrusiveness.
7. Persuasive systems should aim at being both useful and easy to use.

In contrast to earlier decades, the impact of computing technology can no longer be seen as neutral. Technology is now far more ingrained in our everyday lives, which is why it can be so persuasive. Unlike traditional methods of persuasion such as billboard advertising, many people use technology to complete everyday tasks, such as learning at an educational institution. This makes the application of a persuasive system a suitable choice to help improve student learning performance. The second postulate is of particular importance to the present research, as it explains that persuasive systems need to align with users’ views. This is why it is vital to identify the key study strategies and behaviours of students, as the persuasive system will need to conform to this requirement.

Outlining the *intent* of the persuasion, the *event* in which it occurs and the *strategy* by which it is carried out is the core of the second phase of persuasive systems design. In this phase it is important to define who is performing the persuasion and who is being subjected to it. In this research, the persuaders are the teaching staff and the students are those being persuaded to improve their learning behaviour.

Finally, the system features are designed in accordance with the previous two phases. There are four categories in which potential features can be classified: primary task, dialogue, credibility and social support. Primary task support is the user’s main purpose for using the system and therefore anything that makes this easier will likely encourage the user to perform that action. Dialogue support is concerned with creating a likeable human–computer interface. Credibility support ensures that users trust the system by making it clear why the system is credible. Finally, social support leverages the motivation of seeing others performing behaviours in a system in order to encourage others to also adopt those behaviours.

To be effective, persuasive systems should target a single behaviour, as targeting any more may obfuscate the persuasive message [14]. System features should then be designed around this target behaviour. However, this paper is focused on phase 2. Although identifying the current state of behaviours is not directly part of the established PSD framework, it is a crucial step as it provides deeper insights into typical student (or user) behaviour in order to design features in phase 3.

Table 1
MSLQ scales and subscales.

Learning Strategies Scales		Motivation Scales	
Scale	Subscale	Scale	Subscale
Value	Intrinsic Goal Orientation	Cognitive and Metacognitive	Rehearsal
	Extrinsic Goal Orientation		Elaboration
	Task Value		Organisation
Expectancy	Control of Learning Beliefs		Critical Thinking
	Self-efficacy		Metacognitive Self-regulation
Affective	Test Anxiety		Resource Management
			Effort Regulation
			Peer Learning
			Help Seeking

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