Turkish Online Journal of Distance Education-TOJDE January 2015 ISSN 1302-6488 Volume: 16 Number: 1 Article 7

STUDENTS' NAVIGATIONAL PATTERN AND PERFORMANCE IN AN E-LEARNING ENVIRONMENT: A Case from UP Open University, Philippines

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ABSTRACT

The study analyzed the navigational patterns of learners in an online course in Science, Technology, and Society using movement ecological concept. The course site consists of five important pages, namely: home page, resource page, user page, forum page, forum discussion page, and forum add post page. About 11,413 logged data were mined and analyzed for the learners' mean number of visits (NOV) in each page. The computed mean NOV was correlated with the learners' performance, which was measured through their final grades.

Results indicate that learners had visited more frequently the pages that contained information they need to accomplish the course requirements: home page (mean NOV=87.38); resource page (mean NOV=40.33); and discussion forum page (mean NOV=56.29). Those who had visited the resource page were more likely to visit the discussion forum page, participate in the on-going discussion, and/or create a new thread of discussion. These patterns show that learners seek information that is necessary in their learning transactions. The patterns of navigation however did not show a significant relationship with learners' performance (p>0.05). Other factors may have contributed to their performance, and they must be identified as well to create a virtual environment that can maximize the learners' learning experience.

Keywords: **Navigational pattern analysis, science, technology and society, navigation behaviour, UP Open University, movement ecology, open and distance e-learning**

INTRODUCTION

Living organisms exhibit specific movement in certain environment. Crist et al. (1992) cited several studies that indicate a relationship between animal movement patterns and some ecological functions such as foraging (Smith, 1974; Bond, 1980; Pyke, 1984); space use in home ranges (Siniff & Jessen, 1969; Swihart, Slade, and Bergstrom, 1988); population distribution over space (Levin, 1974); dispersion (Okubo, 1980; Stamps, Buechner, & Krishnan, 1987); and interactions (Murdie & Hassell, 1973; Banks, Kareiva, & Murphy, 1987). Animal movement is directed by certain factors such as availability of food, vegetation, social factors, or changes in habitat landscapes (Crist et al., 1992). The differences in physiology, vagility, size, and life history characteristics have also been observed to influence movement patterns

(Greenwood & Swingland, 1984; Loehle, 1990; Turchin, 1991 in Crist et al., 1992). These factors are important in their survival, physiology, and reproduction.

E-learners can metaphorically be considered as 'organisms' in a virtual learning environment. Their navigational behaviour can be construed as movement directed by some factors to enable them to achieve the learning goals. The course site consists of several pages that contain the basic resources for the learning process. Though there is a significant difference between students in a virtual environment and organisms in the real environment, they have a common goal, i.e. to be successful in their transactions given a set of environmental conditions.

To do this, both organisms and e-learners should devise strategies that can help them achieve this goal. Movement pattern is only one of these strategies. Though this scenario is an "open" system among organisms, it is a "closed" system among online learners, in a sense that every action they perform is related to the learning process, and with a set of previously established goals (Carbo, Mor, and Minguillion, 2005). In addition, it can be inferred that different students follow different navigational patterns, but these patterns are limited to a few, mostly because of course structure, and temporal and technological restrictions (Carbo, Mor, & Minguillion, 2005).

The analysis of the navigational patterns of students in an online course is useful in instructional design, management, and even in scaffolding learning processes of students. Neuhauser (2002) considered such scientific procedure as crucial for effective online learning, and argued the necessity to better observe and monitor online activities of students and their patterns of navigation. Also, Carbo, Mor, and Minguillon (2005) indicates that tracking users' behavior in a virtual environment can create possibilities for producing and organizing better the contents. The knowledge extracted from the navigational behaviour of e-learners can be utilized to develop contextualized or personalized e-learning processes. Because e-learning transactions are 'closed' (Carbo, Mor, & Minguillon, 2005), navigational patterns can be formulated and validated by means of logged data analysis tools. The capability of Moodle to log navigational data by users can help facilitate the data collection of this study. The University of the Philippines Open University's learning management system, i.e. myportal, is powered by Moodle, and can be a good tool in analyzing online behaviour of students.

The study retrieved the logged data from the myportal, and analyzed them to answer the following questions:

- **How many times do students visit a particular page vis-à-vis their number of visits of the course site?**
- **Which page do students visit more frequently?**
- **Do the navigational patterns affect their performance?**

In general, the study aimed to determine whether or not the navigational patterns of the students affect their performance in an online course.
Specifically, however, the study sought to:

- **calculate the students' mean number of visits per page**
- **identify the most frequently visited page/s**
- **correlate frequency of visits with students' performance**

METHODOLOGY

The Course Site

A site of an online undergraduate Science, Technology and Society (STS) course was used in the study. The site consists of five pages, namely, homepage, users' page, forum page, forum discussion page, resources page, and forum add post page. These pages contain different information and serve different purposes.

As a student logged on to the site, s/he landed on the homepage, which contains course announcements and links to other pages. Users' page contains the names of the students enrolled in the course site; forum page contains the list of forums/fora that each student may participate in; forum discussion page contains students' posts and replies to posts; resources page contains the various resources such as course guide, modules, and supplementary learning materials of the course; and forum add post page is where the student creates another thread of discussion.

Students Logged Data

The UP Open University myportal, which is powered by Moodle, is the current learning platform of the course. It has the ability to log students' visit data. A typical logged data in the myportal consists of the IP address of the student, students' complete name, date and time of access, entry and exit pages, actions taken while being logged on the course site, and pages visited. All logged data were entered into an excel data processing environment where descriptive statistics such as frequencies, means, and percentages were computed.

About 11,413 logged data from 42 students (i.e. 54% of the total number of students) in STS were analyzed in the study.

Measuring Performance

Students' performance was computed through two faculty-in-charge-made written examinations, one at the middle of the term and the other one at the end of the term. The examinations had been used alternately for several terms in this class. The midterm examination covered the first two units of the learning material while the final examination covered the remaining two units of the material.

Each examination consists of multiple choice and essay type questions with a total score of 100 points. Students' scores were transmutated to the University's grading system where 1.0 is the highest and 5.0 is failure. The scale is 0.25, and thus, 1.0 is followed by 1.25, 1.5, and so on. Students who dropped from the course or got an extended grade (EXT) were not included in the analysis.
A grade of EXT means that the student fails to submit at least one requirement of the course.

Data Analysis

Descriptive statistics measurement such as frequency, total, means, standard deviation, and percentages, minimum, and maximum were computed. Correlation analysis between the number of visits and students' performance was done. Data were visualized as graphs and tables.

RESULTS AND DISCUSSION

Number of Visits

Table 1 summarizes the computed number of visits of the students from the logged data of 42 students.

Table: 1
Descriptive statistics summary (n = 42)

Page	Minimum	Maximum	Standard Deviation
home page	25	236	47.41
resource page	12	122	25.59
user page	0	41	11.26
forum page	0	143	25.85
forum discussion page	13	228	38.10
forum add post	0	13	2.92

As indicated in Table: 1, students had visited the course site for about 236 times throughout the term. There were students who had neither visited the forum add post page nor the user add forum pages. On the average however, each student had visited the home page for more than 80 times, resource page for 40 times, user page for 13 times, forum page for 32 times, forum discussion page for 56 times, and forum add post page for 5 times (Figure: 1).

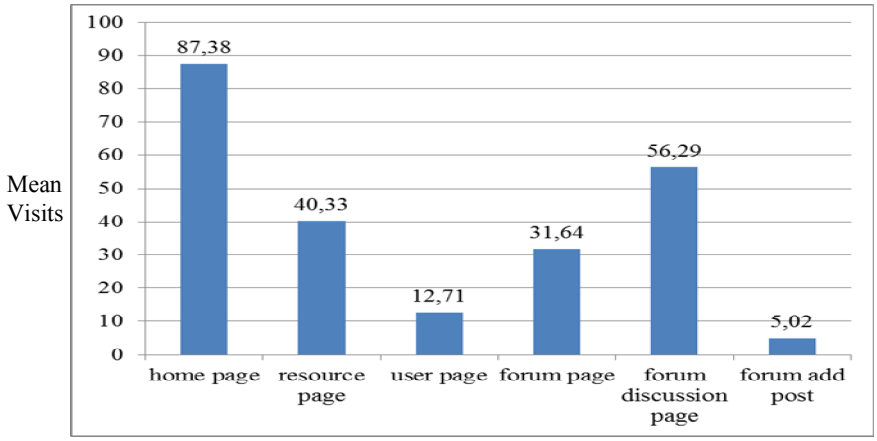

Figure: 1
Mean number of visits per page

Interestingly, students are more likely to visit those pages that contain information about the subject matter. This is indicated by the high mean number of visits of the pages that contain the learning materials (resource page), students' post on certain topics for discussion (forum discussion page), and announcements (home page). This pattern can be attributed to the information seeking behaviour of the students. The decision to navigate more frequently to these pages may have been influenced by students' decision to gather and source information for their assignment, learning activity, and tests. Kakai et al. (2004) in Ajiboye and Tella (2007) observed that students will actively or purposefully seek information as a result of the need to complete course assignment, prepare for discussion, or prepare for taking examinations. Just like the movement of organisms in natural environment, learners' movement is directed towards the pages that contain the resources they need to have a successful learning outcome.

Generally, students visit the page that contains the information they need in performing their academic tasks. According to Chikonzo and Aina (2006) in Onuoha and Awoniyi (2011), students sought information that are important in accomplishing their assignments, and studying for examinations. In fact, they observed that these were the primary tasks for which the students required information (Onuoha & Awoniyi, 2011). In the context of this study, resources page contain the academic information that the students need in engaging in the learning process. The academic information posted in this page includes the course learning materials, supplementary reading materials, and course guide that provide the information on the scope and coverage of the course, schedule of activities, learning outcomes, course requirements, grading system, and assessment tools.

Though individual students may have different reasons for using this page (Onuoha & Awoniyi, 2011), it is clear that they need information to achieve certain learning goals of the course. Dennen, Darabi, and Smith (2007) reported that some of the materials the students wish to see in an online course are information about the course expectations, assignments, and objectives. And this information should be made available even before the start of the class (Conrad, 2002 in Dennen, Darabi, & Smith, 2007).

In addition, the higher computed mean number of visits for resource page and forum discussion page shows the interactions that usually take place in e-learning. Several studies (e.g. Burton & Goldsmith, 2002; Moore, 1989 in Bouhnik and Marcus, 2005; Sims & Bovard, 2004) indicated that interaction is an important part of online learners' learning process.

Moore (1989) as cited in Bouhnik and Marcus (2005) identifies three kinds of interaction in distance education:

- **interaction with content,**
- **interaction with the instructor, and**
- **interaction with classmates.**

These interactions were reported to affect learning in online courses. Thus, online course sites should contain functional interaction-related tools that could facilitate students' interaction. Bouhnik and Marcus (2005) had reported that learning to use these interaction-related tools can significantly influence the success of learning and satisfaction of e-learners in an online course.

Interactions between Course Pages

Figure: 2 shows how students' navigational behaviour affects their patterns of movement from one page to another.

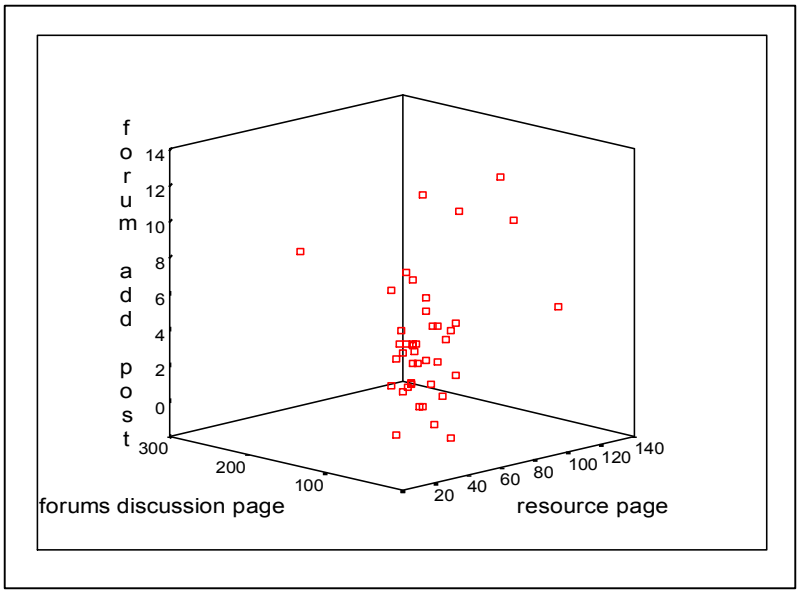

Figure: 2
Students' access patterns between from
add post page, discussion page, and resource page

As indicated in Figure: 2, students' decision to participate in the discussion and add a thread of discussion is influenced by their visit to the resource page. It means that students who have previously visited the resource page are more likely to participate in the discussion and/or create another thread of discussion. This is obvious because students' level of knowledge enhances or increases their level of confidence in participating in any discussion. The resource page provides the students with the sources of knowledge that they can share with their peers. According to Stein, Wanstreet, and Glazer (2010), knowledge sharing is common among online learners, and may facilitate knowledge building. "Knowledge building goes beyond sharing of thoughts and moves toward new collective thoughts that can emerge only in a community committed to pushing the basis of existing knowledge and learning ideas for others to expand further" (Stein, Wanstreet, & Glazer, 2010). McConnell (2006) in Stein, Wanstreet, and Glazer (2010) had indicated that participation and engagement in discussion may produce a collective understanding of an issue, phenomenon, or situation.
The thoughts that emerge are new to the learners, and may be superior to their previous understandings (McConnell, 2006).

Number of Visits and Performance

The correlation analysis between the patterns of navigation and the performance of students showed a slight inverse relationship between these two variables (Table 2). It means that students who have visited the resource page and participated in the discussion in the course site are more likely to get a better grade. The inverse relationship could be attributed to the inverse grading system of the University where lower numbers are considered higher grades.

Table: 2
Correlation analysis between number of visits and students' performance

Correlations

		forum add post	performance	forums discussion page	forum page	home page	resource page	user page
forum add post	Pearson Correlation	1	-.235	.493**	.369*	.491**	.481**	.046
	Sig. (2-tailed)	.	.134	.001	.016	.001	.001	.775
	N	42	42	42	42	42	42	42
performance	Pearson Correlation	-.235	1	-.248	-.118	-.222	-.201	-.037
	Sig. (2-tailed)	.134	.	.113	.457	.157	.201	.817
	N	42	42	42	42	42	42	42
forums discussion page	Pearson Correlation	.493**	-.248	1	.565**	.492**	.477**	.364*
	Sig. (2-tailed)	.001	.113	.	.000	.001	.001	.018
	N	42	42	42	42	42	42	42
forum page	Pearson Correlation	.369*	-.118	.565**	1	.374*	.446**	.443**
	Sig. (2-tailed)	.016	.457	.000	.	.015	.003	.003
	N	42	42	42	42	42	42	42
home page	Pearson Correlation	.491**	-.222	.492**	.374*	1	.351*	.385*
	Sig. (2-tailed)	.001	.157	.001	.015	.	.023	.012
	N	42	42	42	42	42	42	42
resource page	Pearson Correlation	.481**	-.201	.477**	.446**	.351*	1	.275
	Sig. (2-tailed)	.001	.201	.001	.003	.023	.	.078
	N	42	42	42	42	42	42	42
user page	Pearson Correlation	.046	-.037	.364*	.443**	.385*	.275	1
	Sig. (2-tailed)	.775	.817	.018	.003	.012	.078	.
	N	42	42	42	42	42	42	42

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

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

In general, students who were able to get the information needed in completing their academic tasks perform better in the course though the relationship is not significant at $p = 0.05$.

This result coincides with the study of Hung and Zhang (2008) where they observed that increasing frequency of accessing the course materials and/or discussion forum pages led to a better academic performance.

The result is important in building "a predictive model with data collected in the first week of the semester, and then able to identify the frequency of online discussion as a very important factor for improving learning outcomes" (Hung & Zhang, 2008).

The data may then be utilized by the faculty-in-charge to adjust the management of the course or facilitation of the learning process.

CONCLUSION

Students showed diverse patterns of online navigation. In general, students accessed the page that contains the information necessary to accomplish their academic tasks and participate in online interactions.

In the study, three pages were visited more frequently by the students than the other pages.

Computed mean number of visits showed that students are more likely to visit the home page, resource page, and forum discussion page.

Results also indicate that students who have visited the resource page are more likely to visit the forum discussion page and create another thread of discussion.

However, correlation analysis between these patterns and performance of the students indicate a non-significant influence of the patterns though there is a slight inverse relationship between the two variables.

The results highlight the need to design online courses in a manner where information needed by students to accomplish their academic tasks should be readily accessible.

Once properly designed, the course site may allow active participation of students in any online discussion.

As suggested by the result of the study, and existing related studies, active participation in discussion forums and frequent access to courses materials may be utilized to predict learning outcomes.

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