# External Factors Associated with Adopting a CMS in Resident College Courses

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Abstract

Course Management Systems (CMSs) have become a common resource for resident courses at colleges and universities. Researchers have analyzed which CMS features faculty members use most, primarily by asking them which features are used. The study described here builds on previous research by counting the number of CMS features a faculty member used and by analyzing how three external factors are related to the use of CMS features. The external factors are: (a) the college in which a course was offered, (b) class size, and (c) the level of a class—such as 100 or 200. The only external factor showing a statistically significant relationship to the use of CMS features was the college in which a course was offered. Another finding was that CMSs are primarily used to transmit information to students. Implications are described for using external factors to increase effective use of more complex CMS features.

External Factors Associated with Adopting a CMS in Resident College Courses

Course Management Systems (CMSs) such as—Blackboard, Desire2Learn, and WebCT— have become a common resource at American colleges and universities (I. E. Allen & Seaman, 2004; Falvo & Johnson, 2005; Green, 2001). Current research has shown that faculty members use these systems primarily to transmit course documents to students in resident courses (Ansorge & Bendus, 2003; Dutton, Cheong, & Park, 2004; Morgan, 2003; Woods, Baker, & Hopper, 2004). This gives students convenient access to course materials and can lead to moderate increases in student performance (Grabe & Christopherson, 2005). Nonetheless, many CMS features allow faculty members to create more complex learning activities than transmitting course content to students.

This article summarizes research showing how faculty members use a CMS and describes a study that builds on this research. One purpose of this study was to identify the features used most, applying performance-based methods that are uncommon in existing research. A second purpose was to identify external factors that are related to the use of various CMS features.

Faculty members often receive help in using a CMS (Arabasz, Pirani, & Fawcett, 2003; Grant, 2004). This help typically comes from professionals who focus on instructional design or technology. Information about which features are used most could provide these professionals with a starting point for promoting effective use of more complex CMS features. Information about how external factors influence use could identify situations in which more complex features can be successfully promoted. For example, the current study found that the external

factor of class size had no relationship to using specific CMS features, but the college in which a course was offered showed a significant relationship to the adoption of some features. This finding and others provide guidance about which CMS features should be promoted in which situations.

*CMS Definition and Research Summary*

The authors developed the definition below by considering previous definitions, educational theory, and a proposed model for conducting research into CMSs:

CMSs provide an integrated set of Web-based tools for learning and course management. Some tools are static and allow faculty members to transmit information to students—such as a syllabus, assignments, reading materials, and announcements. Other tools are interactive. One type of interactive tool allows people in a class to interact with each other, using asynchronous or synchronous discussions. Other interactive tools allow students to interact with a computer, such as quizzes or surveys. A final set of CMS tools utilize the integrated nature of CMSs. For example, statistical tools can show if students have viewed information that a faculty member transmitted or how students have interacted in the CMS. Most of the tools described here existed before CMSs, on the Web or a previous technology. A unique feature of CMSs is how they integrate the tools in ways that increase their usefulness. (Malikowski, Thompson, & Theis, 2006, p. 4)

CMSs are used to offer distance education courses, provide Web sites for resident courses, and to offer hybrid courses—which are a combination of distance education and resident courses. CMSs are used to provide a Web site for resident courses three times more often than they are used for distance education or to offer hybrid courses (Arabasz et al., 2003; Morgan, 2003). Therefore, this article will focus on how a CMS is used to provide a Web site for resident college courses.

*Current CMS Research*

A few studies have analyzed how faculty members are using CMSs as a resource in resident courses (Ansorge & Bendus, 2003; Dutton et al., 2004; Morgan, 2003; Woods et al., 2004). These studies show which CMS features are used most and least, and sometimes include comments or survey results from faculty members who use these systems.

One ambitious study of how faculty members use a CMS surveyed 862 faculty members at 38 institutions in the US that use Blackboard as a resource in resident courses (Woods et al., 2004). Faculty members were asked a variety of questions about using a CMS, including which features they used most. The researchers found:

The dominant course administration usage of blackboard was for course document and resource delivery by instructors to students. Syllabus publication was the most common usage of the tool by the faculty, with 75% frequently publishing their syllabi and another 11% occasionally doing so. Eighty-one percent (81%) reported that they either frequently or occasionally sent email to

the entire class through blackboard, 75% frequently or occasionally made supplemental readings available online, 61% sent email to selected students, and 59% used the online gradebook. This pattern did not carry over to assignments, as only 28% frequently or occasionally collected assignments online (via the Digital Drop Box) and only 20% frequently or occasionally returned materials online through blackboard. (Woods et al., 2004, p. 286)

Morgan (2003) conducted a another ambitious study. She surveyed 730 faculty members and instructional staff from 13 colleges and universities in the University of Wisconsin System. Data were also collected by analyzing the Web server logs of three campuses and examining CMS Web sites in three other campuses. Results from this study are provided with descriptions and charts of how a CMS is used on each campus. Morgan's summary of CMS use at all campuses is below.

The extent to which faculty use the full range of CMS tools is less than many may have anticipated, but use is growing quickly. Faculty tend to first adopt the static content tools that let them post announcements, syllabi, and text or graphic content. Once they're more familiar with the system, they begin using the assessment, gradebook, and communication tools. A strong majority of faculty report that their CMS use has increased over time. (2003, p. 74).

One smaller study published after Morgan's work, and the results of the study described later in this article, suggest that her comment about faculty using more CMS features over time may only be partially correct. This smaller study surveyed 191 faculty members at a private US university (Dutton et al., 2004). Researchers found that "Most respondents placed most value on

distributing information rather than on online discussions, group facilitation, virtual chat and other more interactive forms of communication" .

A final study surveyed 192 faculty members at the University of Nebraska at Lincoln (Ansorge & Bendus, 2003). Researchers found:

> The largest percentage of faculty respondents (69% of 192) reported the "posting of electronic documents" to be the most useful feature of CMSs. The second most preferred feature was the "discussion board," selected by 17% of the respondents. Smaller percentages of faculty selected the "assessment tool" (8%), the "chat feature" (1%), and "other tools" (5%). (p. 10)

Currently, not enough CMS research has been conducted to provide the basis of a formal meta-analysis, but patterns within this research have appeared. These patterns will now be explained using simple fractions. The most common use of a CMS is to transmit information to students. About three fourths of faculty members use a CMS to transmit documents to students, such as a syllabus or assignment information. The second highest level of use is evaluating students. Just over half of faculty members use the grade book and one quarter use quizzes. CMSs are not used very often to create class interactions. About one third of faculty members are creating class interactions in a CMS, primarily through asynchronous discussions. Other CMS features are rarely used by faculty members (Malikowski et al., 2006).

*Summary of CMS Research Findings*

There are at least two ways to explain the teaching strategies being used in CMSs. One explanation is that faculty members are using a CMS to transmit information to students and evaluate them on their performance. In terms of learning theory, this teaching strategy reflects Behaviorism or simple elements of Cognitivism (Driscoll, 2005; Ertmer & Newby, 1993). Of course, other theories may be represented in learning activities conducted in a classroom, or in other spaces outside of a CMS. The emphasis in this explanation, however, is which teaching strategies are being used most often in a CMS.

A second explanation considers the simplicity of transmitting course content compared to more complex uses of a CMS, such as creating interactive quizzes or computer-based instruction. It is possible that faculty members are in an early state of CMS use, with simple tasks being completed now and more complex tasks in upcoming years (B. S. Allen, Otto, & Hoffman, 2004). Both explanations are likely premature because more research needs to be conducted to see if either is accurate or if other explanations will best describe teaching strategies used in a CMS.

*Building on Existing CMS Research*

Currently, researchers have gathered data about CMS use primarily by surveying or interviewing faculty members who utilize these systems (Ansorge & Bendus, 2003; Dutton et al., 2004; Morgan, 2003; Woods et al., 2004). Morgan's study was an exception. She analyzed Web server

logs for some courses or viewed CMS Web sites when counting the use of CMS features (Morgan, 2003). Surveys and interviews have been used to ask faculty members a variety of questions. These questions include which features they use most, why they chose to use a CMS, why their use increased, why their use decreased, what would increase their use further, pedagogical reasons for this use, student-satisfaction reasons for this use, and time-saving reasons for using a CMS. As this list shows, many topics have been analyzed with surveys or interviews, so one way to build on previous research is to rely less on asking faculty members how they use a CMS, such as actually looking at their CMS Web sites to see which features are used.

Another method to build on previous research is to statistically analyze the results. In the four studies previously described, only the study by Woods, Baker, and Hopper (2004) provides a statistical analysis. Other studies show results by giving a list or chart of which features are used most. Lists and charts of commonly used features contain helpful information, but without a statistical analysis, it is difficult to determine if the results are due to chance.

Another method to build on existing CMS research is to elaborate on a few categories of faculty members, instead of briefly describing many categories. Currently, CMS research tends to provide results from all faculty members who were part of a study or many categories of faculty members. The most common situation is for researchers to report the CMS use of all faculty members involved in a particular study. One exception is a study conducted by Woods (2004). In this case, the researchers considered many factors—such as a faculty member's age, gender, years of teaching, academic discipline, experience with technology, attitudes toward a CMS, and

other characteristics. Analyzing many factors leads to interesting results because of the breadth of issues considered. One way to build on this research would be to analyze a few factors in depth.

A final method to build on previous research is to consider issues related to how people learn (Hannafin & Rieber, 1989), particularly from research in learning psychology. Currently, research into CMS use has considered CMS features, opinions from teachers about these features, and student satisfaction with CMS features. Gagné, Briggs, and Wager summarize the importance of considering both learning psychology and technology, which they refer to as "media." They emphasize "the primacy of selecting media based on their effectiveness in supporting the learning process. Every neglect of the consideration of how learning takes place may be expected to result in a weaker procedure and poorer learning results." (Gagné, Briggs, & Wager, 1992, p. 221). For decades, researchers have studied how teaching methods affect learning outcomes. Several recent publications describe seminal research findings, research that has built on these findings, and learning theories that have emerged from this research (Driscoll, 2005; Gagné et al., 1992; Jonassen & Association for Educational Communications and Technology., 2004; Reigeluth, 1999).

The authors proposed a model for CMS research that considers both CMS features and what is known about how people learn. This model should assist in the process of building on previous CMS research. The purpose of the model was to guide CMS research questions and summaries in a way that considers both CMS features and learning issues.

Considering both features and theory is challenging because they are at very different ends of a continuum. Features are specific, technical, and typically based on technological advancements. Learning theory is abstract, psychological, and typically based on research into learning outcomes. The proposed model is meant to provide a conceptual middle ground between CMS features and learning theory. … The model contains five categories: (a) transmitting course content, (b) evaluating students, (c) evaluating courses and faculty members, (d) creating class interactions, and (e) creating computer-based instruction. (Malikowski et al., 2006, p. 10)

A practical benefit of this model is that it could help synthesize CMS research that is conducted on different systems, such as Blackboard or Desire2Learn. These CMSs contain similar features but give the features different names. The categories in the model represent the pedagogical function of common CMS features, regardless of the name a vendor gives them. This research model allows CMS research to build on past research and develop a series of new research that focuses on pedagogical issues, instead of technical names within particular CMSs.

The study described in the remainder of this article builds on previous research in four ways. First, courses were analyzed by having researchers look inside of CMS Web sites. In this regard, data were collected by looking at how faculty members actually used a CMS, instead of asking them about their use with a survey or interview. Second, a statistical analysis was conducted to determine how likely the findings were due to chance. Third, technical features and learning issues were both considered by using the CMS research model mentioned earlier. And last, this study built on previous research by exploring how a few external factors relate to CMS use. The specific external factors that were analyzed were the college in which a course was offered, the

number of students in a course, and the level of the course—such as 100 level, 200 level, or 300 level.

*Methodology*

A method was selected to collect data about how a CMS is used in resident college courses and how this use is related to factors external to faculty members. An important point to clarify is that the method applied in this study was not intended to determine if external factors caused the use of CMS features. Identifying causation is an important but particularly challenging research goal (Fraenkel & Wallen, 1990). Instead, the current method and study only sought to determine if significant relationships existed between external factors and the adoption of specific CMS features. Once these relationships are clarified, future research can make more informed decisions about investigating which factors cause the use of which CMS features.

*Participants*

Participants were faculty members at a comprehensive university in the Midwest, which has about 15,000 students. The CMS used at this university is Desire2Learn (D2L). A simple random sample of 200 faculty members was drawn from the 308 faculty members who requested a D2L Web site during the spring 2005 semester. Eighty-seven faculty members agreed to participate. Each faculty member used D2L for 1 to 10 courses. Courses using D2L for distance learning were excluded from this study. Distance learning was defined as a course where students met in

a resident group one time or less. The resulting sample included 81 faculty members and 153 D2L Web sites.

*Research Team*

A team of two faculty members, three graduate students, and seven undergraduate students collected data in this study. Faculty members coordinated the work of students and collected data about sensitive information, such as grades. Before collecting any data that were used in this study, all team members analyzed three practice courses and compared their results, to become familiar with the data collection materials.

*Data Collection Materials*

A data collection form was created to assure that members of the research team collected the same data. This form described 40 features in D2L. Examples of items on this form were the number of quiz questions, files in a drop box, grade book entries, or posts to a discussion board. The form focused on features that could be counted, in which case a number was entered on the form. Other parts of the form were completed by identifying if a feature existed or not, in which case a yes or no was added to the form.

Another source of data was the course descriptions that appeared in D2L. These course descriptions were used to obtain two of the three external factors that were analyzed in this study, which were the college in which a course was offered and the level of a course—such as

100, 200, or 300. The third external factor, which was class size, was obtained by looking at a report that is automatically generated within D2L.

*Procedure and Data Validity*

Students on the research team collected data on 33 of the 40 items on the collection form. This analysis was a labor-intensive process of viewing a D2L Web site for a particular course and completing a copy of the data collection form, by counting how often features in D2L were used. In some cases, members of the research team counted thousands of items.

To increase accuracy, each D2L Web site was analyzed twice, by different students. When differences in the two analyses arose, the D2L Web site was analyzed again by a different student. If differences persisted after a D2L Web site was analyzed four times, an average number was calculated from the three numbers that were most similar. Faculty members analyzed the remaining items on the collection form. They analyzed 25 of the same courses to determine inter-rater reliability. This reliability level was 98.80%.

*Results*

Two types of results are reported in this section. The first describes which features were used most and least. The second describes external factors related to this use.

*D2L Features Used Most and Least*

Of the 40 items on the analysis form, 13 were analyzed for the current report. These 13 items involved D2L features that could contain content or learning activities, such as assignment descriptions, quiz questions, or discussion postings. Most of the features that were not considered in this analysis focused on organizational features within D2L, such as the number of folders in a drop box. Organizational features may be analyzed in the future, but for the current study, the researchers were more interested in learning content, evaluation, or interactions. For example, the researchers determined how many files were in a instead of analyzing how many folders were used to organize those files.

| Feature | Percent of Adoption | Standard Deviation | CMS Research Model Category |
|---|---|---|---|
| Glossary | 0.65 | 8.08 | Transmit Content |
| Checklist | 0.65 | 8.08 | Transmit Content |
| Self Assessments | 0.65 | 8.08 | Computer-based Instruction |
| FAQ | 1.31 | 11.40 | Transmit Content |
| Chat | 1.31 | 11.40 | Class Interaction |
| Survey | 15.69 | 36.49 | Evaluate Course |
| Drop Box | 21.57 | 41.26 | Class Interaction |
| Quizzes | 27.45 | 44.77 | Evaluate Students |
| Discuss | 28.76 | 45.41 | Class Interaction |
| Schedule | 32.03 | 46.81 | Transmit Content |
| Grade Book | 57.52 | 49.59 | Evaluate Students |
| News/Announcements | 66.01 | 47.52 | Transmit Content |
| Content Files | 84.31 | 36.49 | Transmit Content |

*Table 1: Percent of CMS Features Adopted and Category of Each Feature*

Table 1 contains information about the D2L features faculty members adopted. In this study, a faculty member was considered to have adopted a feature if at least one instance of the feature was present. For example, if a faculty member had one quiz question for students, that faculty member was considered as having adopted the quiz feature. This low level of quiz use was uncommon, but it illustrates the definition of "Adopted" used in Table 1.

Table 1 also shows the categories of the CMS Research Model mentioned earlier (Malikowski et al., 2006). Most of the categories in this model are intuitive, but it is worth clarifying that the feature called "content files" refers to items in the "Content" area of D2L. These content files typically include a syllabus, assigned reading, or PowerPoint presentation.

Table 1 shows that only three of the 13 features were adopted by more than half of faculty members. These three features were the grade book, news/announcements, and content files. These same three features were the only items in Table 1 where the percent of adoption is greater than the standard deviation. The high standard deviations in Table 1 show that adoption of CMS features was very broad, usually including zero or no adoption. In many cases, the standard deviation was at least twice as large as the percentage of faculty members using a feature. This follows previous research findings where "In almost every situation, there were more respondents who never used a given instructional feature than used it at all" (Woods et al., 2004, p. 292).

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Insert Figure 1 About Here

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Figure 1 shows how categories in the CMS research model compare to each other. This comparison is based on the cumulative percentage points in Table 1 for each feature and associated category. According to Figure 1, faculty members primarily use a CMS to transmit

information to students and evaluate them, which supports survey findings from previous research.

Paired *t*-tests provided statistical evidence that faculty members adopted some features in Table 1 significantly more than others. Features that were adopted significantly more often than the least used features were analyzed further. For example, Table 1 shows that the glossary was one of the least used features, with an adoption level of 0.65%. The chat feature was adopted by 1.31% of faculty members, but in this case, 1.31% is not significantly different than the 0.65% adoption level of the glossary feature ($p$=0.565). After the chat feature, the next most adopted feature was the survey, with an adoption level of 15.69%. This level of adoption was significantly higher than the glossary feature ($p$=.000), so the survey feature was analyzed further, in addition to all features adopted more often than the survey. Table 2 contains the eight features that were further analyzed and how the adoption of these features compared to each other.

| | Survey | Drop Box | Quiz | Discuss | Schedule | Grade Book | News/ Announce |
|---|---|---|---|---|---|---|---|
| Drop Box | 1.35 | | | | | | |
| Quiz | 2.71** | 1.29 | | | | | |
| Discuss | 2.78** | 1.73 | .26 | | | | |
| Schedule | 3.36** | 2.51* | .93 | .61 | | | |
| Grade Book | 9.70*** | 8.15*** | 6.47*** | 5.60*** | 5.79*** | | |
| News/ Announce | 11.05*** | 9.08*** | 7.71*** | 7.23*** | 6.46*** | 1.70 | |
| Content Files | 15.61*** | 15.57*** | 12.32*** | 12.01*** | 11.49*** | 5.56*** | 3.84*** |

* $p<.05$. ** $p<.01$. *** $p<.001$.

*Note. df*=152 for all paired *t*-tests in Table 2.

*Table 2: T-Values from Paired T-Tests of Feature Adoption Levels*

As previously mentioned, data were also gathered about external factors that related to the adoption of specific CMS features. Adopting a CMS feature was defined as using a particular feature at least once. Three external factors were considered. The first was the college in which a course was offered, and the second factor was the size of the class. Four categories of class size

were used, based on quartiles within the range of class size. This range was 1 to 192. The third external factor was the level of a class.

Several types of analysis were considered to see how these external factors affect CMS use, but most would not provide a concise summary of these findings. For example, all eight features shown in Table 2 were adopted at significantly different levels than other features at the $p< 0.05$ level. Analyzing how three external factors related to these eight features would result in 24 ANOVAs and even more post-hoc tests. For the sake of brevity, external factors were compared to a select few of the CMS features analyzed. One intuitive technique for selecting features would be to select those with the lowest p values in Table 2—such as content files, news, grade book, and schedule. A disadvantage of this intuitive selection is that two of these items, content files and news, are in the category of transmitting course content, according to the CMS research model mentioned earlier (Malikowski et al., 2006).

In an effort to conduct an analysis that considers diverse teaching techniques, one feature in Table 2 was selected for three categories of the CMS Research Model. The feature for each category was selected by identifying the feature that was most statistically significant in that category. The content files feature was selected for the category of transmitting course content, and the asynchronous discussion feature was selected for the category of creating class interactions. The grade book feature was selected for the category of evaluating students.

The three external factors were compared to the three features listed above, using ANOVAs. The only external factor that showed a significant relationship to the level of adoption with any of

these features was the college in which a course was offered. Specifically, the college in which a course was offered significantly related ($p$<.05) to the adoption of asynchronous discussions and the grade book as shown in Table 3.

| Feature Adopted and Source | *SS* | *MS* | *F*(4, 148) |
|---|---|---|---|
| Discussion | | | |
| Between Groups | 4.77 | 1.19 | 6.64*** |
| Within Groups | 26.58 | 0.18 | |
| Grade Book | | | |
| Between Groups | 3.18 | 0.79 | 3.43** |
| Within Groups | 34.21 | 0.23 | |
| Content Files | | | |
| Between Groups | 0.13 | 0.03 | 0.24 |
| Within Groups | 20.10 | 0.13 | |

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

*Table 3: Relationship Between College and Adoption of the Adoption of Select Features*

Table 4 shows the results of post-hoc tests that analyzed how individual colleges used asynchronous discussions more than other colleges. The five colleges are listed with a parenthetical note showing the percentage of faculty members in that college who adopted asynchronous discussions. The number of courses analyzed in each college was unequal, and Lavene's statistic showed a significant difference ($p$=.000) in the variance of adoption, with the

asynchronous discussion feature. The Games-Howell test was selected for post-hoc analysis because this test is well-suited for situations in which group sizes are unequal and variances are significantly different (Toothaker, 1993).

| | Education (58.8%) | | Soc Science (43.5%) | | Business (38.9%) | | FA & Human (26.3%) | |
|---|---|---|---|---|---|---|---|---|
| | *MD* | *SE* | *MD* | *SE* | *MD* | *SE* | *MD* | *SE* |
| Soc Science (43.5%) | .15 | .16 | | | | | | |
| Business (38.9%) | .20 | .15 | .05 | .13 | | | | |
| FA & Human (26.3%) | .33 | .16 | .17 | .15 | .13 | .13 | | |
| Sci & Eng (8.6%) | .50** | .13 | .35* | .11 | .30* | .09 | .18 | .11 |

* $p<.05$. ** $p<.01$

*Note. MD*=Mean Difference

*Table 4: Percent of Asynchronous Discussion Adoption and Post Hoc Tests Between College*

According to Table 4, the College of Science and Engineering used asynchronous discussions significantly less often ($p<0.05$) than other colleges with the exception of the College of Fine Arts and Humanities.

Another analysis involved relationships between the level of adoption of the grade book feature and the college in which a course was offered. In this case, group sizes were again unequal, but Lavene's test showed the variance in adoption levels was not significant ($p=.105$). The Tukey *a* post-hoc test is appropriate in such situations (Toothaker, 1993) and was applied in Table 5. This table shows that the College of Social Science used the grade book significantly more often ($p<.05$) than the College of Business. This may be due to a common CMS feature that allows quiz results to be automatically entered into the grade book. For reasons described earlier, this article has not focused on the quiz feature in a CMS, but since the quiz technically relates to grade book use, adoption of the quiz feature will now be briefly described.

The College of Social Science adopted the quiz feature more than other colleges, but this level of adoption was only statistically more significant ($p<.01$) than the level of adoption in the Colleges of Business and Education. In any case, faculty members in the College of Social Science actively adopted the quiz feature, and this adoption could influence findings about this college adopting the grade book more than the College of Business.

| | Soc Science (86.9%) | | Sci & Eng (60.3%) | | Education (52.9%) | | FA & Human (47.4%) | |
|---|---|---|---|---|---|---|---|---|
| | *MD* | *SE* | *MD* | *SE* | *MD* | *SE* | *MD* | *SE* |
| Sci & Eng (60.3%) | .27 | .19 | | | | | | |
| Education (52.9%) | .34 | .15 | .07 | .13 | | | | |
| FA & Human (47.4%) | .40 | .15 | .13 | .13 | .06 | .16 | | |
| Business (41.7%) | .45** | .13 | .19 | .10 | .11 | .14 | .06 | .14 |

** $p<.01$.

*Note. MD*=Mean Difference

*Table 5: Percent of Grade Book Adoption and Post Hoc Tests Between College*

*Discussion*

This study sought to provide information for those interested in helping faculty members effectively use a broader set of CMS features. Past research has shown that faculty members primarily use a CMS to transmit information to students. The study described here supported that finding, using different data collection and analysis methods. Specifically, past research

primarily gathered data by asking faculty members how they use a CMS, through surveys or interviews. The current study gathered data by looking inside CMS Web sites and counting how often features were used. In any case, both data collection methods yielded the result that faculty members primarily use a CMS to transmit information to students. This finding clarifies the current state of CMS use, which provides a starting point for helping faculty members adopt more complex CMS features.

*Leveraging External Factors*

In an attempt to find more options to increase effective use of more CMS features, the current study built on previous research by analyzing how a few external factors influenced which CMS features were adopted. The external factors were the number of students in a course, the level of the course, and the college in which a course was offered. Only the college in which a course was offered resulted in a significant difference in the level of adoption of some CMS features. This supports previous research into traditions and norms of faculty members within a particular discipline. More specifically, individual academic disciplines have distinct patterns for how often they use lecture, collaborative learning activities, or other teaching strategies (Braxton, Eimers, & Bayer, 1996; Smeby, 1996).

In the current study, the college in which a course was offered significantly related to how often asynchronous discussions and the grade book were used. In the case of asynchronous discussions, Table 4 shows that faculty members in the College of Science and Engineering used these discussions significantly less than faculty members in most other colleges. One explanation

supports the norm that engineers and other members of this college are less inclined to learn and teach in groups than people in other disciplines. In terms of the CMS research model used in this article, this norm would predict a low level of use in the class interactions category.

A tradition or norm could also explain different levels of adoption with the grade book feature. Faculty members in the College of Social Science used the grade book significantly more than faculty members in the College of Education. As previously mentioned, this could be due to the high use of the quiz feature by faculty members in the College of Social Science because CMS grade books can automatically store scores from a CMS quiz. Faculty members in this college may be more inclined to use a quiz because they have a long history of using psychological tests, which are similar to CMS quizzes. These faculty members include psychologists, sociologists, and therapists. Some of the psychological tests include IQ tests or the Minnesota Multiphasic Personality Inventory. This history of testing may lead faculty members in the College of Social Science to adopt a quiz feature. Since quiz results can be automatically transferred to a grade book, the high level of quiz adoption may explain the high level of grade book adoption by faculty members in the College of Social Science.

These findings about how external factors affect CMS use could be helpful in increasing effective use of more CMS features. Instructional designers and technologists who assist faculty members in their CMS use could emphasize external factors that are influential for particular groups. For example, faculty members in a college of social science, who do not use quizzes, should be receptive to suggestions for using CMS quizzes.

Faculty members who do use quizzes may be receptive to using related yet more complex teaching strategies. For example, the CMS research model referred to in this article has a category of computer-based instruction, which can be similar to CMS quizzes. This computer-based instruction could be as simple as an extra-credit or low-credit quiz, with detailed feedback for correct and incorrect answers. This feedback could also contain hyperlinks to Web sites with more information. Questions for such quizzes are increasingly available with textbooks.

Another way to apply findings about external factors is to avoid factors that are not related to a significant increase in adoption of specific CMS features. For example, findings in this study suggest that faculty members in a college of science and engineering would not currently be receptive to suggestions to use an asynchronous discussion, and probably not other CMS features that support class interaction.

A final example to apply findings from this study involves faculty members from the College of Fine Arts and Humanities. These faculty members were consistently among the lowest adopters of CMS features. In this case, one plan for encouraging effective use of more CMS features could be to encourage these faculty members to transmit information on a CMS, by posting a syllabus or other class information. At the least, this would allow students to have convenient access to course materials. Other examples of external factors to emphasize or de-emphasize can arise from findings in Tables 3, 4, and 5.

*Implications Regarding the Current State of CMS Use*

A broad issue to consider in this study is the current state of CMS adoption, considering all three external factors and CMS features. Even though these systems have been available for a decade, the significant and non-significant findings in this study suggest that CMS adoption is in an early state. One research finding supporting this claim is that faculty members are using CMSs for very basic tasks, such as transmitting content to students. When people learn any new system, basic tasks are adopted before complex tasks (B. S. Allen et al., 2004).

Results from the three external factors analyzed in this study also support the implication that CMS use is in an early state. As previously described, only the college in which a course was offered significantly related to the use of CMS features. One implication from this finding is that faculty members consider traditions and norms within their own college more than course size or level.

The finding that class size or level did not significantly relate to the adoption of CMS features is surprising because some CMS features could be useful for different class levels or large classes (Bongey, Cizadlo, & Kalnbach, 2005). For example, large classes can offer limited opportunities for class interaction, but as shown in Table 3, CMS features supporting this interaction were not used more often for large classes. Instead of considering class size or level, faculty members used a CMS for the simple task of transmitting information, or they chose CMS features that reflect traditions in their own discipline. This implies an early state of CMS use because tradition

within a discipline appears to be more influential than using a CMS to meet the needs of different learning situations, such as class level or size.

*Research Limitations*

One limitation of the current study was that fewer faculty members were involved in this study than in previous studies. This study included 81 faculty members, and 153 D2L Web sites. The following list shows the number of faculty members who have been involved with previous research: 862 (Woods et al., 2004), 730 (Morgan, 2003), 192 (Ansorge & Bendus, 2003), and 191 (Dutton et al., 2004). One reason previous research was able to include a high number of faculty members is that surveys were often used to identify which CMS features were used most, by asking faculty members which features they used. Researchers in the current study chose to count the number of features in each CMS Web site, to avoid differences in what research participants say they did and what they actually did. As previously described, each D2L Web site was analyzed at least twice to increase data validity. This data collection and validation was a time-intensive process, since many D2L Web sites contained thousands of items. An advantage of this process is that data were based on observing which features were used instead of faculty perceptions of how features were used. A disadvantage is that fewer research participants could be involved. Fortunately, enough participants were involved to complete the statistical tests that were to analyze the data.

Another limitation to this study involves the Web server that contained the CMS Web sites that were analyzed. For technical reasons, analyzing CMS Web sites generally occurs on either the

server on which a faculty member creates the CMS Web site, sometimes called the "live" server, or the analysis occurs on a backup server, which contains a copy of each CMS Web site. Intuitively, analyzing CMS Web sites on a backup server is more appealing, since faculty members cannot make changes to the CMS Web site once a study is underway. Unfortunately, complications can occur when using a backup server. These complications arise from moving a large number of Web sites from the live server to the backup server, particularly when a large number of faculty members are involved in a study. Morgan used a backup server for some of her analysis and reported that she lost data in the process of moving Web sites from the live server to the backup server.

The current study analyzed CMS Web sites when they were on a live server. The limitation in this case is that a faculty member can change a Web site while it is being analyzed. Fortunately, the university at which this study occurred has faculty members create a different CMS Web site each time a course is offered. For example, if a faculty member teaches Math 101 during the fall semester of 2005, and creates a CMS Web site for the course, she will have to create a new CMS Web site for this course if she teaches it during the spring semester of 2005. This policy discourages faculty members from changing a past CMS Web site because the changes will not apply to a current or future course.

A final limitation of the current study is that the analysis compared external factors to only three CMS features. These features were D2L's content files, asynchronous discussion, and grade book. As shown in Table 1, D2L has many more features. Only three features were analyzed in the current study for the sake of brevity. As previously described, eight of the CMS features in

this study were used significantly more often than the least used features. Analyzing how these eight features related to the three external factors would require 24 ANOVAs and even more post-hoc tests. Therefore, three features were selected which reflect a variety of teaching strategies.

### *Conclusion*

The results of this study built on previous research, provide options for future research, and should be helpful in efforts to increase more effective use of more CMS features. Each of these topics will now be described.

### *Additions to Previous Research*

The study described in this article built on previous research in a few ways. First, a rank-ordered list of commonly used CMS features was created by looking at CMS Web sites and counting the number of features that were used. Another way this study built on previous research was by statistically analyzing the results. This provides information about which items in the rank-ordered list occurred significantly more often than other items and which items arrived at a particular position in the list due to chance. The result of the two issues in this paragraph is that a list is now available of which CMS features have been observed to be used significantly more often than other features.

Another way the current study built on previous research is that it considered how a few external factors were related to the adoption of CMS features. Surprisingly, the only external factor that related to the adoption of CMS features was the college in which a course was offered. This suggests that faculty members are using a CMS in a way that follows the customs and norms of their discipline. This finding also provides opportunities for expanding CMS use to accommodate the needs of large classes and different levels of classes.

### *Future CMS Research*

Future research could explore how CMSs can be used to increase learning outcomes of large classes or different levels of classes. Future research could also explore how the integrated nature of CMS features can be used to increase learning outcomes. As previously described, most or all of the features in a CMS have existed in previous technologies. The most unique element of a CMS is that these features are integrated into a single system. Researchers could explore how this integration can be used in specific learning activities to increase learning outcomes.

A final method to build on previous research would be to analyze factors related to how much faculty members use CMS features, or depth of use. The current study analyzed how frequently faculty members adopted CMS features, which meant that a feature was used at least once. Analyzing depth of use would go beyond adopting features and analyze which factors are related to how often features are used.

*Increasing Effective use of More CMS Features*

There are a few strategies for instructional designers, technologists, and researchers to encourage more effective use of more CMS features. The study described here showed one strategy. That is, these professionals could identify and utilize external factors that are related to the adoption of more complex CMS features. Another strategy is to develop CMS learning activities that are based on research into how people learn. Faculty members may tend to adhere to traditions within their discipline, but few reasons for change are more compelling than learning activities that demonstrate increased learning outcomes.

Efforts to increase effective use of CMS features may appear to be yet another wave of integrating a new technology into learning. CMSs have the potential to be more than just another technological trend. In the history of using technology for learning, few systems have contained so many features and, more importantly, few technical systems have received such widespread adoption in higher education (Saettler, 1990; Shrock, 1991). The technical systems and stakeholders are in place. All that is needed now are the efforts to show stakeholders how to effectively use the system to increase learning outcomes.

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