Instructional Delivery in Developmental Mathematics: Impact on Retention

By Carol A. Zavarella and Jan M. Ignash

ABSTRACT: Studies of students enrolled in computer-based instruction have yielded mixed results, with some reporting a high dropout rate. This article describes a quantitative study examining the probability of students’ withdrawal from a computer- versus lecture-based developmental math course based on learning style, reasons for selecting the instructional format, and entry test scores. Students in the computer-based format were more likely to withdraw from the course compared to those in the lecture-based format, and personal reasons for choosing a specific format appeared to influence completion rates. Implications for practice include suggestions for providing appropriate information to students prior to their enrollment in online developmental education courses.

Computer-based instruction, including distance learning, is fast becoming an integral part of higher education. Among its many advantages, computer-based instruction reaches “a broader student audience, better addresses student needs, saves money, and more importantly uses the principles of modern learning pedagogy” (Fitzpatrick, as cited in Tucker, 2001, p. 1). Questions remain, however, about the effectiveness of computer-based instruction with different types of learners, especially with those enrolled in developmental education courses. In this study, computer-based instruction is used as a general overarching term that includes online courses (distance learning) and/or computer-mediated instruction where the delivery format requires a computer and a packaged software product to deliver the content of the course.

Much of the current research on the effectiveness of computer-based instruction has found that it is as effective as lecture-based instruction (Lesh & Rampp, 2000; Perez & Fosday, 2002; Tucker, 2001). These studies mainly examined student outcomes, attitudes, and overall satisfaction (Phipps & Merisotis, 1999). Although the evidence supports that students enrolled in computer-based instruction perform equally well compared to their lecture-based counterparts, there is a well-documented high dropout rate in courses delivered via computer-based instruction in general and distance learning courses and programs in particular (Carr, 2000; Diaz, 2002; Kozeracki, 1999; Parker, 2003; Phipps & Merisotis, 1999). Far less research has investigated the effectiveness of computer-based instruction specifically for students in developmental education. One such study conducted by Bendickson (2004) found the retention rates for developmental mathematics in computer-based courses were as low as or lower than retention rates in traditional lecture-based courses.

Although research designed to understand why the dropout rate is higher in computer-based instruction compared to traditional instruction is limited, the high dropout rate has prompted critics of computer-based instruction to question whether it is an appropriate delivery method for every student or for every subject area. Some researchers posit that retention and success in computer-based instruction is affected by the particular learning style of the student (Boles, Pillay, & Raj, 1999; Diaz & Cartnal, 1999; Gee, 1990; Grasha & Yangarber-Hicks, 2000; Sherry, 1996; Terrell, 2005; Tucker, 2001). Other researchers claim that students’ reasons for choosing computer-based instruction may be related to the high dropout rate within this particular delivery format (Berg, 2001; Kinney & Robertson, 2005; Roblyer, 1999). For example, several studies designed to measure student perceptions of computer-based instruction have found that students perceive that the use of a computer will help them to understand the material and that courses delivered via computer-based instruction will be less time-consuming (Lesh & Rampp, 2000).

Of the few studies that examined learning style and student choice within computer-based instruction, none focused on the developmental student enrolled in a community college, a group that has been documented as high risk for dropout (Roueche & Roueche, 1993; Tinto, 1996). A key component of the effectiveness of computer-based learning, especially for students in developmental education, may be students’ preferred learning styles (Berg, 2001; Terrell, 2005; Tucker, 2001). Researchers have developed varying definitions and descriptions of learning styles. For example, Higbee and Ginter (1991)
state that learning style may refer to personal-
ity type, cognitive processes, environmental fac-
tors, or affective variables. James and Galbraith
(1985) and Ginter, Brown, and Scalise note that
“a person’s learning style is directly related to
ability to process and retain information” (as
states that “the majority of studies that connect
positive academic achievement to students’ pre-
ferrred learning style have focused on student
achievement and perception in the traditional
classroom setting” (p. 3). In contrast, detailed re-
search on learning style within computer-based
instruction is limited.

Students’ reasons for choosing a course deliv-
ery format is an often-overlooked area of inves-
tigation within distance learning. Instead, most
studies concentrate on the demographic charac-
teristics of students choosing computer-based
instruction over the traditional lecture-based
format (Perez & Foshay, 2002; Valentine, 2002;
Phipps & Merisotis, 1999). An equal number of
studies examine the characteristics of students
who are successful in the computer-based for-
mat. However, it is important to investigate
students’ reasons for choosing one particular in-
structional format over another. Roblyer (1999)
argues that, as they begin to consider replacing
traditional formats with distance learning for-
mats, the administrators need to better under-
stand the potential impact upon students. In
addition, if a preference for distance learning is
found in a certain type of student, such as “stu-
dents at certain educational levels, with more
experience using technology, or with greater
academic commitment” (p. 3), this information
may help institutions determine who is most
likely to succeed in distance learning endeavors.

Research Questions
This study attempted to examine the differences
in students’ withdrawal and completion rates in
classes delivered via different instructional for-
mats (distance learning, hybrid, or traditional).
The three research questions guiding this study
were:

1. Is there a relationship between students’
   learning styles and their completion or
   withdrawal from a beginning algebra de-
   velopmental math course by a particular
   instructional delivery format (i.e., lecture-
   based, hybrid, or distance learning)?
2. Is there a relationship between students’
   reasons for choosing a particular instruc-
   tional delivery format (i.e., lecture-based,
   hybrid, or distance learning) and their
   completion or withdrawal from a begin-
   ning algebra developmental math course?
3. Is there a relationship between students’

College Placement Test (CPT) mathemat-
ics score and their completion or with-
drawal from a particular instructional de-
ivery format (i.e., lecture-based, hybrid,
or distance learning) of a developmental
basic algebra math course?

This nonexperimental quantitative study ex-
amined the relationship between student learn-
ing styles, student reasons for choosing a par-
cular course delivery format, and students’ en-
tering math placement test scores on the College
Placement Test, and the completion or with-
drawal from a particular course delivery format
(traditional, hybrid, or distance learning). Par-
ticipants were students in a beginning algebra
developmental mathematics course at a large
urban community college. The hybrid format is
an instructional delivery method that requires
a computer and a packaged software product
to deliver the content of the course. The course
meets on campus, and the instructor acts as a
facilitator who offers personalized instruction as

Social interaction is an
important scale to include
in distance learning
research.

needed. The instructor may or may not deliver
minilectures, but the majority of the content is
delivered via the computer. The distance learn-
ing format is an instructional delivery method
that is taught completely online from packaged
software and is delivered at a distance.

The research questions were examined using
data from student test scores, a learning style
survey, and a survey of students’ reasons for
selecting a delivery format which was modified
from an existing Roblyer (1999) survey.

Method

Site and Sample Demographics
The site of the study was a large, urban, multi-
campus community college located in Florida.
The population consisted of students who were
enrolled in different sections of the same devel-
opmental math course offered in a traditional
lecture-based format, a hybrid format, and a
distance learning format. The study was limited
to students who were enrolled at two of the col-
lege’s five campuses because these were the only
two campuses that offered all three methods of
instructional delivery for the course. The main
campus had the highest enrollment (12,710
unduplicated headcount in Fall 2006) and the
other campus, located in an historical, urban
setting, was smaller (7,090 unduplicated head-
count in Fall 2006). In addition, the develop-
mental course studied was limited to beginning
algebra because it was the only developmental
course offered in all three instructional for-
mats. The sample consisted of three groups: (a)
69 students enrolled in three sections of a basic
algebra traditional lecture-based course on the
two campuses, (b) 67 students enrolled in three
sections of the hybrid version of the course on
both campuses, and (c) 56 students enrolled in
three sections of the course delivered via dis-
tance learning. Random sampling was not pos-
sible for this study because students self-selected
into their courses. A nonprobability (purposive)
sampling technique was used to choose the sec-
tions involved in the study in an effort to obtain
a sample that was as representative as possible of
the population being studied.

Data Collection
Data from three sources were used for this study:
(a) the Grasha-Reichmann Student Learning
Styles Scales” (Hruska-Riehmann & Grasha,
1982), (b) an institutionally developed survey of
students’ reasons for selection of delivery for-
mat, and (c) college-level institutional data on
participants’ demographic characteristics and
mathematics entry test scores.

The Grasha-Reichmann Student Learning
Style Scales (GRSLSS) was the instrument used
to determine the learning styles of the students
involved in the study. For over 20 years, the
GRSLSS has “been used to identify the prefer-
ences learners have for interacting with peers
and the instructor in classroom settings” (Gras-
sha, 1996, p. 127). The GRSLSS was selected for
this study because “the scales fall into the gen-
eral learning style category of social-interaction
models...as opposed to other categories of
learner differences such as cognitive styles or
developmental-stage models” (Hruska-Riech-
mann & Grasha, 1982, p. 81). Although several
other learning style instruments have been used
in research involving distance learning, “the
GRSLSS focuses on how students interact with
the instructor, other students, and with learning
in general” (Diaz & Cartnal, 1999, p. 2). Social
interaction is an important scale to include in
distance learning research because one of the
defining characteristics of distance learning is
“the separation of teacher and student” (Gar-
rison, 1989, p. 2). Therefore, the GRSLSS ad-
dresses “one of the key distinguishing features
of a distance class, the relative absence of social
interaction between instructor and student and
among students” (Diaz & Cartnal, p. 2). In addi-
tion, the GRSLSS “is one of the few instrumen-
tes specifically designed to look at student differ-
ences in senior high school and college/univer-
validity for the survey's Likert scale:

She used the following four constructs to develop a locally developed survey. Roblyer conducted a study several years of recent college-level, institutional data regarding the reasons students chose to enroll in a distance learning course to the items found in Roblyer’s (1999) survey. There were several comments from students related to logistical and control factors that were not included in the Roblyer survey. As a result, Roblyer’s original survey was modified to incorporate these additional items for the study.

The third source of data for this study was information obtained from the college database. It included student demographic characteristics and entering CPT math test scores.

Each of the research questions was addressed by logistic regression, chosen for its predictive ability. “Logistic regression allows one to predict a discrete outcome such as group membership from a set of variables that may be continuous, discrete, dichotomous, or a mix” (Tabachnick & Fidell, 2001, p. 537). This type of regression can be used to predict a dichotomous dependent variable based on either continuous or categorical independent variables.

Results

Results of the study are discussed below in five major sections. In the first section, some descriptive statistics are provided for the research sample, including frequencies for general student characteristics (gender, race/ethnicity, age) and for general findings relating learning styles to student course completion rates. The latter four sections present results for each of the research questions.

General Student Characteristics

Frequencies comparing gender, age, and ethnicity of the research group as a whole and by instructional delivery method revealed some differences between the groups. Although the research population was small, the similarity of participant demographics in all three groups supported comparison. Similarity of characteristics to developmental students in other studies further supported some transferability for findings.

Gender. Females represented a higher percentage (71%) of the research group than males. The higher proportion of females is consistent with other studies that have found more women enrolled in developmental courses (Saxon & Boylan, 1999; Young, 2002) and in distance learning (Phipps & Merisotis, 1999). Within each of the three subgroups, the proportion of females versus males stayed fairly constant, showing no significant difference between gender and type of instructional delivery format.

Race/Ethnicity. Race/ethnicity was a variable in which the research group differed from the population of other studies. Two-thirds of the research group in this study (65%) was reported as non-Caucasian, including African American (34%), Hispanic (28%), Asian/Pacific Islander (2%), and American Indian/Alaskan (1%). These results differed from the proportion reported in a similar study by Baltzer (as cited in Young, 2002) who found that only one-third of students in developmental classes were from a minority group. Further, both Diaz (2002) and Saxon and Boylan (1999) found that more majority students enrolled in distance learning classes than minority students. Therefore, the minority group representation in this study was higher than would have been expected, in light of representation reported in similar studies.

Table 2
Completion Status by Instructional Delivery Format

<table>
<thead>
<tr>
<th>Completion Status</th>
<th>Lecture Format n=69</th>
<th>Hybrid Format n=67</th>
<th>Distance Learning Format n=56</th>
<th>Total All Sections N=192</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Completed</td>
<td>55</td>
<td>80%</td>
<td>39</td>
<td>58%</td>
</tr>
<tr>
<td>Withdrew</td>
<td>14</td>
<td>20%</td>
<td>28</td>
<td>42%</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>100%</td>
<td>67</td>
<td>100%</td>
</tr>
</tbody>
</table>


Continued from page 4

Age. The age of the participants in this study, however, was comparable to age ranges reported in similar studies. Two-thirds of the participants in this study were under 25 years of age; this group also composed the highest percentage enrolled in the hybrid (72%) and the traditional, lecture-based format (65%), compared to only 48% of students in the distance learning format. Consistent with these results, Diaz and Carnal (1999) found that most students enrolled in distance learning courses/programs were older than the traditional-aged college student.

Learning styles. The collaborative and participant learning styles were the predominant learning styles among students in the research group as a whole and in each of the three instructional delivery formats. This distribution is consistent with the learning styles among college students found in a national sample. Grasha (1996) analyzed the distribution of learning styles of pre-med students and found that “the students displayed relatively higher scores on the independent, collaborative, dependent, and participant styles and relatively lower scores on the avoidant and competitive styles” (p. 174).

Table 3
Main Effect Variables as Predictors of Completion Status

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Completion Status</th>
<th>Odds Ratio</th>
<th>95% CI (Odds Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>Hybrid</td>
<td>Noncomplete</td>
<td>2.54</td>
<td>1.13</td>
</tr>
<tr>
<td>Distance</td>
<td>Noncomplete</td>
<td>2.83</td>
<td>1.16</td>
</tr>
<tr>
<td>Learning Style</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidant</td>
<td>Noncomplete</td>
<td>2.16</td>
<td>0.63</td>
</tr>
<tr>
<td>Competitive</td>
<td>Noncomplete</td>
<td>1.30</td>
<td>0.40</td>
</tr>
<tr>
<td>Dependent</td>
<td>Noncomplete</td>
<td>0.74</td>
<td>0.21</td>
</tr>
<tr>
<td>Independent</td>
<td>Noncomplete</td>
<td>0.68</td>
<td>0.24</td>
</tr>
<tr>
<td>Participant</td>
<td>Noncomplete</td>
<td>0.46</td>
<td>0.19</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Noncomplete</td>
<td>0.62</td>
<td>0.30</td>
</tr>
<tr>
<td>Gender</td>
<td>Noncomplete</td>
<td>1.31</td>
<td>0.65</td>
</tr>
<tr>
<td>Age</td>
<td>Noncomplete</td>
<td>0.70</td>
<td>0.33</td>
</tr>
</tbody>
</table>


Table 4
Student Reasons for Choosing Format as Predictors of Completion Status (N=192)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Completion Status</th>
<th>Odds Ratio</th>
<th>95% CI (Odds Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>Hybrid</td>
<td>Noncomplete</td>
<td>4.55</td>
<td>1.90</td>
</tr>
<tr>
<td>Distance</td>
<td>Noncomplete</td>
<td>8.15</td>
<td>2.68</td>
</tr>
<tr>
<td>Personal Factors</td>
<td>Noncomplete</td>
<td>0.59</td>
<td>0.35</td>
</tr>
<tr>
<td>Learning Needs</td>
<td>Noncomplete</td>
<td>1.79</td>
<td>1.24</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Noncomplete</td>
<td>0.70</td>
<td>0.34</td>
</tr>
<tr>
<td>Age</td>
<td>Noncomplete</td>
<td>0.66</td>
<td>0.31</td>
</tr>
<tr>
<td>Gender</td>
<td>Noncomplete</td>
<td>1.25</td>
<td>0.61</td>
</tr>
</tbody>
</table>


Learning Styles and Course Completion Rates
We examined study data to determine whether there was a relationship between students’ learning styles and their completion or withdrawal from a developmental math course by a particular instructional delivery format (i.e., lecture-based, hybrid, or distance learning). Based on the sample size of this study and controlling for delivery format, the results indicated that learning style did not appear to impact the completion or withdrawal of students enrolled in the course (see Table 3).

Reasons for Choosing an Instructional Format and Course Completion Rates
Personal factors (i.e., whether the course was offered at a convenient time) and learning needs (i.e., as whether the student perceived online courses to be easy) were statistically significant in predicting withdrawal from the course when controlling for delivery method, age, ethnicity, marital status, and gender (see Table 4). Specifically, students who enrolled in a course because it met their personal needs had greater odds of completing the course. In contrast, students who...
enrolled in a course based upon their perceived need for face-to-face instruction versus online access to either the instructor or their peers were more likely to withdraw from the course.

Placement Scores and Course Completion Rates
Research question three asked “Is there a relationship between students’ College Placement Test (CPT) mathematics score and their completion or withdrawal from a particular instructional delivery format (i.e., lecture-based, hybrid, or distance learning) of a developmental math course?” Students who enrolled in either the hybrid or distance learning formats had greater odds of withdrawing from the course compared to students enrolled in a lecture-based format regardless of their placement test scores. CPT scores appeared to have no relationship with completion status of the course while controlling for delivery method.

Discussion
The results from this study revealed three major findings: (a) Students enrolled in either a distance learning or hybrid developmental mathematics course were twice as likely to withdraw from the course as those who enrolled in a lecture-based course; (b) students who enrolled in a hybrid, distance, or lecture-based developmental mathematics course for personal reasons were more likely to complete the course as compared to those who enrolled based on their perceived learning needs; and (c) student learning styles and CPT scores did not seem to affect their completion status in a developmental mathematics course delivered via any of the three instructional formats.

Instructional Format and Completion Rates
The results revealed that the instructional format involving the computer-based section negatively affected the retention rate within the course. Other research findings also have shown a higher dropout rate for students using computer-based instruction compared to those students taking courses or programs delivered in a traditional lecture-based format (Carr, 2000; Diaz, 2002; Kaplan 2004; Phipps & Merisotis, 1999; Parker, 2003; Searcy & Others, 1993).

Choosing an Instructional Format and Completion Rates
The results of the analysis further suggest that while controlling for delivery method, age, ethnicity, and gender, students who enrolled in the course because it met their personal needs were more likely to persist in the course. In contrast, those students who enrolled in a course based upon their perceived need for face-to-face instruction versus online access to either instructor or their peers were more likely to withdraw from the course. The results show a statistically significant difference in the prediction of withdrawal in the course based on students’ reasons for selecting a particular delivery format. An examination of students’ reasons for withdrawal from the course provides insight: Although only a small number of students shared their reasons, 55% (11/20) of the students who withdrew from the computer-based sections did so because this mode of instruction presented challenges that they did not anticipate. For example, a student wrote, “This proved to be much harder than I thought,” and another student wrote, “Learning math online was a problem . . . it was a mistake signing [sic] up for an online math class.” Students enrolled in the developmental course may have perceived the computer-based instruction to be less challenging than that of a traditional lecture-based course. Specifically, students may have believed that the course material delivered via computer would be more comprehensible than that same material delivered in a classroom setting. Students may also have perceived computer-based instruction to be less time-consuming than that of traditional courses.

Another challenge students reported experiencing in their computer-based sections was the lack of available tutorial services. Although students were informed during their mandatory orientation session that tutoring was available, the instructor who taught the distance learning courses reported students rarely utilized posted office hours, even when encouraged to make appointments during or outside posted hours. The instructor also stated that the distance learning students came on campus to access the computers in the lab but did not seek tutoring.

Participants’ Learning Styles, CPT Scores, and Completion Rates
The study found that student learning style and CPT score do not appear to impact the retention rate within the course. It must be noted however, that some of the values may be too small to be reliable (see Table 3, p. 6), which could impact the results. Another possible explanation of why learning styles do not appear to influence course withdrawal or completion rates may be attributed to the nature of the learning styles. Hruska-Riehmann and Grasha (1982) state that every student will have some combination of each of the six styles and that no one person will prefer one style exclusively. Although the researcher was able to identify a dominant learning style for each of the participants, the interaction of the other five learning styles that each person possesses may have played a confounding role in the study.

Implications for Practice and Future Research
The results of this study suggest a number of recommendations for practice and for research. Arguably, the most important recommendation has to do with student retention. A major finding of this study is that students enrolled in a developmental mathematics course taught in a computer-based format had a higher dropout rate than students enrolled in a traditional lecture-based course. Postsecondary institutions are affected by student attrition because state funding is often based, at least in part, on individual college retention rates. Another financial implication is the number of dollars spent on recruitment of students into the college. Persistence in college has a direct impact on students as well, and studies have shown that students who have successfully completed a developmental program are as successful in college-level work as those who entered the institution academically prepared (Young, 2002).

More importantly, the mission of the U.S. community college is to provide open access to higher education for students who hold a high school diploma or equivalent or who have the ability to benefit from a postsecondary education. Technology has made it possible to provide access to an even greater number of students. If a large number of students who are enrolled in computer-based developmental instruction are not completing their courses, however, then the goal of increasing access is not being attained.

Regarding the impact of students’ reasons for enrolling in a particular delivery format and their completion of the course, the results of this study revealed that students who enrolled in the course based on personal factors and/or direct experiences with computer-based instruction and technology were more likely to complete the course as opposed to those students who enrolled because of their perceived need for
face-to-face versus online interaction between the instructors and/or their peers. This finding suggests that students who are enrolled in developmental courses may not be cognizant of their particular learning needs or have misconceptions of computer-based instruction. They may believe that learning online is easy or less time-consuming than “regular” classes, only to discover that, at least for them, this is not the case.

In an effort to improve the retention rate within computer-based courses and programs including distance learning, an increase in two-way communication between the institution and the student is recommended. This recommendation is a direct result of the second major finding of this study, which showed that students who withdrew from computer-based sections of developmental math course had misconceptions of both their learning needs and what was expected when enrolling in a computer-based course. More specifically, results also suggest that students need to be aware of the particular demands of online and Web-enhanced learning delivery systems, whether their particular reason for selecting a delivery format bodes well for their success in these courses, and what resources they can use to enhance their understanding of Web-based course content. Colleges might consider establishing an informational Web site that students are required to access prior to enrolling in computer-based courses which outlines expectations for and characteristics of successful students in such courses.

Garrison and Shale (as cited in Garrison, 1993) expanded the notion of quality within distance education by arguing that an increase in two-way communication is the most important component in the education process. A well-designed computer-based course or program is the result of expertise in the areas of academics, course/curriculum design, and production of media materials. This implies that, in order to have an effective distance education program, an institution should have a dedicated department to meet the special needs and challenges associated with computer-based instruction and teaching at a distance. The department would then be responsible for communicating information to students who wish to enroll in computer-based instruction as well as provide the necessary expertise to address the unique problems and/or unanticipated events that may arise with computer-based courses and programs.

The finding that students who enrolled in the developmental course based on personal factors including previous experience with computer-based instruction and/or technology—either positive or negative—had greater odds of completing the course further implies that there is a need for choice in instructional format to meet students’ needs. The study revealed that 55% of those students who withdrew from their computer-based sections did so due to unexpected challenges. As discussed earlier, these results may indicate that students lack an understanding of what is expected in a computer-based course/program or that the institution is not effectively communicating to students what is required to be successful in a computer-based course/program. These misconceptions may result from the disparity between characteristics of a typical student enrolled in a developmental course and the characteristics of a successful distance learner. Training workshops for students with limited or no previous experience with computer-based courses, offered by the college prior to beginning such a course, might be another way to assist students’ enrollment decisions and success.

An area for which it was difficult to collect information but may prove beneficial to future researchers is student reasons for withdrawal from computer-based instruction. A consistent procedure for the accurate collection of reasons for student withdrawal from a course may provide invaluable information to the institution and data for future research. Information regarding students’ impetus for withdrawing from a particular instructional delivery format, systematically tracked and recorded, may help guide educators interested in the area of retention.

Another possible explanation of why students reported the computer-based sections to present unexpected challenges is in the area of time management. Students who have outside responsibilities may enroll in computer-based instruction with the perception that it will allow them more time to attend to their other responsibilities than if they enrolled in a traditional lecture-based course. It could be beneficial to conduct exit surveys or focus groups with students who have withdrawn from a computer-based course to gain a better understanding of their perceptions of computer-based instruction as well as their reasons for withdrawal from the course in order to gain a deeper understanding of retention in general and particularly in computer-based instruction.

Although study findings do not indicate a relationship between students’ learning style and retention in various course delivery formats, some affective characteristics of students may be related to reasons for choosing computer-based instruction. Clearly, no one medium can meet the expectations and needs of every student. Distance learning theorists suggest that a well-designed computer-based course or program is one that “delivers information in various forms, suited to various learning styles, and gives the greatest range of alternative communication modes” (Moore, 1989, p. 9).

In terms of students’ ability to assess their capabilities, students in developmental courses are often uncertain about their goals and demonstrate low self-efficacy toward academic tasks (Saxon & Boylan, 1999). Perin and Greenberg (1994) suggest that issues related to goal attainment and motivation affect persistence for students enrolled in adult basic education as students “realize that academic demands are higher than expected and that specific educational steps (e.g., college-level study) needed for career advancement may be difficult to achieve” (p. 185). These characteristics are in opposition to the characteristics of successful distance learners who have been found to have a high tolerance for ambiguity and a need for autonomy and flexibility (Valentine, 2002).

Another recommendation for practice concerns the area of computer-based instruction and access to tutorial services and/or utilization of instructor office hours and its impact on success and retention. The fact that distance learning students came to campus to access computers but did not access tutoring may imply that, although help was available and accessible, students did not perceive they needed help beyond the course materials they had to access. The implication is that students may not understand the importance of combining tutoring with their computer-based instructional materials. The effectiveness of tutoring alone and in combination with computer-based instruction and its effect on retention is supported in the literature. Students who receive both tutoring and computer-based instruction have significantly higher retention rates than those who receive computer-based instruction alone (Kaplan, 2004). Therefore, the importance of receiving tutoring for students enrolled in computer-based instruction for developmental courses should be communicated early and often throughout the semester. In addition, institutions might consider implementing mandatory or optional on-
line tutoring for students enrolled in hybrid or distance courses.

Although student CPT scores did not appear to affect retention within the course, there was a statistically significant negative correlation between age and CPT score. The issue of how much time had elapsed since a student's interaction with math may explain this association. The average age of the community college student in this study was 25.9 years. It had been several years since most students had taken a mathematics course, which may have negatively affected their CPT score. However, once a student enrolls in the course, the concepts and ideas are refreshed, and the student often continues to successfully complete the course. In another scenario, a student may take the CPT the semester following high school and perform well on the test. However, many semesters may pass before he or she takes the required mathematics course. The student may then struggle to relearn math concepts and ideas, negatively affecting his or her ability to complete the course.

Further research should also be conducted to track the subsequent enrollment status of those students who withdrew from a computer-based course to ascertain whether they re-enroll the next semester in the same instructional delivery format, a different instructional delivery format, or dropout of college completely.

If colleges implement the preceding recommendations and examine the viability of their computer-based courses and programs, they may be better able to project the number of sections of hybrid and distance learning courses that should be offered each semester, especially in developmental education. This practice may help the overall retention rate while still maintaining a choice in instructional delivery formats to meet students' needs.

Conclusion

Student retention in general, and within developmental programs in particular, is an important issue for institutions of higher education. A large number of students enrolling in college require at least one developmental math course. It is important for both the student and the institution that these students complete and successfully pass their developmental courses in a timely manner.

The high dropout rate within computer-based instruction implies that computer-based instruction is not a panacea for teaching and/or learning in a developmental mathematics course. Computer-based instruction can be a viable educational alternative for some students, as shown in this study. However, this study also has found that the withdrawal rate was double for those students enrolled in a computer-based format compared to those students enrolled in a traditional lecture-based format of a developmental mathematics course, with more than half withdrawing because the course presented challenges they did not expect. Students may not fully understand what it takes to learn mathematics in a computer-based format.

Before institutions spend additional time and money increasing their distance learning offerings or developing new computer-based programs for developmental mathematics, institutions should increase the communication between themselves and their students to gain a better understanding of their issues and concerns. Armed with accurate information about students’ needs in computer-based developmental courses, educators can better address the issues that interfere with success and retention in computer-based developmental courses.

Institutions should increase the communication between themselves and their students to gain a better understanding of their issues and concerns.

References


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