Online Learning Students' Profiles

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Introduction

Interest in online education has grown rapidly over the past and will continue to grow (Bonk, 2002; Sofres, 2001). An increasing number of universities are offering online learning (OL) opportunities (Duffy & Kirkley, 2004b). Teacher professional development is part of this trend as well. Numerous recent studies of online teacher professional development environments have been published. Most renowned are the cases of Tapped In (Schlager, 2004), ILF (Barab, MaKinster, & Scheckler, 2004), LTTS (Duffy, Kirkley, del Valle, & Malopinsky, 2004), and the Math Forum (Renninger & Shumar, 2004).

As Duffy & Kirkley (2004a) point out, while many view OL as a highly promising educational opportunity, offering several advantages including not only access aspects, but also reforming teaching practices and offering new models for life long learning, others view OL as a threat to education that lower the quality of instruction. Like in traditional face-to-face learning, OL design and implementation vary widely, and so do instructional quality and levels of students' engagement and learning. OL might simply repeat the problems of traditional professional development, but it can be used to implement alternative professional development approaches while meeting the practical needs of teachers.

Multiple studies have compared online versus face-to-face learning, with some results showing positive outcomes for OL (Hiltz, Coppola, Rotter, & Turoff, 2000; Olson, 2002), and others yielding non-significant results (Russell, 1999) showing that web-based can be as effective as campus-based environments (Hall, 1999). But more important than media comparisons are the instructional approaches used (Clark, 1983, 1994), the variables that might affect learning in each environment, and the affordances and constraints they have. These factors, along with quality implementation and design, determine how effective a learning approach can be.

In general, we know that what students "do" or do not do is critical to their learning. We expect students to read, reflect, write, discuss, etc. From a constructivist perspective, the learner's goals affect what they do and therefore what is learned and how it is learned (Duffy & Cunningham, 1996; Duffy & Orrill, 2004; Jonnasen, 1999). If a teacher is taking a course mainly to renew her license, she will learn differently than if she is working on the course to apply what she learns in her classroom. The understandings she is constructing will be different, and so will her approach to the course activities, and the amount of energy devoted to them.

One of the seeming advantages students perceive in asynchronous courses is having the freedom and flexibility in organizing their learning activities. They have the ability to make decisions about what resources or tools to use, when, in what order, or for how long. Flexibility and learner freedom are attributes that are particularly present in online open-ended, learner-centered environments. The possibilities for sustained discourse and discussion using asynchronous tools, in which learners have time to think, and contributions are recorded, have great potential for promoting critical thinking. OL can also support the instructor's ability to provide just in time feedback, and develop one-on-one mentoring strategies. Easy access to a variety of learning resources, and the possibilities for supporting communities of practice, also illustrate the enormous potential OL has (Barab, Kling, & Gray, 2004; Bonk & King, 1998; Duffy, Dueber, & Hawley, 1998; Duffy & Kirkley, 2004b).

We began the previous paragraph noting the "seeming" advantage of the asynchronous, online environments; while many students flourish with the freedom, many others flounder. High dropout rates in distance education reflect this situation (Bonk, 2002; Parker, 1999). Thus, as asynchronous learning environments flourish, it is important to begin to understand OL strategies. To understand how learners work online, how they interact with the facilitator, how they use available resources, and how those strategies relate to learning are salient questions for both course design and mentoring strategies.

Unfortunately, we do not know much about how learners work online. In traditional face-to-face contexts, it is usually possible to observe learners. But in OL environments, especially asynchronous ones, this is not feasible: since we cannot observe them, we do not know what students are "doing," or what their reactions, attitudes, and levels of engagement are. In OL we can get a good sense of what students "click on," but it is harder to know what they do after the click. Nonetheless, OL courses can offer information about what learners are "doing" at home when they are working online, which is not possible in face-to-face environments. Complex log-files (click-stream data), along with other forms of data, allow us to paint a rich description of what learners do while working online.

Click-stream data is not limited to counting the number of clicks. Structural measures (patterns of activity), and temporal measures (when and for how long) can complement basic "click" data to help us follow and understand the "footprints" learners leave when working online.

There have been several studies in recent years examining how learners use hypermedia and web based environments. Most of these studies use log files as an efficient and non-intrusive way of studying and understanding the dynamic nature of web based learning (Hall, Balestra, & Davis, 2000; Young & McNeese, 1995).

Barab, Young, & Wang (1999), and Hall et al (2000) focused on the impact of different learning interfaces and learner control, others focused on individual differences and students profiles (Barab, Bowdish, & Lawless, 1997; Barab, Fajen, Kulikowich, & Young, 1996; Ford & Chen, 2000; Lawless & Kulikowich, 1996, 1998).

Barab, et al. (1997), for example, presented students with a campus Kiosk and gave students tasks of finding information. Using cluster analysis to analyze click stream data of the types of pages examined and the depth of those pages they were able to identify 4 types of users according to the way they navigate on the kiosk:

- *Model users:* compliant and earnest, pick the simplest task, fewer deviations
- *Disenchanted volunteers:* rebellious and impatient, explored very little
- *Feature explorers:* featured oriented and confused, use help screens, lowest self-efficacy
- *Cyber cartographers:* curious, goal directed, longer time, deepest levels, highest self-efficacy

Some studies analyzed student's hypermedia traversal focusing on the number of pages they visit (on different categories), others on the pattern they use. Hall et al. (2000) considered both approaches using a cardinal measure (numbers of times a page is visited), a structural measure (pattern of linking), and adding also a temporal one (time on pages). With this comprehensive model for the analysis of hypermedia navigation, Hall et al. analyzed student's use of a traditional linear interface versus a non-liner "hypermap" interface. The results indicate that the two groups were similar on the cardinal navigation measure, but the temporal and structural measures clearly differed, showing that a comprehensive analysis of navigation patterns can provide useful insight to understand hypermedia processing.

Lawless & Kulikowich (1998) emphasize the importance of cognitive and affective variables, especially domain knowledge, individual interest and situational interest, with regard to different profiles. Their research lead to the following profiles: Knowledge seekers, Feature Explorers and Apathetic hypertext users (Lawless & Kulikowich, 1996).

It is important to notice that it only makes sense to study online learning profiles within a flexible environment in which learners have the freedom to make enough decisions about their work so clearly distinguishable approaches may emerge. A fixed linear environment with a strictly defined set of required readings and activities would most probably leave very little space for different learning profiles to emerge.

The studies we have reviewed offered a flexible environment, but they were conducted mainly over brief experiences, most of them in experimental context, in which the learner interacted with the environment over a relatively short period of time with an instructional task assigned by the researchers. While those studies provide a context for the present research, this one focuses on authentic and more prolonged learning environments; real in-service and pre-service teachers taking online professional development one-credit courses.

Method

Learning Environment

The freedom learners have while working in online learner-centered-environments is especially prevalent in the Learning to Teach with Technology Studio professional development environment (LTTS: http://ltts.indiana.edu). LTTS consists of a catalogue of 50 facilitated self-paced web-based courses. The increased freedom of the self-paced environment provides the students with even greater control over their learning practices, permitting them to use the approach that is comfortable in their learning. They can plow through systematically, jump around, procrastinate and then rush through it, be thoughtful and systematic, etc. Considering these characteristics, LTTS courses were used as the study learning environment. Courses are short (between 20 and 25 hrs), entirely web based, self-paced, individually mentored, and address technology integration on learner centered teaching. Course design is guided problem solving (Malopinsky, 2000; Savery & Duffy, 1996), providing a non-linear, resource-rich environment with an open-ended structure. Four to seven tasks guide student work, and the outcome is a student-designed product to use in his/her professional work.

Participants and Procedure

The participants were graduate students enrolled at a large Midwestern university in the graduate course

"Elementary and Secondary School Curriculum". Twenty of twenty-three students selected LTTS as their option to fulfill the technology integration requirement in the course, and all twenty agreed to participate in the study.

Fifteen of the twenty participants were between the ages of 20 and 30, while five were over 40. Eight of the participants had been or were full time teachers returning to school, while the other twelve had only field work and student teaching experience. Of those with no full time teaching experience, one was a technology coordinator and one was a library specialist. A wide range of subject areas and grade levels were represented and this is reflected in the fact that thirteen different LTTS courses were selected by the twenty participants. All learners were randomly assigned to one of two LTTS trained facilitators.

Click stream data, including cardinal, structural, and temporal measures, were collected for all actions learners made while online. Table one describes the eight critical variables that were defined in order to determine student profiles on LTTS self-paced online courses. Although the amount of click stream data LTTS collects would allow us to define dozens of variables, hierarchical cluster analysis requires that only a limited set of meaningful and distinct variables is selected. In this study only those variables that were meaningfully related to student's online freedom and flexibility in the LTTS environment were selected.

Table 1: *List of variables and their scales and definitions*

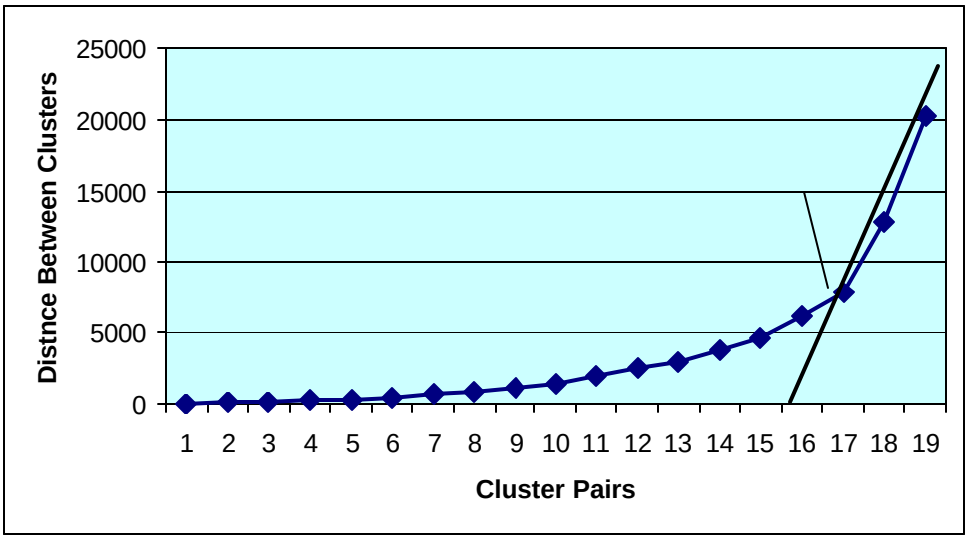
Variable	Definition
Sessions	Number of sessions used to complete the course. A session is defined as a series of activities not more than 15 minutes apart, so after a user is inactive for more than 15 minutes the session is consider being over
Days	Number of calendar days from beginning to completion of the course
Online Time	Total number of hours spent online
Interval Mean	Average number of days between logins
Interval Standard Deviation	Standard deviation of number of days between logins
Time on Resources	Proportion of time spent on content resources provided on the course
Messages Read	Number of facilitator messages read. Facilitator messages consist mainly of feedback for course activities, and they are critical to the LTTS pedagogical design. Students post their work on a workbook, and their messages outside this environment are reduced to a minimum, therefore they were not considered. Facilitator messages are often long and rich in content so students often go back to them. Thus this variable considered each time a message was read.
Transitions	Number of times the learner "jumped" between course activities not following a linear path. Following a total linear path through the course activities would imply cero transitions. More transitions indicate going back and forward through course activities.

Results and Analysis

Cluster Analysis

Click stream data were collected for all 20 participants until they completed the course. Following Barab et al (1997) Ward's (1963) hierarchical cluster analysis was used to identify naturally occurring groups of students. A scree-plot (Figure 1) was used to evaluate the between clusters distances, and determine the number of meaningful clusters according to the larger between clusters variability. When the coefficient drops below 7500, between clusters 16 and 17, the scree-plot levels off indicating that the variability between clusters stops suggesting the existence of separate groups. Therefore, the data supports the existence of three clearly differentiated clusters or groups of learners with similar approaches to online learning according to the defined set of variables.

Figure 1: Scree-plot used to determine number of meaningful clusters



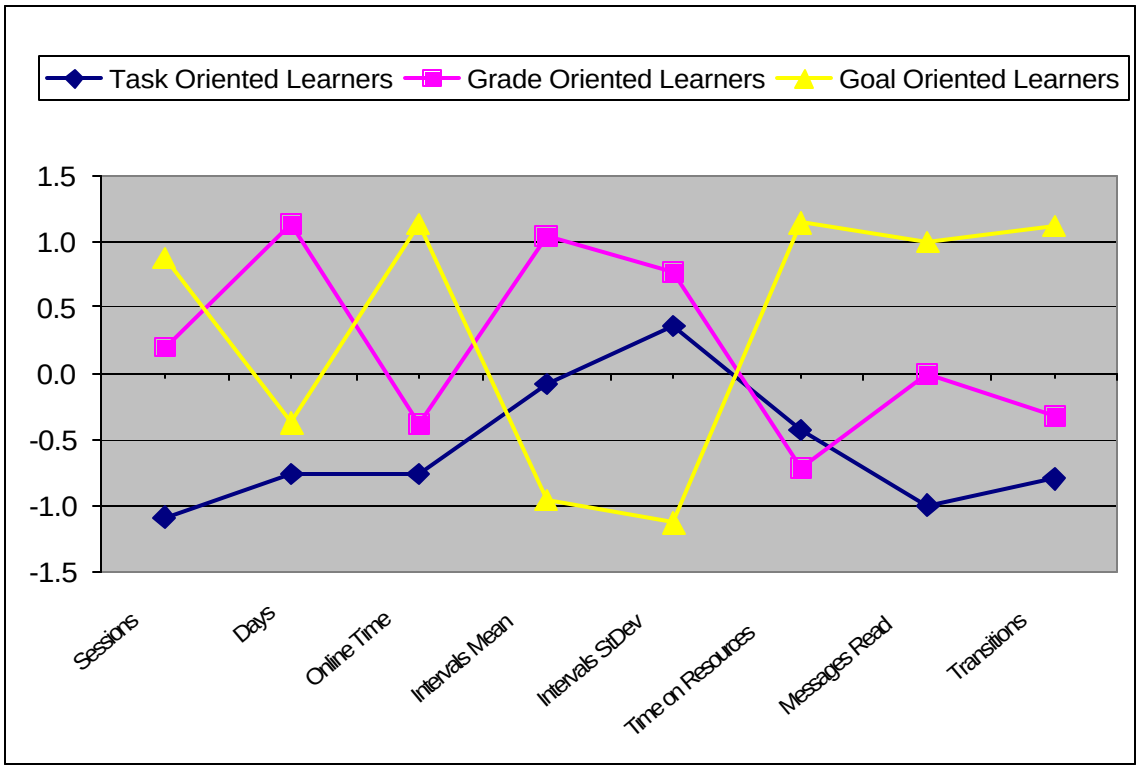
Mean scores and standard deviations for each dependent variable on all three clusters (Table 2) show how clusters comparatively behave on each variable. Refer to table 1 for a detailed description of the variables and their scales.

Table 2: *Mean scores and standard deviations for each dependent variable separated by cluster*

	Cluster 1 Task Oriented Learners (n=3)		Cluster 2 Grade Oriented Learners (n=14)		Cluster 3 Goal Oriented Learners (n=3)	
Variable	M	SD	M	SD	M	SD
Sessions	22.33	6.66	37.21	10.21	45.00	14.11
Days	23.67	8.39	60.79	6.65	31.33	7.77
Online Time	5.17	3.30	6.22	2.28	10.54	4.42
Interval Mean	1.24	0.67	1.84	0.73	0.76	0.29
Interval SD Mean	2.84	1.81	3.32	1.72	1.09	0.55
Time on Resources	19.17	15.48	17.86	9.38	26.03	13.71
Messages Read	19.00	3.61	34.43	8.11	49.67	2.31
Transitions	2.67	2.08	16.21	8.50	57.00	24.25

Standardized means were used to compare clusters scores in a complex set of variables that had different scales and a wide variety of ranges. A graphical depiction of the Z scores for the eight studied variables (Figure 2) illustrates how learners on each of the clusters comparatively behaved on each of the variables that shaped the profiles in a unique way.

Figure 2: Depiction of the standardized means of the 3 clusters on the studied variables



Naturally Occurring Profiles

The following are the profiles of the three clearly differentiated resulting clusters.

Task oriented learners

Individuals on the first cluster (n=3) present in average the lowest number of course sessions (M=22, SD=6.66), the lowest online time (M=5.17 hours, SD=3.30) and the lowest number of days invested in the course (M=23.67, SD=8.39). According to these results, they tend to spend only the indispensable time on the course without spreading it over several days or sessions. They tend to be focused on their work, completing the course as soon as possible with an average of just over 3 weeks. At the same time, they have the lowest number of transitions (M=2.67, SD=2.08), indicating a linear path trough the course activities with minimal deviations, revisions of previous work or exploration of future activities. They also have the lowest number of facilitator messages read indicating less contact with their facilitators, and minor reviewing of feedback messages. Regarding the use of resources, they spent about 20% of their online time reviewing the content resources provided on the course. Considering these characteristics, we describe this group as "task oriented learners"; they have an assignment, and they want to complete it efficiently and quickly.

Grade oriented learners

The second cluster is the largest one (n=14). Members of this cluster used the highest number of days to complete the course (M=60.79, SD=6.65), and their work intervals are the most extended ones with an average of almost two days between logins (M=1.84, SD=0.73). They tend to spread their work over time, with not very frequent logins, and on average took them almost nine weeks to complete a course. Nevertheless, despite of all days spent on the course they have only an intermediate total online time (M=6.22, SD=2.28), intermediate number of messages read, intermediate number of transitions (wander around the course and review some activities), and the lowest time on resources. As a result, we called this group "grade oriented learners". They seem to have no hurry to complete, and want to earn the course credit spending only a minimum time on the available resources, with an intermediate level of commitment.

Goal oriented learners

The third cluster (n=3) represents those students with the highest number of course sessions (M=45.00, SD=14.11), and the highest online time with an average of 10.54 hours (SD= 4.42). They also have the lowest work intervals, and an intermediate number of days spent on the course with an average of 31.33 days (SD=7.77). They work very intensively on the course, and logged in very often spending an average of about 4 weeks to complete the

course. They also have the highest number of transitions, the highest time on resources, and the highest number of messages read. This indicates that they tend to revisit their course work, review previous and subsequent activities, and ponder facilitator feedback. Taking into account these characteristics, we have labeled this profile as "goal oriented learners" since they seem to be highly committed to the course and self-driven in their work.

Discussion

The present study used click stream data, including cardinal, structural, and temporal measures, to identify online student's profiles. Coinciding with the informally reported perceptions that LTTS facilitators have about the different approaches learners take when working on the courses, cluster analysis led to the identification of three clearly differentiated groups of learners: task oriented, grade oriented, and goal oriented learners.

The sole existence of these three groups confirms that different learners make a different use of the freedom and flexibility provided by the self-paced environment. For example, while some learners (goal oriented) tend to "jump around" the course having a high number of transitions, others followed a more linear path.

Regarding the use of time, learners do make use of the flexibility provided by the self-paced environment having three clearly differentiated groups. Nevertheless, those that used more days to complete the course (grade oriented) were not the ones that spent more online time or had more courses sessions. Similarly, different learners spent different amount of time using the course resources, this being in some cases over 40% of their total online time, and in others less than 10%. In this sense, it seems relevant to provide enough resources for all types of learners, and the flexibility to use only part of them.

Even if students' approaches to OL are not substantially different from those of face-to-face courses, online environments, and the reasons why learners take online courses, might exacerbate the characteristics of different profiles, or perhaps online courses augment a self selection of certain learning approaches. Given how online learning might meet the personal goals and practical needs teachers have when pursuing professional development, we could have expected that the task and goal oriented profiles would amount for a larger number of students, but those two profiles account for only 30% of the participants. Nevertheless, it is important to notice that although participation in the study was voluntary, participants choose to take an LTTS course in order to fulfill a requirement of the graduate course they were enrolled in. This situation may have affected the predominance of students in the grade oriented learner profile (70%).

The results of this study might have important implications for the type of support mentors have to provide to different students. For example, while task-oriented learners seem to rest less on facilitator feedback, grade-oriented and goal oriented-learners tend to interact more with facilitators. In the same way, facilitators can expect to have some learners that will promptly complete the course (task-oriented) while grade-oriented learners will probably need frequent reminders in order to pursue their work. If this is the case, future studies should also investigate how mentoring strategies in online learner-centered environments (Collison, Elbaum, Haavind, & Tinker, 2000) relate to students' OL approaches.

Since this study was conducted with participants that completed the online course they were taking, one important group that obviously could not be analyzed was the students who dropout of OL. Reasons for learner attrition in general (Tinto, 1987), and in OL in particular (Beatty, Malopinsky, & Duffy, 2003) have been studied, yet we need to investigate what can be done, from a design and facilitation perspective, in order to support teachers and other professionals seeking online professional development, and to reduce their attrition rates. Taking into account the existence of different OL profiles might prove useful in these efforts.

Although LTTS presents a rich, unique, and successful online teacher professional development environment (Duffy et al., 2004), using only one learning environment is a limitation of this study. The possibility of replicating these efforts using other learner-centered online environments should be explored.

Unfortunately, this study was conducted using a small sample. Nevertheless, current results call for promising replications, and more studies, with larger samples, linking these profiles to other variables affecting OL are needed. In addition, collecting qualitative data would be helpful for interpreting results, and for triangulation to support or dispute findings.

Linking OL profiles with variables affecting OL strategies, including self-efficacy, trust, learning goals, beliefs about learning, and previous experience would provide a rich context to study online learning strategies. In addition, studying the interaction between different learner profiles and outcome variables such as learner satisfaction, perceived and actual learning, and transfer expectations, will also be relevant for the future of OL, especially in the context of teacher professional development.

This study, and the results of other similar studies we are currently conducting, might yield interesting findings that will help the OL community understand effective online learning and facilitation strategies for adult learners (teachers). Findings could have implications for the type of support facilitators must provide for learners

with different profiles, and for how online courses are designed and implemented. Finally, if one approach were found to be more successful than others, then investigating how to foster that approach using specific facilitation strategies and course instructional design, would also be relevant.

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