Observations of student working practices in an online distance education learning environment in relation to time

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Abstract

AESOP is *An Electronic Student Observatory Project* consisting of a set of tools written in Smalltalk allowing student's activities and progress through an on-line distance education course to be remotely recorded, replayed and analysed. Recordings of a specific, short-structured chapter of practical sessions estimated to take a total of 4 hours, were obtained from a cross-sectional group of 120 student volunteers undertaking the Open University's distance education course *M206 Computing: An Object-Orientated Approach*. The records were analysed for patterns in student working practices with regard to time and also compared with performance on independently marked assessments. The date on which students started the chapter and the number of days over which they took to complete it was shown to be very variable. Also noted was the high proportion of students leaving the work for long periods of time before continuing with it. No particular day of the week was found to be favourable although students did show individual preferences for the time of day they worked. Most working in the evening with a peak of starting work at 8pm. A smaller sub-peak was noticed at lunchtime (12pm). Time was not found to be a factor influencing performance in assessed work.

Introduction

AESOP is An Electronic Student Observatory Project, at the Open University[i] (Thomas, MacGregor et al. 1998; Thomas, MacGregor et al. 1998; MacGregor, Thomas et al. 1999; Thomas and Paine 2000; Thomas and Paine 2000; Thomas and Paine 2000; Thomas and Paine 2000). It consists of a collection of software applications for recording, replaying and automatic analysis of recorded data, which allows remote detailed observation of subjects studying on-line expository material. AESOP has been built around the Open University's distance education course M206 Computing: An Object-Orientated Approach[ii], which teaches students, amongst other things, programming in Smalltalk using the Learning Works environment (Goldberg, Neometron Inc et al.; Open University). The work of AESOP aims to:

- Inform educators how best to effect object technology transfer by improving their teaching.
- To provide an apparatus for identifying problems students may experience while learning to program.
- To provide empirical evidence for improving the design of the programming environment.

Students' interactions are observed using two main applications, one designated as the 'Recorder' and another the 'Replayer'. A fuller description of these and the other AESOP tools can be found in earlier work by Thomas, MacGregor, Paine and Logan (Thomas, MacGregor et al. 1998; Thomas, MacGregor et al. 1998; MacGregor, Thomas et al. 1999; Thomas and Paine 2000; Thomas and Paine 2000; Thomas and Paine 2000; Thomas and Paine 2000). In summary, the Recorder consists of two small application files that extend the Learning Works system. The Recorder launches automatically and invisibly records whenever a student opens up a Learning Book (LB), a set of computer based practicals organised into chapters. It does not record anything outside the Learning Works

environment when in use, but records to a text file interactions and events occurring within a Learning Book. Each individual event is time and date stamped. If a Learning Book is reopened at a later time the Recorder appends any new events to the original file.

Given this wealth of data one of the questions that we wanted to answer was when and how do distance education students work relative to time of day, day of week and other time related issues. Additionally does the time of day they choose to work influence their performance or the number of types of error they make?

Method

Subjects

Subjects were student volunteers from the Open University's distance learning course M206. An invitation to be part of the study and to complete a pre-study questionnaire was made to all students at the same time they received their course material in January 2000 (n = 3399). Students who indicated their desire to take part by completing the pre-study questionnaire were sent further information and the AESOP Recorder. No incentive was offered to the students other than explaining the purposes of the study.

Students returned recordings as email file attachments at times convenient to them through the duration of the course and were also asked to complete a post-study questionnaire near the end of the course.

Questionnaires

Two questionnaires, made available to subjects via the web before and after the M206 course, were designed to collate and monitor information that the recorder was not designed to capture. For example subjects' demographic details (age, gender, occupation) as well as current knowledge of computers, level of comfort carrying out computer related tasks and other information about the specification of the computer they were using to study the M206 course. The second questionnaire was used to compare in a repeated measures design any changes from the pre-study questionnaire in levels of comfort and use of computers.

Study Material

The delivery of M206 Computing: An Object-Orientated Approach comprises paper based course work, terrestrial television program transmissions and computer based practicals supplied on CD-ROM. The Learning Works environment provides the core of the online practical work and is divided into a number of chapters, known as Learning Books, each corresponding to a relevant chapter in the paper based course text.

The Learning Books themselves are divided up into sessions each with a number of practicals to be completed.

For the purposes of this part of the study the records returned by students for Learning Book 9 were selected for the analysis, as this Learning Book is the first one in the course to contain structured practical programming exercises. Studying structured sessions as opposed to unstructured ones helps minimise the time differences created by students working on tasks that may have more that one solution. All references here to a Learning Book refer to Learning Book 9.

All Learning Book recordings were analysed using both Microsoft Excel and SPSS for Windows. In addition, data obtained from the recordings was compared with data from the pre-study questionnaire and the scores obtained on their first four pieces of assessed work, known as Tutor Marked Assignments (TMAs).

Results

Subjects

368 students volunteered to take part in the study, of which 182 (49%) returned one or more recordings. 120 recordings were available for Learning Book 9. A comparison of subjects' age, gender and TMA scores against the total intake for the M206 course that year showed volunteers to be a good cross section. Minor discrepancies were noted indicating the volunteers taking part tended to be slightly older with a slightly higher proportion of females in the sample, although these differences were not found to be statistically significant. The subject group was also found to have TMA scores that were 4-5% on average higher than the averages obtained for the total intake that year.

Identification of time points

For the purposes of this study, only those events signifying the opening and closing of Learning Book have been analysed. These events represent the times at which a student starts and finishes their study of the Learning Book. Of course it is possible for a student to open and close a Learning Book on several occasions when there will be multiple open and close events recorded.

Sittings

A 'sitting' is defined here as the time period between a subject opening the Learning Book and subsequently closing it. Learning Book 9 is arranged into 4 sessions and a student is expected to work through it in 4 sittings.

A frequency analysis of the number of sittings by 119 students is shown in Figure 1. One extreme outlying data point, of a student who took 32 sittings has been excluded from the graph, but the number of sittings students undertook to complete the Learning Book can be seen to follow an essentially normal distribution around the expected value of 4.

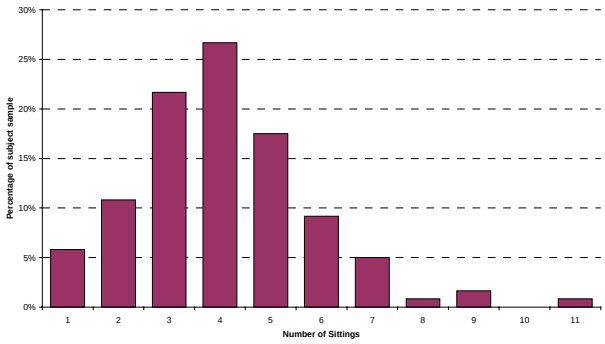


Figure 1 – Histogram showing number of sittings taken to complete Learning Book 09 (Contains 4 sessions). One record of 32 sittings excluded.

Chronological timelines

As a method of looking at the overall pattern of an individual's sequence of opening and closing events, the date and time for each open and close event was plotted sequentially on a time line. The complexity of all 120 individual time lines is too difficult to display but a representative sample of 15 records is displayed in Figure 2. The time line on the y axis is marked off at 7 day intervals (Saturdays).

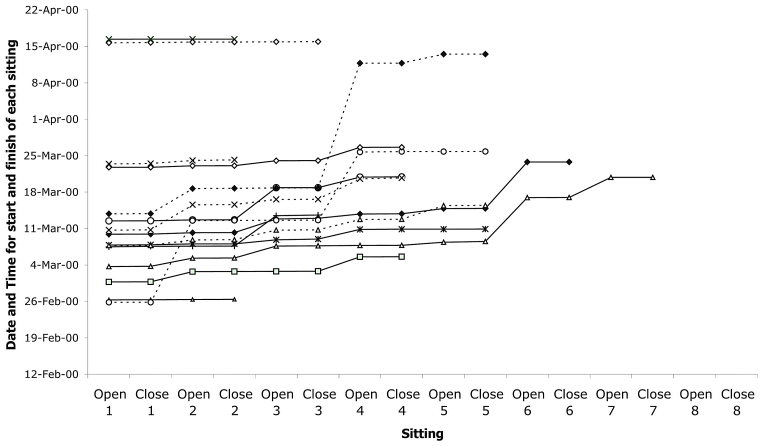


Figure 2 – Representative sample of 15 individual timelines showing sequential opening and closing of learning book.

There is no set date on which students start to work through the Learning Book, with start dates for all 120 records ranging from 10 February, 2000 to 16 April, 2000 (mean = 6 March, 2000, sd = 11.8 days).

The number of days over which students take to complete a Learning Book also varies considerably (mean = 7.58 days, sd = 9.31 days, min = 3 minutes, max = 49.91 days), with only 15% of students working on it for less than one day. Often students were observed not to work on the Learning Book for several days before returning to it. 25% students at one point or other were found to leave a gap of more than 7 days between sittings.

Preferences for day of week and time of day to work

Time and date data was analysed for most frequent day of week and time of day that each individual student worked as a way of determining preference. In this context preference being the day and time a student is seen to work the most, it does not necessarily indicate this is the best time for the individual student or indicate the level of desire by a student for working on that day or at that time.

The median of the time at which each student started a sitting was used for this, but to avoid bias that would be introduced when a student studies several sessions within a short time frame, only those time values which were greater than 2 hours apart were counted.

Figure 3 shows a frequency plot of the day of week preferred by students. Figure 4a and 4b show the preferred time of day by students to start and finish studying respectively.

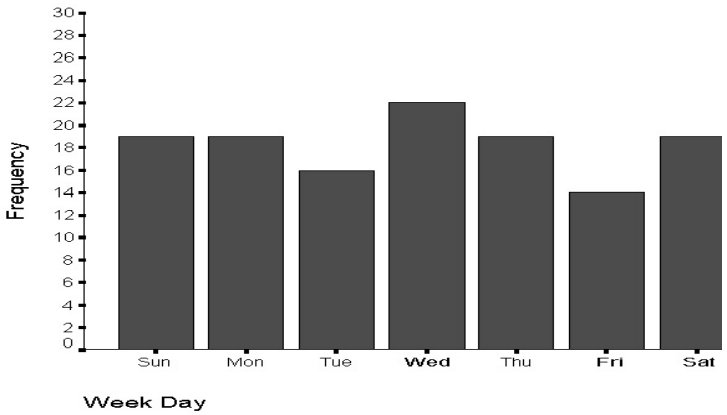
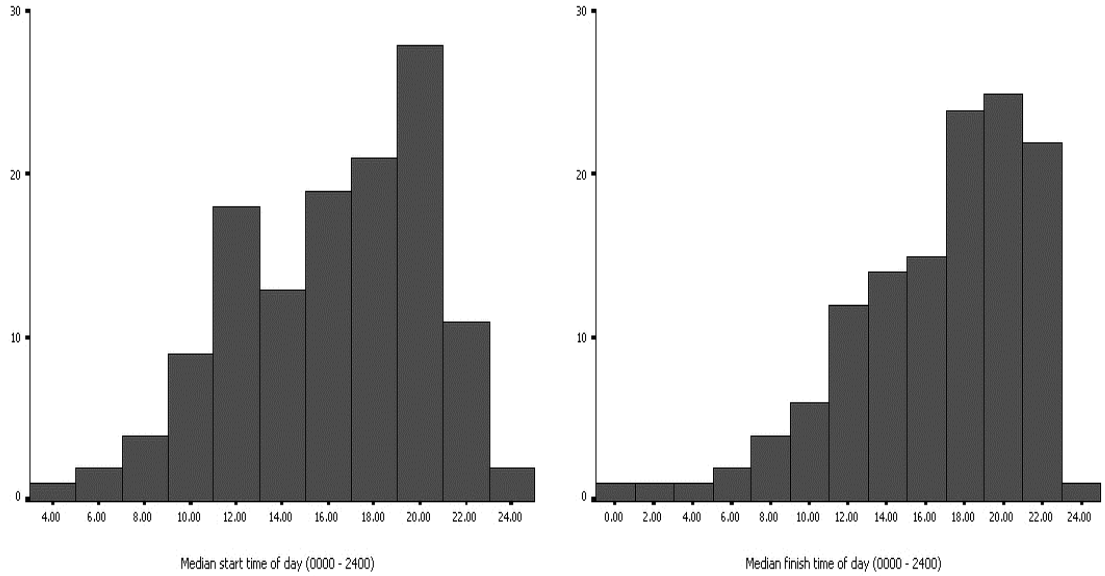


Figure 3 – Histogram showing preferred day of week for working.

The data shows students have no preferences with regards to the day of the week they work either as a group (as shown here in Figure 3) or as individuals. Individual students did show a preference for time of day that they worked, frequently being seen to start work at the same time each day. As a



group this shows up as general distribution peaking at 8pm in the evening (20:00 hours) and a secondary peak at lunchtime (12:00 hours).

a *b*

The frequency of individual students' usual time of day for starting work (Figure 4a) and stopping (Figure 4b)

Comparison with performance on marked assignments .

Looking into the possibility that the time of day that students work could influence performance on marked assignments, students' preferred time of day was compared with the average score for their first 4 TMAs. The results are displayed in Figure 5. No relationships were found between time of day students usually worked and their performance on marked assignments.

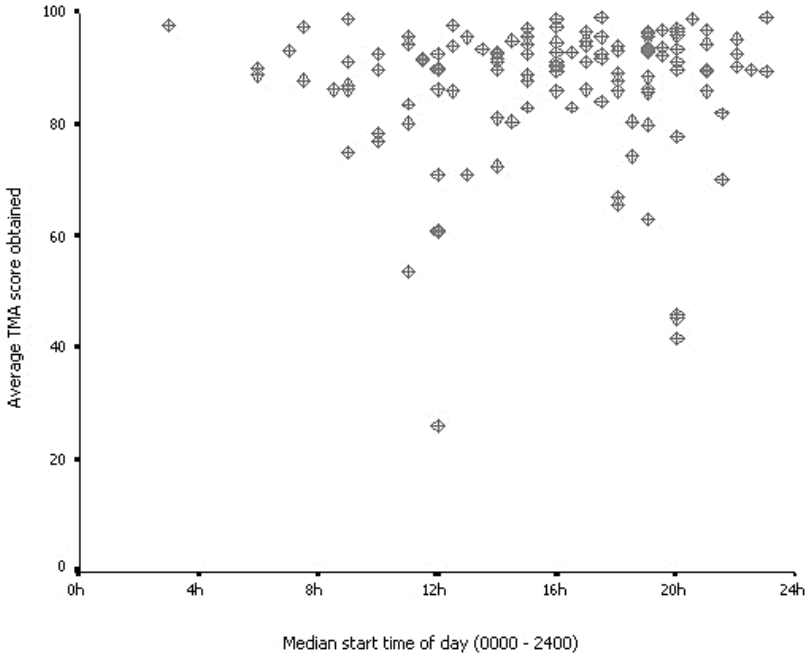


Figure 5 - Scatterplot of individual's average TMA scores against usual working time of day.

Further analyses were carried out, but no factors involving time were found to influence performance in assessed course work. Other factors investigated included individual differences in levels of confidence as indicated in the pre-study questionnaire, age and total amount of time students spent actively working on the Learning Book.

Future work

Although no relationships were found between time of day and performance on marked assessments, much more detail is recorded by the Recorder including error messages and information on the type of error students make. Whether time influences the number or type of errors a distance education student makes has yet to be investigated and is an area of future work.

Conclusion

General conclusions that can be drawn from this research is that there is no predictable day on which distance education students work although it can be expected that most students tend to work the same hours each day and, as a group, the peak of student activity can be seen in the evening with a sub-peak at lunch time.

Students also do not generally complete Learning Books in one day, with only 15% noted to do so. Students were found to take a number of days over which they completed their work and this was seen to be very variable as some Learning Books were left for long periods of time before being returned to.

Despite these differences in working patterns, time as measured here does not seem to influence students' performance in assessed work and it would appear that this could be because we are seeing students working at times most convenient to them, that is, when they feel they are able to study. There is no data however to show whether the same student working at a different time would perform better or worse, or any information regarding the type or frequency of error they make.

Acknowledgements

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[i] http://www.open.ac.uk/aesop

[ii] http://www3.open.ac.uk/courses/bin/p12.dll?C01M206