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Reducing Procrastination while Improving Performance: A Wiki-powered Experiment with Students

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ABSTRACT

Students in higher education are traditionally requested to produce various pieces of written work during the courses they undertake. When students' work is submitted online as a whole, both the ethically questionable act of procrastinating and late submissions affect performance. The objective of this paper is to assess the performance of students from a control group, with that of students from an experimental group. The control group produced work as a unique deliverable to be submitted at the end of the course. On the other hand, the experimental group worked on each part for a week, and their work was managed by a wiki environment and monitored by a specifically developed software. Positive effects were noticed in the experimental group, as both students' time management skills and performance increased. Replications of this experiment can and should be performed, in order to compare results in coursework submission.

Author Keywords

Procrastination; students' performance; wikis; monitoring; time management

ACM Classification Keywords

K.3.2. Computers and Education: Computer and Information Science Education

INTRODUCTION

Students in higher education are traditionally requested to produce various pieces of work during the modules and courses that they undertake. In the UK education system, undergraduate students enrol into single or joint degrees, that are composed of modules, evaluated with marks, each yielding a number of credits (typically 20). A ordinary degree is completed when 300 credits are accumulated; a honours degree requires 360 credits.

The need for authenticity in the module assessments, to protect the true identity of a student against their work, has long been recognised as in contrast with the requirement of delivering computer-based assessments [17]. Personally attending a viva, or sitting in an exam classroom are the normally adopted solutions, with the latter being a preferred option, given a reported lack of reliability of vivas [8]. More in general, vivas, oral examinations or common-room exams are not always possible or practical, especially for online courses and institutions, or larger classes.

On the whole, when students' work is submitted online, assessors are typically only able to evaluate the final deliverable, and not the process that the student undertook to produce the result. Although online learning environments provide students' content usage statistics, handling this enormous volume of data is unmanageable [19]. In such a scenario, getting students to work steadily, limiting procrastination and improving their time management skills is not usually under the control of the educator. Previous studies have shown that procrastination is an ethically questionable behaviour inherent to human nature that affects student performance negatively [5, 1, 20].

Allowing students to work in a supervised environment, and helping them to break down the tasks of an assignment could be beneficial in the time management aspect. Using clearly sign-posted milestones would keep the whole work in check before the final deadline. Learning tools can be leveraged adopted for the purpose: online environment tools offer sandboxes, collaborative benchmarks and tracking systems that

can be easily deployed in an academic environment to help students take responsibility of their work [27]. In particular, the users of a wiki can collaborate in order to develop topics or concepts: the wiki environment keeps a log of every contribution from each user to any wiki page. In a scholarly context, and posing subsequent milestones, a wiki environment can be used to monitor the time management of students [26, 12].

This work reports the results of an experiment carried out with two cohorts of students undertaking a Computer Science course at Brunel University London (BUL), UK. A wiki environment was set up for students to work on a number of tasks: although the final deliverables were individual, collaboration between students was encouraged. A monitoring tool was developed to check that students comply with the time limits. The time management outcomes of the students undertaking this experiment was compared to what was observed within the previous year's cohort of students in the same module. The objective was to evaluate the deployed wiki environment as a practical approach to improve students' performance, avoiding procrastination and late submissions.

The rest of the paper is organised as follows: in section 2 previous works have been evaluated. Section 3 explains the experiment, introducing the hypotheses and the experiment design; while section 4 illustrates the main features of the tool that was implemented to monitor the activities of the students. Section 5 shows the results of the experiment, comparing the behaviour of the control and the experimental groups. Section 6 discusses the findings and the limitations of the approach, while the last section presents the conclusions.

RELATED WORK

Although procrastination is a habit that negatively affects work performance, its ethical aspects have hardly been addressed in literature [3]. Some authors discuss whether procrastination can be considered a vice [25, 5]. According to Boice [6], "procrastination means putting off a difficult, delayable, important task in favor of something easier, quicker, and less anxiety-provoking". Thus, procrastinators are not effective doing their work, they present a lack of time management skills, and they do not accept advice or feedback about their future behaviour [11]. Nevertheless, Baker (2010) stated that considering procrastination as a vice is unsettled. She demonstrated that procrastination is not a vice merely because it keeps us from getting things done and offered several complete ethical theories that make sense of procrastination as part of our nature. Then, if teachers have to assume procrastination as part of their students nature, they should plan out students activities in order to moderately avoid procrastination. Ariely and Wertenbroch [4] show that working by self-imposing deadlines helps people to control the procrastination habit. However, Allevato and Edwards [2] offered 10% extra credit for delivering a handout three days before the deadline, with no results, concluding that the problem was the poor time management of students. Moreover, Häfner et al. detected that students with good self-regulatory skills procrastinated less than those in the control group [16].

A negative relationship between procrastination and performance was found in several works. Learners' participation was measured from the number of messages posted in a forum concluding that students with high procrastination tendencies may learn through observation, whereas those with low procrastination tendencies prefer to learn by participating with others on discussion forums [22]. In fact, there is strong positive correlation between student–student interactions and grades in individual assessment of teamwork activities [13]. Another paper proposes complementing indicators from a virtual learning environment with 'time to' variables to assess learning activities, as these variables are related to negative forms of procrastination [9].

Students' interaction patterns in virtual learning environments are related with their performance. In a recent paper, students were clustered by their behaviour from the records of a Moodle-based course [7]. The results confirm that the procrastinating students are characterized by the lowest grades. Besides, the analysis of the variable related to procrastination indicated that the students who handed in the task later are more likely to receive a lower score. Therefore, an intervention to combat procrastination might be beneficial. The paper presented by Johnson et al. [18] reinforces the aforementioned hypothesis, since they showed how procrastination decreases as explicit rules are established.

Procrastinators perform poorly in highly structured, web-based courses with frequent enforced deadlines [28]. When wikis are used to support learning experiences, the tasks to be developed by students in their pages are usually subject to deadlines [29]. These experiences based on wikis are common in higher education as they facilitate collaboration among students [24]. But even if students do not collaborate in the development of a wiki-based work, simply being aware of their classmates progress in completing their work encourage students to complete their work in time [14]. Teachers can use the history function in the wiki system to monitor students task completion [15]. For this purpose, a monitoring tool to collect data related to students' effectiveness (task completion) and efficiency (task in time) is required [21].

EXPERIMENTAL DESIGN

This section presents the goals and hypotheses of this work, as well as giving a description of the experiment following the guidelines of the American Psychological Association [30].

Goal and purpose of the work

The goal of the experiment is to compare the work produced by the *control group*, students who worked on a traditional assignment submitted 'as a whole' at the end of the semester, with the work produced by the *experimental group*, students who worked on a series of tasks in a wiki environment monitored by an extended wiki tool.

The purpose is to evaluate the work of the two groups in terms of (i) time management skills, and (ii) performance.

Research Questions

In traditional settings, assignments are typically handed in by students as one large document, with the teacher setting a

deadline and asking the students to submit their work before it. This approach is brittle to performance and time management issues:

- Students tend to work according to fixed deadlines, and the vast majority will produce their work very close to the final date [23]. From an assessor's perspective, it is difficult to identify and acknowledge students who managed their time better, or even contribute to classmates' assignments. The research question derived from this context is: "*By monitoring students' work in a wiki environment, how effective is the usage of milestones and intermediate tasks towards the time management of the students?*"
- Students are often asked to submit their work by the end of a term, with little feedback along the way. Breaking a large coursework into parts of manageable size, due in shorter cycles (weekly, for instance), would have the benefit of keeping the students aware of their efforts, as well as keeping their work on track. The research question here is: "*By monitoring students' work in a wiki environment, will the assignments produced through several milestones along the course obtain, on average, better results than the assignments produced as a whole?*"

These research questions were formalised into one hypothesis each, below, and separate metrics were used to evaluate each hypothesis.

Hypotheses

Based on the issues presented above, this paper posits the following two hypotheses:

1. The first hypothesis ($H_{0,1}$) states that there are no differences in how effectively the two groups handle the time management for delivering the coursework.

   Rationale: the presence of a monitoring tool, used by teachers to evaluate the time management of students, will encourage students to work on time. Fewer students in the *experimental group* will deliver their work late, as compared to the students in the *control group*.

   Metric: to evaluate this hypothesis we used the number of assignments handed–in late in each group.

2. The second hypothesis ($H_{0,2}$) states that there are no differences in the results obtained by the control and experimental group.

   Rationale: students who work in consecutive (and evenly distributed in time) parts towards a coursework submission (i.e., the experimental group) are more aware of their effort, and will obtain better results than students submitting one piece of work at the end of the term (i.e., the control group) [23].

   Metric: in order to assess this hypothesis we used the distribution of grades in the two groups.

Experiment Design

A standard design with one factor and two treatments was used [30]. The treatments correspond to the two approaches: (i) coursework with controlled steps (experimental group); and (ii) coursework submitted as a whole (control group), as described in section .

Participants

The participants of the experiment were two cohorts of students from the Computer Science and Information Systems degrees at BUL, attending the same module. The control group was the cohort of students of the *Software Development and Management* module, mandatory for all students in year 2. The experimental group was the new cohort of students of the same module, a year later. The module required students to learn concepts and techniques to analyse and produce more consistent software. The first cohort consisted of 185 students, the second one had 166 students.

For both the control and experimental groups, no prerequisite knowledge was required to perform the tasks, i.e., lectures and tools provided what was needed to produce the work in the assignment. A one-off lecture was provided to the experimental group on the features of a Wiki environment. Also, two mock sessions were run to help students familiarise with the Wiki environment and syntax, before the actual tasks were recorded and assessed.

Settings and Experiment Tasks

The lab rooms were equipped with 90 PCs running standard Windows operating systems. In order to fit all the students, the experimental group was split in two sessions, of two hours each. The two sessions were hosted on the same day of the week (Friday) in two adjacent time slots (2-4 pm and 4-6 pm).

The wiki environment was set up and managed with the MediaWiki software (`https://www.mediawiki.org/wiki/MediaWiki`): version 1.19.14 was installed on a standard Ubuntu GNU/Linux server. The server was hosted outside the lab session, but still within the premises of BUL. Only the students within the BUL campus could access the wiki pages: this prevented interferences by external users.

In the following subsections, the apparatus of the control and experimental groups are discussed.

Courseworks

In both the control and experimental groups, the courseworks were worth 50% of the final mark, the rest of the mark being evaluated with an examination in term 2. Both courseworks were divided in six parts.

Albeit the courseworks required students to work on slightly different aspects, as described below, the parts of the two courseworks were mapped to similar Learning Outcomes (LO). The context of the two courseworks was also the same: the analysis of real software systems, based on the extraction of metrics via software tools. It is important to notice that, since the tasks are not comparable one-to-one, such a test was not performed: the comparative analysis was performed on the outcomes of the two courseworks, rather than their parts, since the two courseworks have a comparable level of complexity.

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Control group The coursework of the control group required students to select an open source project from a list of available projects. The projects were comparable: the list was populated with 1,000 projects with at least 20 files of source code. All the projects were hosted, at the time of selection, under the GoogleCode open repository, and they were all coded in Java.

The students had three months to produce a final coursework split in six parts. Each part required to analyse the project from various perspectives, extracting metrics and reporting the findings. Lab sessions were provided to support each of the six parts composing the assignment, but the attendance was not mandatory.

Experimental group Each student was given a unique ID to access the Wiki server, and a single monolithic open source system (FreeCol, available at: `http://www.freecol.org/`) was partitioned in files and classes. Each student received 3 Java source files, and 7 binary classes that became the object of the analyses in the six parts of the assignment. Students were requested to create their wiki user page. Each week, students were requested to create and link new pages based on the weekly task. All the reports, metrics and discussion were required to be hosted under the wiki page for the task of that week.

All students in the wiki could read the pages created by other students. Each student was assigned an individual and unique piece of code to analyze and had to reflect on the individual results obtained. Additionally, the history of changes in each page is publicly available, so the assessor had the overall view of the progress of the class. As a contrast, reading over classmates' pages could had a positive effect on students who had problems with their task: they could read the work that others were doing to get insights of what they were expected to do. Moreover, if they detected the wrong content, they could fix it and get recognition for it.

There were other reasons for contributing to other students' pages. If a student finished their task early, they would help populate and restructure common pages that all the students needed (for instance, the list of packages, developers and so on). Concerning this, students were warned that each student was responsible of the content in their wiki page. This way, they had to implicitly decide how to handle the contributions in their pages: leaving them if considered correct, modifying them if completed but needed improvement, or directly removing them if they are not interesting (this could imply reporting the supervisor if they are considered intentionally wrong). As a result, the collaboration benefits both students: the *helping student* implicitly compared their approach to solve their task with the other students'. Conversely, the *helped student* had to properly integrate the contribution in their coursework.

Procedure

The assessed LOs were made known in advance, according to the standard format in use at BUL. They are summarised in table 1 and they are common for the two groups.

LO1	Identify, explain, and evaluate the key concepts in software engineering (including architectural and design methodology, patterns and notations).
LO2	Analyse a real software systems from three points of view: the users, the developers and the managers of its development.
LO3	Translate design models into a range of software artifacts (namely program code of three or more languages, types or tiers).

Table 1. Learning outcomes (LO).

Control Group – Students in the control group had the opportunity to learn the techniques, metrics or tools needed for the coursework during the lab sessions. The six tasks, as summarised in the first column of table 2 were due in a unique final hand-in, at the end of term.

Experimental Group – Regarding the experimental group, the students received general instructions on Wiki editing. Two practical sessions (two hours each) were run beforehand to practice with the format, editing and basic syntax wiki skills. After those, six sessions were run and used as tasks for the coursework as indicated in the second column of table 2.

Students were told that their actions were monitored by a versioning system embedded in MediaWiki, in order to give credit to the owner of each task. The monitoring tool allowed the teacher to check whether students did the tasks in their Wiki pages during the time slot established for each group. This way, late work was discouraged: if students worked outside the allotted time, a cap was applied to their work, in terms of maximum marks for each task. A minimal (5%) amount of work was permitted on top of the allotted time, but a proportional decrease of marks was made known to the students, had their work exceeded the given time. This is in line with any other piece of work that students might submit late during their academic life, so it is assumed that students were comfortable with the rule.

Experiment Variables and Formalized Hypotheses

The main independent variable of the experiment is group affiliation. It indicates whether a participant belongs to the experiment (the coursework split in monitored tasks) or control (the whole coursework due in one submission) group.

The main dependent variable is the performance of the students in the sessions. The performance is defined as the level of participation and understanding of students in a taught module. The number of late submissions is well-suited for measuring the time management of each group.

WIKIASSIGNMENTMONITOR (WAM)

WikiAssignmentMonitor (WAM) is an open-source tool specifically developed for this case study (available at `https://www.assembla.com/spaces/WikiAssignmentMonitor`). WAM is implemented as a PHP web application that queries a MediaWiki database. It provides the instructor with objective indicators of the students' work in a MediaWiki environment.

Task	Control Group	Experimental Group
I	Identify the domain (LO2)	use ckjm tool on files and classes, copy and paste results (LO2)
II	List the functions of the system of choice (LO2)	identify dependencies of classes, copy and paste graphs (LO2)
III	Size and staffing using TortoiseSVN (LO1)	Size and staffing using TortoiseSVN (LO1)
IV	Effort estimation (LO2)	SVN vs Git (LO2)
V	UML translation I (LO3)	Effort estimation (LO2)
VI	UML translation II (LO3)	UML translation (LO3)
Worked on	**System chosen by the students**	**Source files and classes assigned earlier**

Table 2. Lists of tasks.

WAM diplays a web application with several sections: when setting it up, instructors can create *groups* of students, attending specific *sessions*, while monitoring their *time management*. As shown in Figure 1, the groups are defined by the teacher, and students are assigned to one or more groups. Groups are assigned specific lab sessions: WAM allows an instructor to create the links: student → group → lab-session.

In the *time management* section of WAM, instructors can obtain two types of reports for a *group* of students: *work per session* and *work per hour*. The work-per-session report provides a table where each cell represents, per week, the percentage of work that each student performed within the session. The colour of the cells changes from yellow to green tones as long as the percentage moves from 0% to 100%.

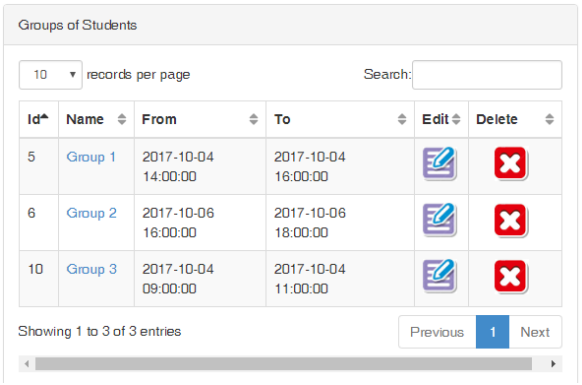

Figure 1. Configuration of the groups in WAM

The second report is the *work per hour*, a table that represents the hourly percentage of the work performed by each student. The corresponding time-slot for these students is enclosed by two red lines. The table has the anonymised students in each row and 24 columns, one for each hour of the day. The background-colour of the cells are painted **green** when a given student performed the majority of the task (more than 30%) in the hour indicated by the column; **yellow** if they did a significant part (between 10% and 30%) of that task; and **red** if they worked less than 10% on that task.

The data reflected in both reports are directly obtained from the MediaWiki database. Thus, if the instructor changes the information of any group or any session (for instance, reflecting an extension to a deadline, or a change within groups of students), all the changes will be reflected. In addition, a CSV file is also provided with every report. Through this file the instructor can download the information and process it using a spreadsheet.

RESULTS

We present below three sets of results: (i) from the teacher's perspective, reports the time management monitoring results observed in the experimental group; (ii) from the students' perspective, tests the null hypothesis $H_{0,1}$, by considering the control and the experimental groups, and checking if the amount of late submissions was different in the two groups; (iii) from the students' perspective, tests the null hypothesis $H_{0,2}$, by considering the control and the experimental groups, and checking if students' marks were different in the two groups.

WAM Reports (Experimental Group)

Figure 2 shows two aspects related to the work of the experimental group in every session (S1 – S6). The first compares the work done by the students in the allowed session (dark bars), to the attendance to the same session (grey bars).

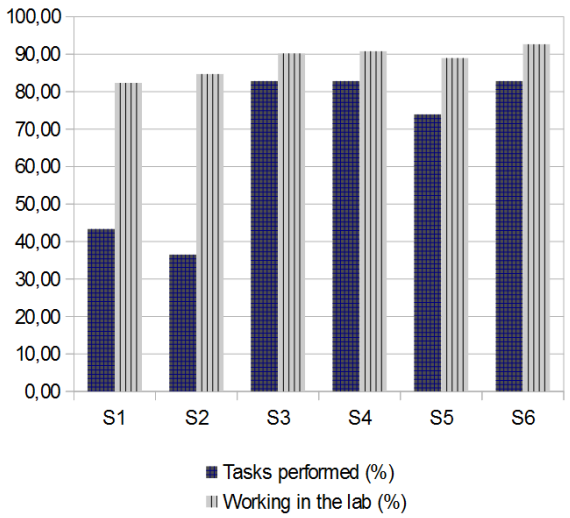

Figure 2. Students attendance and engagement during the lab sessions

Considering the students' attendance, it is evident that most students were regularly attending the lab sessions since the very first one. The first and the second sessions registered

around 80% of attendance, while the last four sessions had around 90% of students.

On the other hand, the work completed during the first and second session was only around 40%. Even though students knew the restrictions and the capping rule, the majority of students finished their task well over the allowed time (one week or several weeks after the lab session was over).

WAM helped the teacher to real-time analyse time management issues, addressing them at an early stage instead of waiting for marking. After reminding students that they should perform their work in their lab sessions, the last four sessions the completed work increased to about 80%.

Observing the WAM screenshot (figure 3), the course instructor was able to determine this discrepancy between lab attendance and work completed. For instance, we can see the fourth student (CS2002 004) in this figure 3. During the first (Oct 17) and the second (Oct 24) sessions, she performed the 21.39% and the 46.76%, respectively, of the entire work during the allowed sessions. However, from the third session (Oct 31) she improved her performance during the sessions, completing her tasks in each of them (100%).

Using these reports, the instructor concluded that the time management of students improved in the last four sessions.

Student	17/10	24/10	31/10	14/11	21/11	28/11
CS2002 001	0.00 %	100.00 %	100.00 %	59.72 %	3.65 %	100.00 %
CS2002 002	96.92 %	47.40 %	100.00 %	100.00 %	100.00 %	100.00 %
CS2002 003	85.79 %	1.70 %	100.00 %	100.00 %	100.00 %	100.00 %
CS2002 004	21.39 %	46.76 %	100.00 %	100.00 %	100.00 %	100.00 %
CS2002 005	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
CS2002 006	66.12 %	82.20 %	100.00 %	100.00 %	100.00 %	100.00 %
CS2002 007	98.71 %	0.00 %	100.00 %	92.71 %	99.12 %	18.06 %
CS2002 008	50.07 %	100.00 %	53.44 %	100.00 %	100.00 %	99.66 %
CS2002 009	100.00 %	0.00 %	100.00 %	0.00 %	29.07 %	100.00 %
CS2002 010	71.30 %	1.38 %	100.00 %	100.00 %	100.00 %	100.00 %

Figure 3. WAM view of work completion

Time Management: Control vs Experimental Group

The *control group* had to submit their work as a whole, and before a known deadline, without further check-points. The observations on their time management were as follows:

1. **Late submissions**: 30 students (16%) submitted their work after the deadline passed. Three of them claimed extenuating circumstances, due to personal problems, so the final number of late submissions was 27.

2. **Retakes**: Three students retook the module exam in the summer, either because they failed the second part of the assessment, or because they did not agree with the mark given in the first instance.

Group	Late sub's (rate)	Ext. Circ. (rate)	Retakes (rate)
Control	30 (16%)	3 (2%)	3 (2%)
Experiment	4 (2%)	0 (0%)	0 (0%)

Table 3. Time Management: Control vs Experimental groups

The *experimental group* had to wrap up their tasks into one document to be submitted before a known deadline. This process was based on a print-out of all the Wiki pages produced by each student, and submitted as one coursework.

1. **Late submissions**: It was observed that only 4 students (2%) handed in their work later than expected. No student claimed for specific extenuating circumstances.

2. **Retakes**: No students retook the module in the summer, therefore agreeing to the marks given in the first attempt.

As far as the definition of the research question, and the formulated hypothesis, the Fisher exact test was ran in order to evaluate the null hypothesis $H_{0,1}$. The p-value was 6.737e-06, less than 0.05. Then, the null hypothesis is rejected at 95% confidence and the alternative hypothesis is accepted: the time management of the students in the experimental group was more effective than that of the students in the control group, as far as the amount of late submissions. Table 3 summarises the findings of this first research question.

Performance: Control vs Experimental Group

The results of the second research question are reported below. The marks were collected for the students in the control and the experimental groups, and categorized in 6 grade bands (A, B, C, D, E and F). Figure 4 shows the percentage of students getting each grade band.

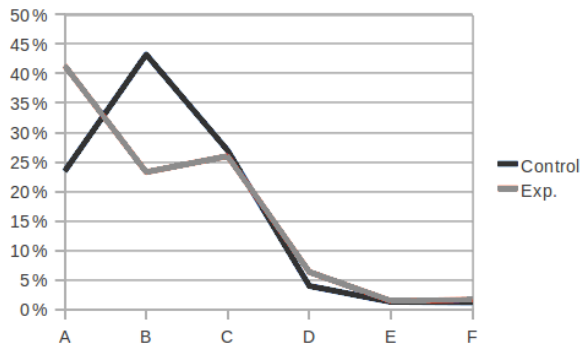

Figure 4. Ratio of students getting each grade in each lab session

Having a look at the overall grades, it seems that in the control year, the students' grades followed a bell distribution: a few A's, mostly B's, again a few C's, and a tail of D's, E's, and F's. But in the experimental year, the distribution has a long tail, with most students receiving A's, many fewer B's, then similar results for C's, and the same tail for D's, E's and F's, as shown in Figure 4.

The bars in Figure 6 show that the number of students getting an A increased in the three LO. This is especially visible in LO2, where the ratio of students getting a B is the only one to fall. In the previous year, more than 50% of the students had

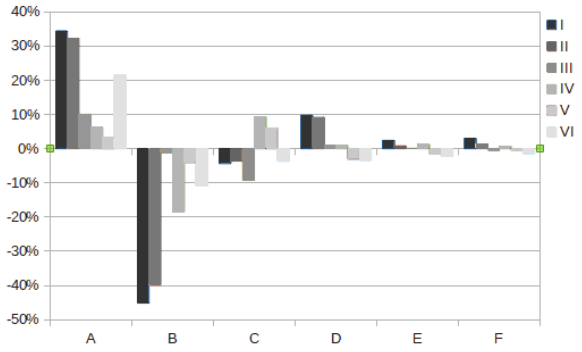

Figure 5. Difference of ratio of students getting each grade in coursework

a B in the LO2 sessions, but in the year of the experiment it was just 15%. And most of that ratio of student having B in LO2 in the experimental year now had an A. The behaviour in LO1 is similar, but with lower figures: the B's and C's decreased and the ratio is spread mainly in A, but also a bit in E. And finally, in LO3, the ratio of B's, D's, E's and F's decreased, while those of A's and C's increased, reinforcing our hypothesis.

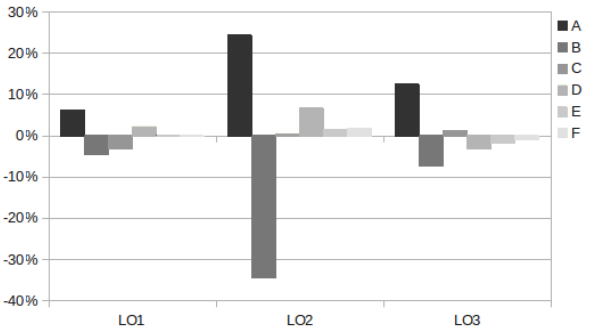

Figure 6. Difference of ratio of students getting each grade in every learning outcome

DISCUSSION AND POST-HOC ANALYSIS

The findings show a positive effect when using a wiki environment to monitor the time management of students, and to prevent procrastination in completing a multi-part assignment: from the *assessor* perspective, the WAM tool can be an effective tool to provide an early warning for single students, or the whole cohort, if they are lagging behind in terms of work before a deadline. From the *students* perspective, our results show a positive effect when using a wiki environment to monitor their own time management. Firstly, students prevent the procrastination of work in delivering a (multi-part) assignment; and secondly, their academic performance improve. These effects were measured by the drastic drop in late submissions and by the increase in grades, both obtained by the experimental group, as compared to the control group.

An analysis of the distribution of students according to the grades obtained in the sessions (A, B, C, D, E and F) shows (figure 5) that the rate of student who obtained a B mark has reduced drastically: in the control group more than 23% of the students got an A mark and more than 43% of them got a B, while in the experimental group figures are almost the opposite: 41% got A and only 23% got B. This happened in every individual task. A possible reason for this is that students were allowed to add extra work after they had finished their task. It is likely that a few students finished their work and left the lab, and afterwards they corrected minor mistakes before handing in their task. Additionally, the ratio of students who passed the course with a C grade remained similar (around 26%), but the number of failed ones increased in 3%.

It is worth reporting that the experiment was not easy to deploy. Students were used to a certain type of coursework, as deployed the year before, and they expected something along the same lines. Students showed a good amount of resistance that had to be reconciled by pointing out the basic rules of individual assignment. The attempt at clearly and uniquely pointing out the responsible of a piece of work was probably perceived as a limitation of how students could "game the system", but it was also recognised as a transparent method at marking studentsAs one student pointed out: "(...) *using the wiki as a submission medium could be one of the fairest method of judging the work someone has done*".

It is also worth mentioning that the means used to prevent students from working outside the allotted time, i.e., the capping applied to the grade of an over-run part, was also not easily accepted, and perceived as an unnecessary addition to the module specification. Again, BUL students were expected to be fully knowledgeable about the mechanisms of late submissions, and how this could be reducing the overall mark as it was for the control group before if the whole coursework was handed in late.

THREATS TO VALIDITY

In the following, the threats to validity are illustrated.

Internal validity

It should be noted that the two courseworks were not exactly the same. As visible in table 2, the LOs of the various parts are similar in both tasks, thus the level of difficulty, but the exact equivalence cannot be guaranteed, given that the coursework specification was changed between the two cohorts. In order to test the null hypothesis, this is not required: our experiment is designed to test how students manage their time using two similar pieces of required work, that can be split in various, independent parts.

External validity

Although the research power (generalisability) is limited due to having carried out the study in a setting typical of UK's institutions, it represents a quite common and thus generalisable setting. In order to generalise the findings to other universities, and more importantly, to other subjects, a replication of the experiment is needed.

Construct validity

It is assumed that the time management skills of a student can be measured by their ability of working to a certain deadline. This is an approximation, and it misses other important factors, including the quality of work, or the resulting stress.

What this work measures is one of the outcomes of poor time management, if not the most visible.

CONCLUSION

The ethical aspects of procrastination are a subject of discussion among philosophers and psychologists. Baker (2010) showed several ethical theories arguing that procrastination is not a vice, and even considering procrastination as a fundamental element in our nature (akratic approach). Thus, in the academic context, teachers should plan students' activities to deal with procrastination.

This paper presented the results of an experiment using a Wiki environment enriched with a monitoring tool for early detection of deviations. Firstly, in the experimental group, better time management skills (i.e., fewer late submissions) were observed, than for the assignments produced by the control group. Secondly, using the grades of students from the previous years as a baseline, there was an observed increase in the number of A's.

These findings are valuable to teachers and researchers, and may be practically adopted in any higher education degree, specifically when educators are interested in analysing the interactions between students, and when the assignment can be broken down into loosely coupled components (engineering and computing tasks in particular).

As a future work, the experience will be repeated using a richer wiki environment for assignment management aligned with actual corporate strategies [10].

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