Internet and Higher Education xxx (2008) xxx-xxx

Contents lists available at ScienceDirect

Internet and Higher Education

journal homepage:

Factors relted to breadth of use in course management systems

Steven R. Malikowski *

Miller Learning Resource Center, 204H, Saint Cloud State University, 720 Fourth Avenue South, Saint Cloud, Minnesota 56301-4498, United States

ARTICLE INFO

Article history:
Accepted 20 March 2008
Available online xxxx

Keywords:
Course management system
CMS
Multiple features
Diverse features
CMS adoption
CMS learning activities
Desire2Learn
Blackboard
WebCT
Research methods
Faculty use
Faculty adoption
Resident courses
Learning theory
Cognitive psychology

ABSTRACT

A unique resource in course management systems (CMSs) is that they offer faculty members convenient access to a variety of integrated features. Some features allow faculty members to provide information to students, and others allow students to interact with each other or a computer. This diverse set of features can be used to help meet the variety of learning goals that are part of college classes. Currently, most CMS research has analyzed how and why individual CMS features are used, instead of analyzing how and why multiple features are used. The study described here reports how and why faculty members use multiple CMS features, in resident college classes. Results show that nearly half of faculty members use one feature or less. Those who use multiple features are significantly more likely to have experience with interactive technologies. Implications for using and encouraging the use of multiple CMS features are provided.

1. Introduction

Course Management Systems (CMSs), such as Blackboard or Desire2Learn, contain a variety of technical features for learning. Many of these features are the same in systems from different vendors, but each system gives the feature a different name. For example, all course management systems allow faculty members to transmit documents to students, such as a syllabus or assignment. With the default settings, this feature is called "Course Documents" in Blackboard, but the same feature is called "Content" in Desire2Learn. Other systems use other names for this feature. A recent analysis categorized features by their function, instead of their name (Malikowski, Thompson, & Theis, 2007). This analysis also summarized research into which categories of CMS features are used most. The most used categories are: (a) transmit documents to students, (b) communicate asynchronously, (c) quiz students, (d) use a drop box to exchange files with students, and (e) survey students. These features make CMSs well-suited for distance learning courses, but CMSs are now used three times more often for resident college courses than they are for distance learning courses (Falvo & Johnson, 2005; Malikowski et al., 2007; Morgan, 2003; West, Waddoups, & Graham, 2007). When CMSs are used for resident courses, faculty members use these systems to create a Web site for the course. CMSs can be used to create a sophisticated Web site for a resident course because of the variety of features they contain, and most importantly, the integrated nature of these features (Malikowski et al., 2007; Morgan, 2003).

Researchers have increasingly studied how faculty members are using these systems and analyzed the pedagogical implications of this use (Ansorge & Bendus, 2003; Dutton, Cheong, & Park, 2004; Malikowski, Thompson, & Theis, 2006; Morgan, 2003). Currently, this research has focused on factors that relate to the use of individual features, instead of how combinations of features are used. Research into combinations of CMS features would provide insights into a particularly unique characteristic of CMSs, which is integrating many features into a single system. The study described below involved one attempt to analyze how and why multiple features were used when a CMS Web site was created for resident college courses.

2. Related theory and research

This section will provide a theoretical framework that is well-suited for CMS research, describe related research, and state how one study builds on this research.

* Tel.: +1 651 497 5122; fax: +1 320 308 4778.
E-mail address: srmalikowski@stcloudstate.edu.

1096-7516/$ – see front matter © 2008 Elsevier Inc. All rights reserved.
doi:10.1016/j.iheduc.2008.03.003

2.1. Theoretical framework

A theoretical framework was selected that addresses individual and integrated learning goals, which is similar to the individual and integrated features offered in a CMS. This theoretical framework is cognitive psychology. This form of psychology has a particularly long history of empirical research (Anderson, 1990; Bonner, 1988; Neisser, 1967; Winn, 2004) and application with learning technology, particularly research that focuses on learning outcomes (Foshay, Silber, & Stelnicki, 2003; Smith & Ragan, 2005). Research into cognitive psychology has identified a few, discrete categories of learning goals. These categories are goals that involve declarative knowledge, concepts, procedures, principles, psychomotor skills, cognitive strategies, structured problem solving, and ill-structured problem solving. Generally, items at the beginning of this list are simpler forms of knowledge that are required for learners to succeed at more complex forms of knowledge, which are at the end of the list. In this situation, learners are particularly challenged when they attempt to solve problems before they have learned new facts or other forms of declarative knowledge related to the problem.

One example is teaching students how to make a Web page. If learners do not learn the definition of terms, such as upload, local drive, and server, the learner will struggle when trying to complete more complex tasks, like publishing a Web page or troubleshooting problems that arise in the process. Most teaching environments use this type of sequencing, with basic learning goals proceeding complex goals, but cognitive psychology provides a research base of what kind of teaching method is best suited for what kind of teaching goal. For example, teaching goals involving definitions can be effectively reached by having learners repeat and memorize the definitions. Teaching goals involving troubleshooting or problem solving can be effectively reached by presenting one strategy to solve a problem and then giving students slightly different problems to solve on their own. Cognitive psychology offers many other specific types of empirically analyzed teaching strategies for specific types of learning goals.

CMSs can support diverse teaching goals with the diverse features these systems contain. CMS quizzes can help students learn definitions of relevant terms and concepts. Drop boxes can be used to collect essays where students are assigned to effectively use new terms, and CMS discussions can be used to allow students to discuss questions they have or complex problems they are trying to solve. More advanced CMS features require that students receive a minimal value on a quiz before seeing an upcoming assignment or that a paper be submitted to a drop box before students are allowed access to a class discussion. And finally, since all of these features are integrated, a CMS can provide multiple reports describing student progress in various learning activities.

2.2. Research analyzing individual features

Despite these possibilities, current CMS use reflects, or is relegated to, a transmission model of learning. More specifically, CMSs are primarily used to transmit information to students, such as a syllabus or assignment description. Interactive CMS features are used less than half as often (Ansorge & Bendus, 2003; Dutton et al., 2004; Malikowski et al., 2006; Morgan, 2003) as features for transmitting information. This is unfortunate because CMSs offer many resources for students to interact with each other or with a computer.

One study investigated factors that related to the adoption of individual CMS features, particularly interactive features. Adopting a feature was operationally defined as using a feature at least once, as opposed to analyzing how often a feature was used. This study investigated how the adoption of individual features was influenced by factors that are external to a faculty member. These external factors were class size, the college in which a class was offered, and the level of a class, such as 100, 200, or 300. Findings showed that the college in which a class was offered was the only external factor that showed a statistically significant relationship to the adoption of individual CMS features. For instance, faculty members in a college of social science adopted a CMS quiz more than other faculty members, and faculty members in a college of education adopted CMS discussions more than faculty members in other colleges. Surprisingly, class size or level showed no significant relationship to the adoption of specific CMS features (Malikowski et al., 2006).

The study just described considered how external factors influenced the adoption of CMS features. A follow-up study (Malikowski, Theis, & Skophammer, submitted for publication) analyzed how external and internal factors influenced how often individual CMS features were used, instead of how features were adopted. This follow-up study considered the same three external factors that were previously described. The internal factors in this follow-up study focused on each faculty member's previous experience with related technologies. For example, faculty members were asked how long they had used computer based quizzes and asynchronous discussions, which existed decades before CMSs. Surprisingly, previous use of computer based quizzes, discussions, or other technologies that are similar to CMS features accounted for a small portion of the variance when faculty used these features in a CMS. The most prominent factor in predicting the use of individual CMS features was that faculty members from different colleges used CMS features in significantly different ways. For example, faculty members in a College of Social Science used CMS quizzes significantly more often than faculty members from other colleges.

The research just described can help resolve the problem of underutilizing CMSs. This underutilization comes from the research findings that CMSs are used to transmit information to students over twice as often as they are used for anything else, even as CMSs have continued to add more features. This problem is further complicated by the fact that much simpler and economical technology can be used to transmit files to students, such as an email attachment or basic Web page. Instructional designers, researchers, and others interested in increasing effective CMS use can use the research just summarized to emphasize factors that are related to the use of uncommon CMS features and deemphasize factors that are not related to increased use. For example, if a researcher wished to experiment with a new technique for using CMS discussions, she would find faculty members in a college of education to be most receptive to her research. She could then refine her ideas before moving on to colleges or situations that use CMS discussions less often. Innovations with other CMS features could consider other factors that are or are not related to the use of the features being considered. These efforts could help resolve the problem of using a CMS primarily to transmit information to students, which could be done with an email attachment or simple Web page.

2.3. Research analyzing multiple features

The research described so far has focused on individual CMS features, as opposed to how often or why multiple CMS features are used. As previously described, most of the individual features contained in a CMS existed decades before the Web. One unique element of CMSs is that many features are integrated into a single system, which most colleges and universities already own. Therefore, studying how or why multiple features are used provides information about a particularly unique element of these systems. This research could also be the basis for studying how different sets of features can be used to increase learning outcomes in different types of learning goals.

A small number of studies have investigated the use of multiple features. One study found that the most prominent reason for using more features was that faculty members began to see that CMSs had increased uses in teaching. A second reason was that faculty members level of comfort with a CMS increased. Other reasons were cited less

Please cite this article as: Malikowski, S. R., Factors relted to breadth of use in course management systems, *Internet and Higher Education* (2008), doi:10.1016/j.iheduc.2008.03.003

than half as often (Morgan, 2003). Another study found that faculty members used more CMS features when their colleagues described how a feature could be helpful, and provided help with the feature (West et al., 2007). This supports findings that a college in which a course is offered is the strongest predictor of CMS use (Malikowski et al., submitted for publication, 2006).

One way to build on existing research is to study internal and external factors that lead to the adoption of multiple CMS features. A second way to build on existing research is to collect data by viewing CMS Web sites to observe which features are used, instead of asking faculty members how they use a CMS. Currently, much CMS research asks faculty members how they use a CMS, with a survey or interview. Surveys and interviews are useful techniques for gathering data, but when analyzing behaviors, observing the results of behavior can be more accurate than asking people how they behave. CMS use could be observed by counting how many documents are added to a CMS Web site, the number of quiz questions, and the number of discussion postings. The study described next implemented these two methods of building on existing research, to investigate which external and internal factors lead to the adoption of multiple CMS features. The research question for this study was, "Which internal or external factors relate to faculty members' use of common CMS features?" Results from this study should assist in promoting multiple CMS features to address the multiple learning goals that are part of most college courses.

3. Methodology

This section describes the research participants and the two types of data that were collected.

3.1. Participants

This study was conducted at a public university in the American Midwest, with about 15,000 students. The CMS used at this university is Desire2Learn (D2L). At this university, faculty members are not required to use a CMS. Instead, they need to request a CMS Web site for each of their classes. A simple random sample of 200 faculty members who use D2L for resident courses were asked to participate in this study, during the spring semester of 2005. Eighty-one faculty members chose to participate. A total of 153 D2L Web sites were analyzed, since faculty members tend to use D2L for more than one course each semester.

3.2. Data collection

Two types of data were collected. One type of data involved six commonly used CMS features that also represent diverse teaching strategies (Malikowski et al., 2007). These features are: (a) transmit documents to students, (b) communicate asynchronously, (c) quiz students, (d) use a drop box to exchange files with students, and (e) survey students.

Table 1
Frequency and quartiles of feature use when a feature is used at least once

	Non--zero cases	Minimum	Maximum	Mean	Quartiles		
					25%	50%	75%
Discussion postings	44	1	2913	283.36	7.50	63.00	317.25
Dropbox files	33	2	641	153.94	25.00	81.00	225.50
Gradebook entries	88	1	60	16.49	7.00	13.00	22.75
Content files	129	1	3027	47.37	6.50	17.00	31.00
Quiz questions	42	2	455	135	12.25	73.00	229.5
Survey questions	24	5	240	39.08	20.00	26.00	30.75

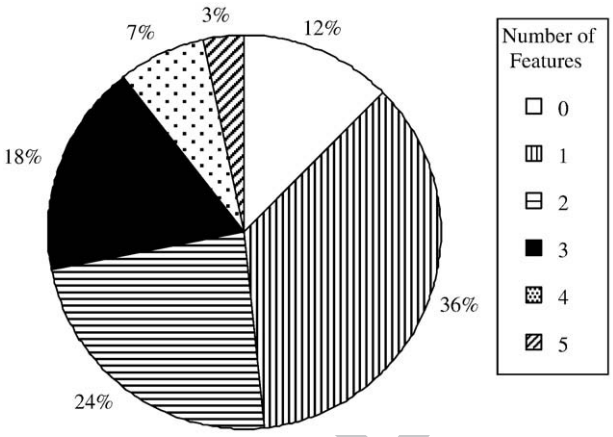

Fig. 1. Frequency of adopting features.

A research team of two faculty members and 10 students collected these data. One team member analyzed a D2L Web site by viewing it and counting how often the six features were used. To increase data accuracy, a second team member also analyzed each Web site. When differences arose in the analyses, the Web site was analyzed one or more times, until two analyses of the same Web site showed the same result.

The second type of data collected in this study used factors that have been considered in previous research (Malikowski et al., 2006, 2007) that could be related to the use of D2L features. These data involved issues that were either external or internal to faculty members using D2L. Three external factors were considered: (a) the college in which a course was offered, (b) class size, and (c) class level, such as 100 or 200. Data about external factors were obtained from each D2L Web site.

The 10 internal factors focused on a faculty member's previous experience with technology. These data were obtained by surveying faculty members about their experience with common technologies, to determine if past technical experience could predict their current CMS use. The surveys asked them how long they had used computer based quizzes, surveys, or simulations. The survey also asked how long they used email, asynchronous discussions, synchronous chat, CMSs, HTML editors, or presentation software, such as PowerPoint. A final question asked faculty members how long they had taught college, to see if years of teaching experience related to breadth of CMS use.

To summarize, data collected in this study involved six features in D2L, three factors that were external to faculty members, and 10 factors that were internal to faculty members. These data were used to determine which factors were related to adopting multiple CMS features. A feature was considered to be adopted when it was used at or above the 25% quartile, which is described next.

4. Results

An important result to start with is a definition of what it means for a faculty member to adopt a CMS feature, since the goal of this study is to determine which factors lead to adoption of multiple CMS features. The definition of "adopting a feature" is challenging. It could mean using a feature once, using a feature five times, or some other consistent value. A consistent value was not used to define adoption because of the broad range of how often features were used, as shown in Table 1.

Table 1 lists each feature considered in this study, how many D2L Web sites contained at least one use of this feature, and some related statistics about these Web sites. In addition to showing the broad range of feature use, Table 1 assists in the operational definition that was created for adopting a feature. In this study, adopting a feature was defined as a situation where a D2L Web site contained enough instances of a feature so this use was at or above the 25th percentile, for a particular feature. For example, if a faculty member created a D2L

Please cite this article as: Malikowski, S. R., Factors relted to breadth of use in course management systems, *Internet and Higher Education* (2008), doi:10.1016/j.iheduc.2008.03.003

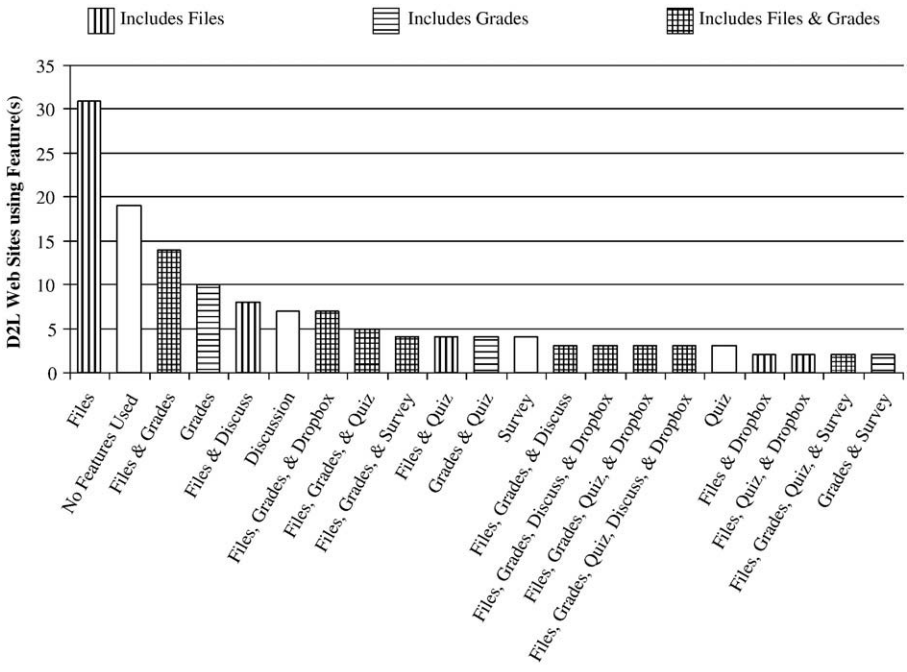

Fig. 2. Combinations of features adopted.

Web site with 10 grade book entries, the grade book feature would have been adopted in this Web site, since the 25th percentile rank for the grade book feature is 7.00. However, if the same Web site contained 10 quiz questions, the quiz feature would not have been adopted since the 25th percentile rank for quiz questions is 12.25.

Considering the level of adoption described in the previous paragraph, the next result to consider is how often multiple features were adopted in this study. Fig. 1 provides one way to show this result.

As shown in Fig. 1, the highest percentage of Web sites contained only one of the six features that were analyzed, which was 36%. Seventy two percent of Web sites used two or less features. None of the Web sites analyzed adopted all six of the features that were considered in this study. Fig. 2 provides more information about which specific combination of features appeared on the Web sites that were analyzed. Fig. 2 uses different bars to illustrate the adoption of CMS features to transmit files or grade information to illustrate a pattern, which will be described later.

Fig. 2 shows which combinations of features that appeared at least twice in this study. Combinations of features that were used only once were not included in the graph to improve the graph's clarity, since many combinations of features were used only once. These combinations of features are listed below.

- Dropbox & Survey
- Files, Discuss, & Dropbox
- Files, Grades, Discuss, Dropbox, & Survey
- Files, Grades, Dropbox, & Survey
- Files, Grades, Quiz, & Discuss
- Files, Grades, Quiz, Discuss, & Survey
- Files, Quiz, & Survey
- Grades & Discuss
- Grades, Discuss, & Survey
- Grades, Dropbox, & Discuss
- Grades, Quiz, Discuss, & Dropbox
- Grades, Quiz, Survey
- Quiz, Dropbox, & Discuss

In Fig. 2, vertical lines are used when transmitting files is part of an adopted set of features. Horizontal lines show when grades are part of a set, and horizontal and vertical lines show when both transmitting files and grades are part of a feature set. These bars show a pattern in the results. That is, features to transmit files or grade information to students are prominent in both depth and breadth. In terms of depth, using a CMS only to transmit files occurred over three times as often than using most other features, as shown in the tallest bar in Fig. 2. The next most common feature is transmitting grade information to students, which occurred at least twice as often as most other features or combination of features. In terms of breadth, using a CMS to transmit grades or files to students was also prominent. Fig. 2 illustrates this breadth with bars containing vertical lines, horizontal lines, or both.

Figs. 1 and 2 show two perspectives on which features were adopted together. These figures support past research findings that have shown that CMSs are primarily used to transmit information to students, such as a syllabus or grades. This finding continues to appear when multiple CMS features are considered. Transmitting files or grades to students is a part of most situations when multiple CMS features are used. The purpose of the current study, however, is to determine if internal or external factors are related to the adoption of multiple CMS features. Reaching this goal requires that a regression analysis be conducted. The dependent variable in this analysis was the number of features adopted, when a faculty member used a D2L Web site. The independent variables were the three external and 10 internal factors previously described.

The best linear combination of external and internal factors for predicting the number of features adopted was determined with stepwise regression. Table 2 contains the results of this analysis. Four of the external and internal factors considered could be used to predict the number of features that were adopted. This prediction accounted for 27% of the variance in adopting the six CMS features considered in this study, based on the cumulative value for adjusted R squared. According to Cohen's (1988) analysis of effect sizes in the behavioral sciences and education, this is a medium effect size.

Even though interactive CMS features are used much less than other features, one notable pattern is that two of the four factors in Table 2 are interactive features, which are quizzes and asynchronous discussions. Quizzes allow students to interact with a computer, and

Please cite this article as: Malikowski, S. R., Factors relted to breadth of use in course management systems, *Internet and Higher Education* (2008), doi:10.1016/j.iheduc.2008.03.003

Table 2
Significant factors related to adopting multiple CMS features

Step	Factor	*B*	*R*	Adjusted R^2
1	Using quizzes	.31***	.41***	.18
2	College of Social Science	.28***	.47**	.22
3	Using asynchronous discussions	.18*	.49*	.24
4	Using presentation software, like PowerPoint	−.17*	.51*	.27

***$p<.001$. **$p<.01$. *$p<.005$.

asynchronous discussions allow students to interact with other class members. The pattern of interaction is continued in Table 2 by the inclusion with the only negative factor, which is the experience with presentation software. Experience with presentation software showed a small, negative, yet significant relationship to predicting the adoption of multiple CMS features. The fourth factor involved faculty members from a college of social science, which continues with past research findings and will be described in the next section.

5. Discussion

One unique element of a CMS is convenient access to multiple, integrated learning technologies, or features as they have been described here. Computer based quizzes, grade books, surveys, online discussions, and dozens of other CMS features existed decades before the Web or CMSs were created. The PLATO computer system, created and revised since the mid 1960s, is similar to a CMS in terms of technical features (Foshay, 1994, 2004; PLATO Learning, 2005), but access to PLATO has never been as convenient as the access to CMSs, due to the popularity of the Web and PLATO's focus on primary education.

Despite the number of features available in a CMS and a decade of use, the most commonly used individual feature is the one that allows faculty members to transmit a file to students, such as a syllabus or assignment description. Furthermore, the current study found that when multiple features are used, the most frequent combination involves features for transmitting different kinds of information to students, such as files and grades.

This situation offers many opportunities for instructional designers, faculty members, and researchers. Little is known about which combination of features is most effective at reaching a particular type of learning goal. For example, cognitive psychology offers a few categories of learning goals, such as declarative knowledge, concepts, procedures, principles, psychomotor skills, cognitive strategies, structured problem solving, and ill-structured problem solving. One hypothesis could be that quizzes alone are best to help students learn declarative knowledge and concepts, but that a quiz and an online discussion are best for learning procedures. Another possibility is that a learning goal involving structured problem solving should begin by requiring students to reach a minimal value on a quiz before being allowed to enter an online discussion, and after the discussion, a student is assigned to submit a reflection paper about the entire learning activity. A more likely situation is that research could provide guidelines for effectively using quizzes, online discussions, other CMS features, and especially combinations of features for specific types of learning goals.

Of course, multiple features should not be used for the sake of using multiple features. Features should only be used when research shows that they can improve learning outcomes or the efficiency of learning, which is the case of most learning technology (Dick, Carey, & Carey, 2005; Gagné, Briggs, & Wager, 1992). CMSs are well positioned to provide at least as much help as other learning technologies because of the many features these systems contain, and the integrated nature of these features. Another advantage of CMSs is that many colleges and universities already own these systems, and many faculty members have started using them.

Since learning activities or research into the use of multiple CMS features is in an early state, one good way to proceed is to work with faculty members who are receptive to using multiple features, especially since this study found that 48% of faculty members use one or less CMS features. Working with faculty members who are receptive to using multiple features would give researchers or instructional designers an opportunity to implement, evaluate, and revise CMS learning activities before promoting the learning activities to faculty members who are less receptive to using multiple features. Table 2 provides information about faculty members who are most receptive to using multiple CMS features.

As previously described, one group of faculty members who are receptive to using multiple CMS features are those who have experience with interactive technologies, such as computer based quizzes or asynchronous discussions. One intuitive explanation for this group is that they are accustomed to investing the time needed to create an interactive learning activity and have experienced benefits from such an activity.

Another group of faculty members who are receptive to using multiple features are those in a college of Social Science. One explanation is that these faculty members have a long history with personality tests, such as IQ tests, the Myers–Briggs test, or the Minnesota Multiphasic Personality Inventory. The delivery and reports created from these personality tests are very similar to the delivery and reports available in CMS quizzes. This pattern of faculty members in a college of social science has also appeared in CMS research that explored factors related to the adoption of individual CMS features (Malikowski et al., submitted for publication, 2006).

Hopefully, creating and revising CMS learning activities with faculty members like those just described can lead to situations where these systems are used for more than transmitting information to students. Of course, faculty members need to transmit information, but they also need to address diverse learning goals and monitor student progress toward these goals. A CMS can assist with both these important tasks.

6. Conclusion

In important ways, CMSs are a historically unique resource for higher education. Few technical systems have integrated so many features and have been purchased by so many universities. This situation may explain why CMS research has focused on individual features. In the past, a single learning technology offered researchers and instructional designers a smaller number of features to consider than CMSs offer, so these professionals were more accustomed to working with a limited number of technical features, at least integrated features. Of course, the emphasis on single features could be due to design problems with CMSs. But in this situation, careful research is the best way to identify such problems and recommend improvements. In any case, researching effective use of multiple CMS features will provide information about a particularly unique resource in these systems, and will hopefully assist in increasing learning outcomes for specific types of learning goals.

References

Anderson, J. R. (1990). *Cognitive psychology and its implications*, 3rd ed. New York: W.H. Freeman.

Ansorge, C.J., & Bendus, O. (2003). The pedagogical impact of course management systems on faculty, students and institutions. In R.H. Bruning, C.A. Horn & L.M. PytlikZillig (Eds.), Web-based learning: What do we know? where do we go? (pp. xxii, 275 p.). Greenwich, Conn.: Information Age Pub.

Bonner, J. (1988). Implications of cognitive theory for instructional design: Revisited. *Educational Communication and Technology Journal*, *36*(n1), 3–14.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*, 2nd ed. Hillsdale, N.J.: L. Erlbaum Associates.

Dick, W., Carey, L., & Carey, J. O. (2005). *The systematic design of instruction*, 6th ed. Boston: Pearson/Allyn and Bacon.

Dutton, W. H., Cheong, P. H., & Park, N. (2004). An ecology of constraints on e-learning in higher education: The case of a virtual learning environment. *Prometheus*, *22*(2), 131–149.

Please cite this article as: Malikowski, S. R., Factors relted to breadth of use in course management systems, *Internet and Higher Education* (2008), doi:10.1016/j.iheduc.2008.03.003

Falvo, D. A., & Johnson, B. F. (2005, March). Use and implementation of learning management systems in the US. *Paper presented at the Society for Information Technology & Teacher Education, 16th Annual International Conference, Phoenix, AZ.*

Foshay, W. R. (1994). *An annotated bibliography of reviews, 1980–1993: Technical Paper #1.* Bloomington, MN: PLATO Learning, Inc.

Foshay, W. R. (2004). *An overview of the research base of PLATO Technical Paper #12, ver. 2.* Bloomington, MN: PLATO Learning, Inc March 2002, Revised August 2004.

Foshay, W. R., Silber, K. H., & Stelnicki, M. B. (2003). *Writing training materials that work: How to train anyone to do anything.* San Francisco: Jossey-Bass/Peiffer.

Gagné, R. M., Briggs, L. J., & Wager, W. W. (1992). *Principles of instructional design*, 4th ed. Fort Worth: Harcourt Brace Jovanovich College Publishers.

Q2 Malikowski, S.R., Theis, J.G., & Skophammer, D.L. (submitted for publication). Factors related to depth of CMS use in resident college courses: Manuscript.

Malikowski, S. R., Thompson, M. E., & Theis, J. G. (2006). External factors associated with adopting a CMS in resident college courses. *Internet & Higher Education*, *9*, 163–174.

Malikowski, S. R., Thompson, M. E., & Theis, J. G. (2007). A model for research into course management systems: Bridging technology and learning theory. *Journal of Educational Computing Research*, *36*(2), 149–173.

Morgan, G. (2003). *Faculty use of course management systems.* Boulder, CO: EDUCAUSE Center for Applied Research.

Neisser, U. (1967). *Cognitive psychology.* New York: Appleton-Century-Crofts.

PLATO Learning. (2005). Company Background — History. Retrieved December 3, 2005, from http://www.plato.com/About-Us/Our-Company/History.aspx

Smith, P. L., & Ragan, T. J. (2005). *Instructional design*, 3rd ed. Hoboken, N.J.: J. Wiley & Sons.

West, R., Waddoups, G., & Graham, C. (2007). Understanding the experiences of instructors as they adopt a course management system. *Educational Technology Research and Development*, *55*(1), 1–26.

Winn, W. (2004). Cognitive perspectives in psychology. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology 2nd ed.* (pp. 79–112). Mahwah, N.J.: Lawrence Erlbaum.

Please cite this article as: Malikowski, S. R., Factors relted to breadth of use in course management systems, *Internet and Higher Education* (2008), doi:10.1016/j.iheduc.2008.03.003