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RUNNING HEAD: LEARNING TECHNOLOGY IN UNIVERSITY

Using learning technology in university courses: do styles matter?

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About the author

Lorenzo Vigentini has been involved with undergraduate teaching in a variety of support and development roles for the two core pre-honours psychology courses in Edinburgh for the past 6 years. His long experience in IT support and software implementation and a keen interest for new technologies allowed him to get involved in a range of projects centred on the provision and evaluation of e-learning resources and tools. His current research specifically focuses on the empirical evaluation of e-learning influenced by psychological theory and supported by behavioural, differential and cognitive data.

Abstract

Purpose – This study explores the relevance of three different types of styles measure for students' learning in a large introductory university course in psychology, using information technology to enhance teaching. The paper examines the relationship between styles, the usage of learning technology, and academic performance in this course.

Design/methodology/approach – Styles were measured using approaches to learning, thinking styles, and cognitive styles. The usage of the online material was measured by considering both time spent on the resources and the amount of material viewed (pages and hits) as well as tools used.

Findings – We found that the academic performance of students who used the online resources was significantly higher than those who either chose to not use the online materials at all or chose to use to the materials to a lesser extent. We determined that the measure of approaches to learning (ASSIST) was the stronger predictor for successful use of the material.

Research limitations/implications – Using a reasonably sized sample in an ecologically valid context offered the opportunity to put styles into context and to consider the practical use of styles. This research is limited by the context and the particular sample. It is also difficult to completely exclude the fact that students using the extra material are generally more motivated and would have obtained better grades even without the resources.

Originality/value – This paper offers further evidence for the relations between different measures of styles and evaluates the effects that styles might have on usage of online material and academic performance.

Keywords Styles, Learning technology, VLE, Web usage, Academic performance

Paper type Research paper

Introduction

The introduction of learning technology in mainstream education and the use of Computer-Based Training (CBT) and Virtual Learning Environments (VLE) has become widespread in both Higher Education (HE) and commercial enterprises. Due to the increasing demands of today's information society (Eisenberg, 2008; Garnham, 2000), e-learning has established itself as one of the strongest drivers of the IT sector. In the landscape of HE in the UK, in which governmental policies are widening the composition of the students' population and increasing the number of students with a broader spectrum of intellectual abilities, one of the key problems is how to avoid uniformity of instruction and maintain a personalised curriculum. E-learning is often seen as the medium able to cater for a wider audience with the potential of providing more individually tailored instruction (Eggers, 2005).

The support for e-learning at both governmental and institutional level, driving large investments based on the grounding belief that e-learning could improve both delivery and effectiveness of instruction, however, is not as strong as one might think. One of the real problems affecting evaluation of learning technology is that the use of real courses for experimental studies is not feasible as it is not possible to use appropriate sampling techniques to split courses without potentially penalising one of the groups. Furthermore, it is impossible to separate the effects of motivated and enthusiastic instructors and their use of available resources. For these reasons, most studies in this field based their findings on lab-based experiments or on a single course snapshot. Overall, it is generally quite difficult to draw clear conclusions about the success of using technology to tailor students' learning experiences. In most cases presented in education research, the results advocate positive effects in promoting learners' engagement to a varying degree of success (Naidu, 2003; O'Neill *et al.*, 2004; Stephenson, 2003). However, there are many studies that strongly endorse the 'no significant effect' of the use of technology in support of learning (Russell, 2001 for an extensive review). Still others, after the hype surrounding e-learning initiatives, are now reconsidering the issues of augmentation versus disruption (Conole *et al.*, 2008; Heilesen and Josephsen, 2008), or in other words: is technology really helping to

improve teaching and learning, or do the expectations and investments not deliver satisfactory results?

Taking advantage of learning technology in a blended course (i.e., a real course enhanced with learning technology), this paper explores the relations between individual styles and the use of learning technology to improve learning and teaching in a foundation course in Psychology at undergraduate level. The use of a VLE affords a certain level of personalisation in the way material is accessed, but, more importantly, how students behave in the system can be monitored in an unobtrusive way. Valuable information about how online resources are used may be obtained by tracking students' interaction with the online material. Ramsden (1992) considered integrated monitoring of the student an essential component of the 'minimum standards' of requirements for online learning provision. Hardy and colleagues (2006) explored students' behaviour patterns using online resources in blended courses. This research revealed common patterns between students. For example, first year psychology and physics students used online material in similar ways: cramming preparation during the couple of weeks before the exams, which showed in a massive increase in usage during this time. However, to overcome the limitations of a simple description, it is necessary to formulate specific hypotheses about the relations between relevant variables. Relating usage and its effects on academic performance is a good start, but we believe that it is necessary to explore a student model emerging from richer user data further to draw meaningful evaluations. With student model, we refer here to a profile which provides information about individual styles of thinking and behaving which may provide a better understanding of the online behaviour. For example, to measure the effectiveness of web-based material, user modelling provided valuable insights for customisation of the interfaces. Early research conducted by Pirolli and Card (1995) identified very different behaviours using online or web-based material. This evolved in modern Web Usage Mining (WUM) widely used in e-commerce, but rarely applied to education. The core aspect of this research is that website structure and usability were the focus, and the effectiveness of websites was evaluated based on usage data (Berendt, 2001; Mobasher *et al.*, 2002). More recently, using a more user-centred focus, Graff (2003; 2005) conducted lab-based research which showed how cognitive styles related to browsing strategies as well as website structure. Cook (2005), reviewing the relations between

web-based learning and cognitive and learning styles, also argued that styles should be carefully considered by educators when designing web-based learning, not just to address usability issues. In his review of the medical and health professions trainings, he identified clear expected patterns between the wholistic-analytic construct with aptitude-treatment interactions.

Theoretical background and hypotheses

Up to this point we have left the conceptual definition of styles vague, embracing the widest possible definition of styles. However, in the last paragraph we also highlighted a number of terms which make it essential to clarify the terminology and the conceptual underpinning. Without exploring in details the history of styles and their conceptualisation (Riding and Cheema, 1991; Zhang and Sternberg, 2005), it seems intuitive that styles have a great potential to provide more detailed user profiles and to characterise a learner for two reasons. Unlike traits, styles have state-like features which make them modifiable (Zhang and Sternberg, 2005). Furthermore, even though styles seem to tap into mental processes, unlike cognitive tasks, styles are not measuring pure abilities but preferences and for this reason they are not creating a domain-dependent bias or a context-specific validity.

Curry (1983) explained state-like features of styles using a layered model. According to this model, "learning behaviour is fundamentally controlled by the central personality dimension, translated through the middle strata information processing dimension, and given a final twist by interaction with environmental factors encountered in other strata" (Curry, 1983, p. 14). In this model, the outer layer is the most malleable and context or task-dependent.

In another recent taxonomy, Zhang and Sternberg (2005) organised styles into the *Threefold Model of Intellectual Styles* which accounts for the core controversies in the field: styles as trait-like or state-like, value-laden or value-free, and similarities versus differences in the constructs. Leaving the theoretical issues aside, also termed the 'styles jungle' (Desmedt and Valcke, 2004), which is beyond the scope of this paper, a number of studies already investigated the relationship between a variety of cognitive and

learning styles and academic achievement. Building on the work of Grigorenko and Sternberg (1995), Zhang (2002; 2004) examined the relationship between thinking styles in a variety of samples (using Sternberg's theory of mental self-government). She consistently demonstrated that those styles denoting conformity and rule adherence as well as organised work related positively with academic performance even though there were mixed findings regarding some styles and with different effects of demographic data (i.e., age, gender and school class level).

McCune and Entwistle (2000) surveyed study strategies in psychology students at the University of Edinburgh and provided a picture of their approaches to learning (using ASSIST and qualitative methods). As further explored by Entwistle and McCune (2004), approaches are not synonymous with styles. Similar to Marton and Säljö (1976), approaches to study are specific reactions to the type and form of the task and the context within which the task is experienced. From the original distinction between a deep and a surface approach, over the years (Entwistle, 2000; Entwistle and McCune, 2004; Tait *et al.*, 1998) developed a third dimension, the strategic approach, to take into account an approach which largely resembled the deep approach for some aspects, but could also take features of a surface approach in specific circumstances. As approaches are typical ways in which learners study in contexts with similar demands, this further distinction made it evident that approaches are very much malleable and could be different for different disciplines and even between courses but for some students could also be fairly constant and stable.

In terms of the relations between the various constructs and conceptualisations, there seems to be a growing body of evidence that some of the measures overlap. For example, Cano-García and Hughes (2000) explored the relations between thinking styles (using the theory of mental self-government, Thinking Styles Inventory (TSI)) and learning styles (Kolb's (1984) model) with academic achievement. They showed that about 10 percent of the variance for academic performance can be accounted for by some scales of the Thinking Styles Inventory (legislative, executive, oligarchic and internal) and two of the learning styles (concrete experience and abstract conceptualisation); clear relations between learning and thinking styles were individuated, but the overlap was not as pronounced as they expected.

Diseth (2003) constructed a model to account for personality dimensions (NEO-PI), approaches to learning (ASSIST), and academic performance and produced an interesting overview of the relations between these aspects. Using structural equation modelling techniques, it was identified that approaches are not mediated by individual traits, but a combination of them and that the relation between openness and achievement is mediated by the deep approach.

There are also a couple of examples in which cognitive styles are used in learning technology. For example, Uruchrutu and colleagues (2005) attempted to customise interface and sequence presentation of content in a web-based system according to the wholistic-analytic and verbal-imagery dimension to provide a better experience for students. Triantafillou and colleagues (2003) used Witkin and colleagues' (1971) construct (field dependence/independence) to drive the adaptivity of their educational system. Results were promising in both studies, showing that concordant presentation, preference and styles provided better post-instruction results.

Even though various studies provide an informative landscape, to date, we were not able to find a comprehensive study which takes into account styles, the use of web-based support material in a real course and the effect that these elements together have on academic performance. Hence, the core aims of this study are threefold.

First, we intend to provide evidence for the relationship between usage of online material and academic performance. (H1) As learning is an active process, we expect that students should benefit by engaging with the online material.

Secondly, we intend to uncover the relationships between styles measure and online activity. Online usage of self-directed resources is predominantly interactive, but it is mainly solitary and requires good time-management and self-regulation skills. (H2) It is expected that students reporting higher deep and strategic approaches will effectively use activities that, in general, improve or enhance the learning process, but that this is not suiting everyone.

Finally, we intend to expand on the current research on styles by relating the various measures used and provide support to the relations between styles and academic achievement (i.e., Cano-García and Hughes, 2000; Zhang, 2002; 2004). Due to a lack of strong supporting evidence, this aspect should be considered explorative.

Methods

Sample and procedure

This is part of a larger study conducted in the past four years in which we scrutinised students' online behaviours (in a VLE) in a first year undergraduate course, which provides the foundations for further study in psychology. The course can be taken as an outside option (i.e., as an elective module not part of the degree programme) and only 30 percent of the students are registered for the full degree in psychology. The course spans across two semesters of 12 weeks each. Students are taught with three one-hour lectures per week. They also have to attend nine tutorials (every fortnight) and complete nine hours of research participation. The course is assessed with three essays (coursework) and two end-of-semester exams with an essay section (worth 1/3 of the mark) and a Multiple Choice Questions section (MCQs; weight 2/3). The two exams have equal weight and account for 70 percent of the final grade, while coursework accounts for 25 percent. The other 5 percent is provided for participation in tutorials and research.

The online VLE support employs WebCT/Blackboard as main platform and it is used as main repository and interaction forum for students and the 12 staff and 17 postgraduates teaching on this course. In this respect the courses can be defined as blended courses. An e-pack [1] course supplemented students' learning and provided additional study material and interactive activities including self-assessment exercises.

In this paper we will focus only on Year 4 semester 1 (2007-08) in which we considered the combination of usage of the e-packs with approaches to learning (ASSIST), thinking styles (TSI) and cognitive styles (VICS-WA). For the period considered, we had a sample of 288 participants (89 males and 199 females) with ages between 17 and 47 (mean 20, median 19). It should be noted that as the e-pack was a voluntary addition which could be purchased by the students with the textbook, the identification of a non-users group was also necessary.

Students completed the TSI and ASSIST online within the first term and as part of the course credits, and then came into the department to complete the VICS-WA. The

online data were extracted from the online systems and collated with performance data from coursework and exam results.

Web usage

After registration, logs of online activity are automatically collected throughout the year by the system. Two different data collection techniques were used where possible: simple reports of usage which can be generated from the VLE, and extended log activity from the web server (web logs, or activity logs) which allow for a click-by-click analysis of usage; the latter will not be considered here. The Pearson e-pack is run on a proprietary server (MyPsychLab) which uses a modified Blackboard environment.

Approaches to learning: ASSIST

In this study we used a version of the ASSIST inventory from the Enhancing Teaching-Learning project (http://www.etl.tla.ed.ac.uk) which allows us to identify the three dimensions (deep, surface, strategic) organised in 13 subscales. This is a self-report questionnaire with 3 sections. The Approaches to Learning Inventory has 52 statements asking the participant's level of agreement (agree to disagree, e.g. "Some of the ideas I come across on the course I find really gripping"). Because McCune (2000) stresses that the results are context-dependent, no normative data are available for these scales. However, there are a number of examples published and we can directly relate our data with a similar sample of first year psychology students in one of her studies.

Mental self-government: thinking styles

Sternberg's (1988) mental self-government theory was an attempt to unify the three main categories of theories and types of styles: cognition centred, personality centred, and activity centred approaches. According to this model, mental self-government is used metaphorically to provide a coat hanger to fit in styles which resemble the societal structure of governments. There are 13 styles that fall into five core dimensions: functions (legislative, executive, and judicial), forms (monarchic, oligarchic,

hierarchical, and anarchic), level (global and local), scopes (internal and external), and leanings (conservative and progressive). In this study, we used the original full version of the Thinking Styles Inventory (TSI) with 8 items for each style, but, based on the work by Nielsen and colleagues (2007) on the Danish adaptation of the inventory, we also decided to add the *democratic* style to the forms of government. The inventory used has therefore 113 items. Participants have to indicate how well the statements describe them with a seven-point Likert scale ('Not at all' to 'Extremely well'). Zhang and Sternberg (2005) consistently reported fairly high construct reliabilities of all scales with exception of the anarchic scale (average scale alpha 0.8, anarchic scale 0.4).

Cognitive styles: VICS-WA

A different measure of cognitive styles, which is exploring the visual versus verbal and analytic versus wholistic dimension, is the VICS-WA. It is different because, rather than using self-reported measures via questionnaire-based items, the VICS-WA uses response times in a psychometric test package modelled on Riding's (Riding and Cheema, 1991) Cognitive Styles Analysis (CSA) (but not validated against it); the two dimensions are measured using median reaction time ratios. Although Peterson and colleagues (2003) demonstrated that the VICS-WA had a test-retest reliability which was much higher than reported test-retest response times for the CSA, Peterson and Deary (2006) did not find a correlation between the two measures and the reliability of the new version VI was still unacceptably low. This makes the VICS-WA more like a cognitive task than a measure of styles. The VICS-WA has four main sections: a verbal task (116 trials), imagery task (116 trials), wholistic task (40 trials), and analytic task (40 trials). Participants were presented with pairs of stimuli in which they have to make a choice between class (natural or man-made), size or have discriminate figures in an embedded figure task.

Results

With a class size of 288, about 63 percent of the students did not use or never accessed the online support material (e-pack). Usage is quantified in hits (visits to unique pages). Figure 1 shows the distribution of hits over the term with a spike in week 12, which is just one week before the exam in week 13.

Take in Figure 1

After grouping the sample based on usage, Figure 2 shows the marks obtained in the various assessed works: coursework essay and exam (MCQ and essay sections) of the first semester exam. There is a pronounced difference between groups based on the level of access and these differences are all statistically significant ($F(3,287) = 6.39$, $p < 0.001$). Post-hoc t-tests were also significant (top quartile vs. bottom quartile mean difference = 11.1, $p < .01$, top quartile vs. non-users, mean difference = 15.2, $p < 0.001$)

Take in Figure 2

It is interesting to note that whilst there is little difference in the coursework essay for the different levels of usage, there is a significant difference of up to 14 marks in the MCQ section of the exam. It is also worth noting that the top users did not perform as well in the essay section of the exam in which middle users excel. This could be indicative of different ways of preparing for exams in the different groups of users. These results support our first hypothesis (H1) identifying a clear correlation between the amount of usage of the online material and academic performance. Table 1 identifies the significant correlations between usage, academic performance and styles, highlighting only the significant correlations.

Take in Table 1

Overall usage (hits) is mildly correlated with the MCQs results ($r = 0.34$, $p < 0.001$), but not with the essay grade. There was no correlation between usage and the first

assessed essay, even if the essay mark has an acceptable correlation with both parts of the exam: essay ($r = 0.45$, $p < 0.001$) and MCQs ($r = 0.40$, $p < 0.001$).

The second hypothesis (H2) is partially supported as we identified a small but significant correlation between one of the dimensions of the strategic approach with online activity and a negative correlation between two subscales of the surface approach and both usage and MCQ score. This is symptomatic of the type of preparation for the exams undertaken by students which might be also reflected by a lack of correlation with the deep approach.

We also computed a stepwise regression model for the exam mark using all the sub-scales of the ASSIST, TSI, VICS-WA, and including the mark in the first coursework essay and the total number of hits during the term. The overall model accounts for 29 percent of the variance ($r = 0.54$). The model, however, shows that there are overlaps between the variables (as also identified in the correlation analysis above). Taken independently, the ASSIST is accounting for 27 percent of the variance in the mark with D2 (relating ideas) and SU3 (Syllabus boundness) contributing to the equation with negative coefficients and D4 (Interest in ideas), S1 (lack of purpose) contributing positively. Usage of online resources alone contributed to 8 percent ($r = 0.28$) of the variance. Looking at the effects of styles in predicting usage of online resources, styles account for 22 percent of the variance ($r = 0.47$). Once again the scores of the ASSIST are taking the largest slice of variance (14%, $r = 0.37$).

Discussion and conclusion

This study explored the relationship between styles, usage of online resources, and academic achievement in a first year undergraduate course in psychology. We hypothesised that there would be a relation between usage of e-packs and academic performance. We also expected that some measures of styles would be better predictors than others in determining both usage and higher academic achievement.

There is evidence that usage of online material allowed students to earn better grades in the exam, especially in the MCQ section, however it is quite difficult to clearly identify the reasons justifying these findings.

Even though the different level of usage was a significant factor in poorer exam performance for the low-usage groups, it would be simplistic to infer that more conscientious students, who are generally more motivated and because of their nature and propensity for a deeper approach to learning (i.e., Diseth, 2003; Zhang, 2004), simply followed their normal pattern of behaviour embracing extra resources and obviously achieved better results. It is necessary to carefully consider the typology of use which is only hinted in this study.

For example, the analysis of time-based observations would suggest that there is little difference in the methods and pattern of accessing the resources between different students. If it was the case that good students behave differently, we would have a completely different picture in Figure 1, with a better spread of online activity rather than cramming in the weeks before the exam, phenomenon already observed for first year students by Hardy and colleagues (2006). The correlation results are not enough to identify a clear relation between styles or approaches and usage. It is essential to go into more depth and understand what students actually do in these visits. From some preliminary analysis, we believe that this is key to differentiate between useful, strategic and efficient use of the resources and a more inefficient and superficial use of the material.

It is entirely possible that the top performing students are simply doing many tests in quick succession to verify their knowledge whilst poor performing students are spending much more time in a few tests attempting to 'learn the answers' in specific sections. More details are required from students to understand this difference. Based on the work by Canter and colleagues (1985), who identified specific features of the routes to explore complex data structures, we think that web logs might provide more detailed information about features and patterns of activity. In the context of online learning, some students explore the resources in a linear fashion, others loop on specific and more limited number of pages/resources within the same session. Similar behaviours can be extracted using a further constraint over time. For example, are students revisiting the same pages or are more pages targeted in what they look for? These and other questions remain still open at this stage.

Admittedly, time engaged online and number of visits are quite coarse measures, however these have shown already some promising insights. Usage data can tell us

what, when and how, but the crucial question of why learners do something in the system can only be inferred by aggregating the behaviours in meaningful intentions. The second semester exam marks will be examined in the future as well as the more detailed record of activity extracted from web logs to solve some of the shortcoming of the current study.

The negative correlation between the surface approach and the grade achieved in the MCQ section of the exam as well as the small correlation with the frequency of use also showed a predictable pattern. This supports the view that students who prefer an approach which promotes understanding are performing better. A little puzzling are the small negative correlations between the monarchic and oligarchic styles with the results in the MCQ section of the exam in 2007-08. The effect of the oligarchic style featured also in Cano-García and Hughes (2000) but they did not venture possible explanations. According to Zhang (2002), the monarchic and oligarchic styles are typical of people who like to do one thing at a time and do not set specific priorities. Our results show that the students in our cohort tend to prefer to multitask and prioritise activities, which was not expected, but could be justified with recent literature focusing on generational differences in cognitive abilities (Beck and Wade, 2004; Prensky, 2001). The new i-generation (net generation, gamers generation, Y-Gen and the like) of individuals who grew up with the internet has been exposed to a multichannel and multimodal information world of unprecedented magnitude. Therefore, they are probably more able to filter and use these different streams more effectively and also prefer this mode of transmission of information. Some (Kennedy *et al.*, 2008; Lippincott, 2005) argued that this preference should be addressed in the revision of teaching, but, as noted above, others (Conole *et al.*, 2008; Heilesen and Josephsen, 2008) are more cautious about the true value of a greater exposure to IT.

We also identified a number of significant interrelations between styles with some specific overlaps between inventories. This is reflected in existing literature (Cano-García and Hughes, 2000; Diseth, 2003; Zhang, 2002), but the interrelations were much less extensive than expected, fuelling further debate about the conceptualisation of styles. The fact that the scores of the instruments used produced only minimally overlapping results seems to support the idea that the instruments are actually measuring different things. The small overlaps between some styles and the lack of

correlations between others raise the question of what styles are actually measuring. It is beyond the scope of this paper to argue in one direction or another. In our case approaches, rather than styles, proved to be particularly effective in interpreting achievement, however the scales were limited in evaluating learning technology use.

This is, however, not particularly helpful for practitioners who are facing a major problem of choice of tools and their associated conceptual frameworks. More in depth research is necessary to find out which are the most suitable measures to inform both educational psychologist and learning technologists.

At this stage it seems obvious that, independently from whichever measure is used (see also de Assis *et al.*, 2005; Triantafillou *et al.*, 2003; Uruchrutu *et al.*, 2005), the measures of styles used lend themselves to enhance the design of learning material and resources, but it should also be taken into consideration for evaluation purposes to drive the interpretations of usage data and feedback into the design and implementation of e-learning.

Practical implications and directions

From the data and samples we used, there are two myths that need to be challenged: "students know what is best for them" and "one size fits all". From the performance of the students using the additional material offered to them, it is clear that students who used the system obtained better results than those who used it less or not at all. Leaving aside the degree of use, which will require a lengthy discussion about how and what they used the resources for and which will probably provide a further differentiation, there is a need to address the self-directedness of new undergraduate students. If one of the key goals of higher education is to lead students to become independent, in the first year they are not yet able to be independent. In the UK, this is probably an endemic problem which emerges from the type of learning and studying in secondary education in which students are literally working for the grades to reach university. With the shift to a mass-education system in higher education, rather than an elitarian system in which only the best can thrive, it is becoming a responsibility of the teachers to offer the best possible opportunities to *all* students. It is still down to the students to take the

opportunities, but when the outcomes are as pronounced as we found, one might question educational practices which empower students by promoting autonomy and self-directedness when students are not yet ready to take this responsibility (Nicol and Macfarland-Dick, 2006). From this, it follows that one-size does **not** fit all! As argued by Laurillard (2003), there are equal and valid pathways to learning (and indeed academic success).

Neither usage nor styles by themselves could account for academic achievement, even though we showed that styles measured by ASSIST are a powerful indicator of students' achievement. This strongly supports the idea that student models currently used by adaptive systems are limited in their scope and would benefit from more detailed and rich databases which go beyond behavioural patterns. In Kobsa's definition (2001), user's data still remain the most underspecified of the possible data sources which can and should be used by automated systems.

By comparing equally successful students, most presented similar styles: do style matter? The answer is probably yes, because to some extent styles determine the way in which students learn and study, but the type of styles measure which is most effective or useful for the practitioners or instructors needs to be carefully considered and it is heavily dependent on what these measures of styles are used for. A key question surrounding the choice of instruments has partially to do with the conceptual framework and revolves around the issue as to what extent styles are modifiable. If we wish to offer equal opportunities to all students we ought to consider that learners, especially in junior years, might need specific training in learning and studying; if their styles are not malleable, then this is a lost cause! Or is it? It could be argued that it is possible to work with learners to enable them to develop strategies to cope in situations which are less favourable to their styles. Then the issue becomes more one of metacognitive awareness and 'learning what to do when you do not know what to do' (Evans and Waring, in press). If individuals are aware of where their strengths and relative areas of weakness are, they could deploy a range of strategies to enable them to cope with these situations (e.g. in leadership – devolving certain tasks / responsibilities to others more equipped and in learning, learners requesting further support and help from knowledgeable others). However, it is essential to explore in more details the relations between the awareness of one's limitations and one's concept of self: in some, becoming aware of

potential weaknesses, rather than promoting strategies to overcome them, will only make self-fulfilling prophecies stronger and provoke avoidance behaviour.

Our belief is that to some extent styles are preferences, and some preferences are malleable therefore can be changed. In our case, we were glad that approaches, the most malleable of the constructs used, seemed to be especially important as these are the sort of styles which one could attempt to change or train.

Extending this knowledge in support of the development of e-learning resources and tools is the next step. Reflecting on the patterns of behaviour online and their relations with a variety of styles measures, will provide a better starting point and a richer student profile for designers of e-learning, and a better insight in how an automated system could (or should?) adapt to shape the learning interaction. We showed that for lower achieving students, more prescriptive teaching measures might be required whilst higher achieving students tend to take learning opportunities autonomously without detailed guidance. In bigger classes with a wider range of capabilities and preferences, a systematic approach to evaluation of styles should allow to supplement traditional ways of teaching and offer a customised and differential experience for all students which ultimately would lead to better instruction.

Notes

[1] E-Packs are a packaged form of digital content provided by (generally) publishers as course cartridges for a VLE (i.e., WebCT/Blackboard etc) ready to be used by teacher/instructors for their courses with little customisation. E-packs are usually produced by the publishers to complement a specific textbook. In 2007-2008 we adopted the following book: Martin, Carlson & Buskist - Psychology, 3rd ed. (Pearson).

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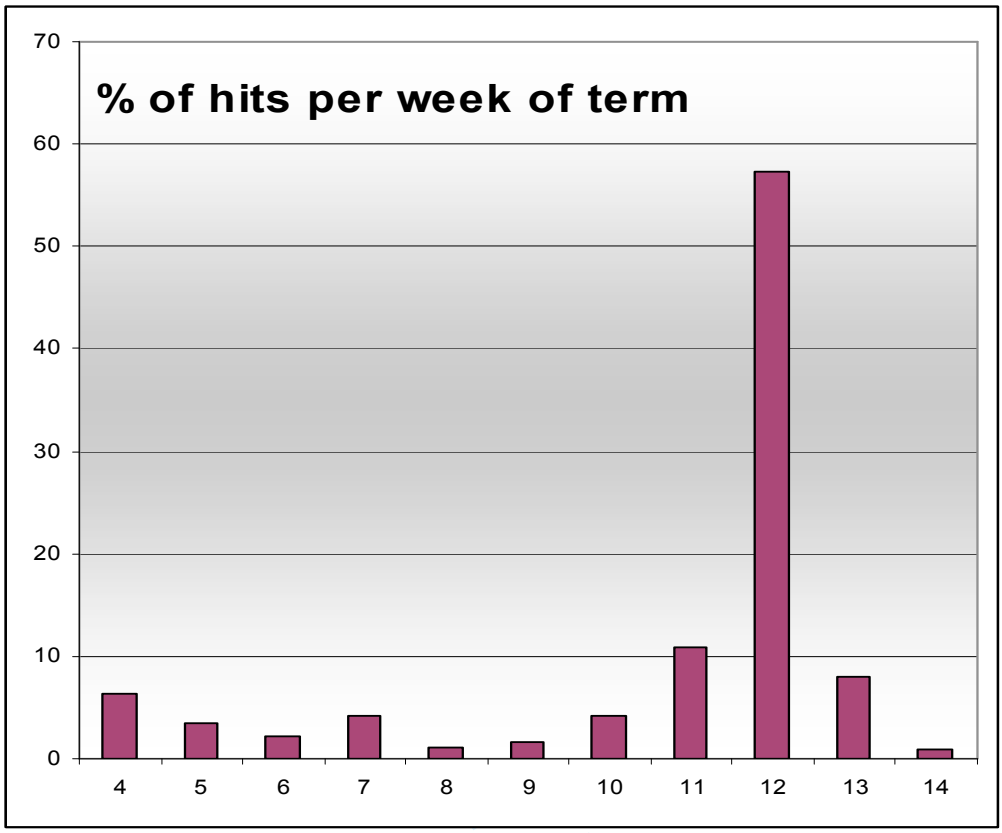
Table 1. Significant correlations between inventories, academic performance and usage

		ASSIST			Acad. Performance			Usage
		D2:Relating ideas	**D3:Use of evidence**	**Transmitting information**	**E1**	**Exam MCQ**	**Exam Essay**	**HITS**
TSI	**LEGISLATIVE**		0.18*		-0.20*			
	JUDICIAL			-0.18*				
	INTERNAL		0.21**					
	GLOBAL				-0.25**			
	OLIGARCHIC					-0.21*		
	MONARCHIC					-0.19*		
	ANARCHIC						-0.19*	
ASSIST	**SU3: Syllabus boundness**					-0.31**		-0.23*
	SU4: Fear of failure					-0.24*		
	ST2: Time management				0.23*			0.20*
VICS-WA	**Ratio Verbal/Imagey**	-0.24**						0.28**
Ac Perf.	**EXAM MCQ**				0.24*		0.28**	0.28**

** Correlation is significant at the 0.01 level (2-tailed).

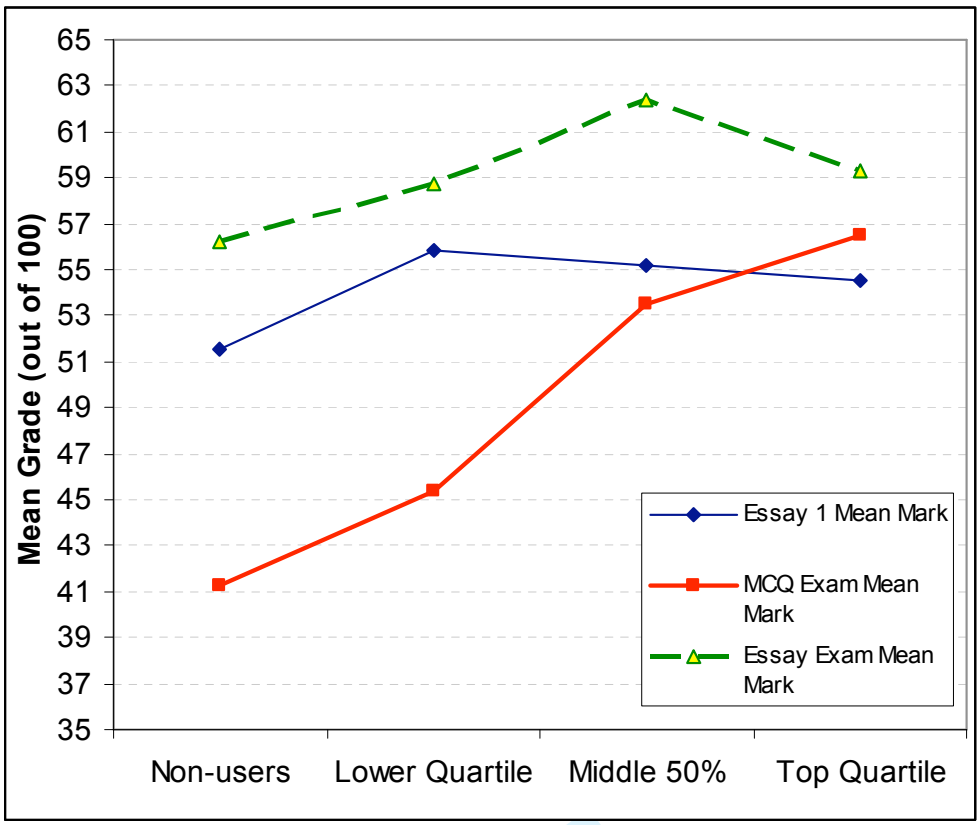
* Correlation is significant at the 0.05 level (2-tailed).

Figure 1. Online usage over time



Note. Distribution of hits (visits) of the online material over the term. The system was made available to students in week 4 and the end of semester exam was held in week 13.

Figure 2. Academic performance and level of usage



Note. The graph shows the difference in grades in the various assessed work in the first semester 2007-08; groups are based on the amount of online activity.

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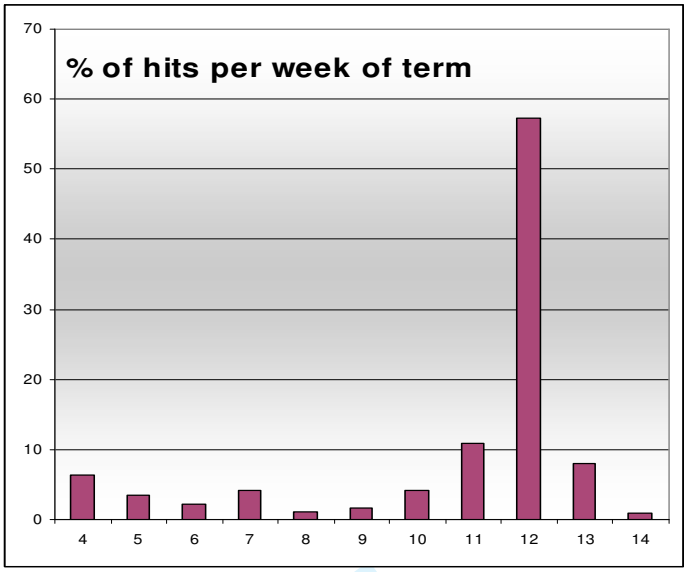
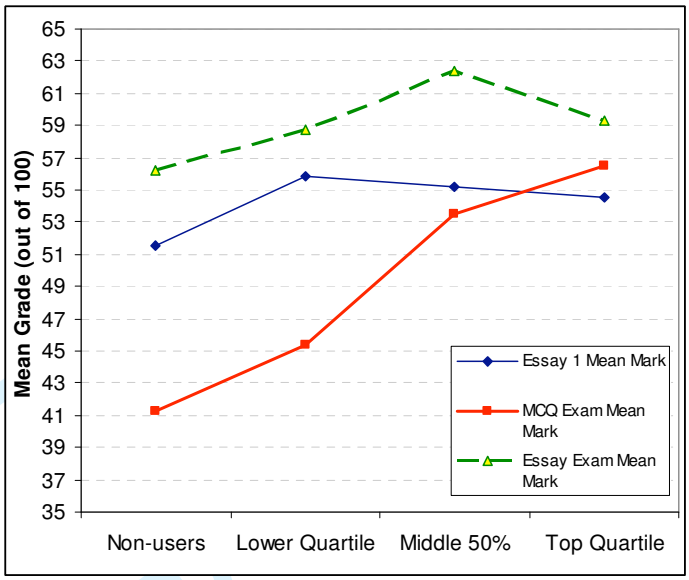


WEEK	hits	% hits
4	357	6.4209
5	191	3.4353
6	117	2.1043
7	227	4.0827
8	65	1.1691
9	89	1.6007
10	229	4.1187
11	610	10.971
12	3184	57.266
13	442	7.9496
14	49	0.8813
tot	5560	100

Note. Distribution of hits (visits) of the online material over the term. The system was made available to students in week 4 and the end of semester exam was held in week 13.

Figure 2. Academic performance and level of usage



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