Developmental Theory: Application in a Developmental Mathematics Program

By D. Patrick Kinney

ABSTRACT: Wambach, Brothen, and Dikel (2000) have proposed a developmental theory for developmental educators that unites three basic concepts: self-regulation, demandingness, and responsiveness. These concepts have been applied to a developmental mathematics program that offers computer-mediated and lecture courses in order to evaluate the program. Explicit examples are provided to illustrate the concepts in this theory. If this theory is useful, according to Denzin (1970), it should perform the following functions: (a) permit organization of descriptions, (b) lead to explanations, and (c) furnish the basis for prediction of future events. The research described in this article was conducted at the General College of the University of Minnesota.

Selecting theory to guide practice has not been a simple matter for developmental educators. Collins and Bruch (2000) observed that there are dozens of theoretical perspectives that can contribute to the informed practice of developmental education including those from adult education, disabilities studies, learning theories, multicultural education, student development theory, and vocational education.

The purpose in applying a developmental theory to the practice of postsecondary mathematics instruction is to move beyond remedial education to developmental education. The term "remedial" is the most common term used to describe classes or courses that address student weaknesses or deficiencies, and it frequently carries a highly negative connotation and implies a "fixing" or "correction" of a deficit (Casazza, 1999, p. 4). Thus, students in developmental mathematics are often viewed through the lens of the deficit model (Lundell & Collins, 1999). That is, they are enrolled in these courses because they have a deficit in their mathematical knowledge that must be rectified before they are prepared for credit-bearing college level mathematics courses. A developmental education approach, on the other hand, "is a comprehensive process focusing on the intellectual, social, and emotional growth and development of all learners" (Casazza, 1999, p. 4).

Students arrive at postsecondary institutions with deficits in mathematics for a variety of reasons including: (a) They did not take the relevant courses in high school, (b) they took the relevant courses but did not master the content, and (c) they have forgotten much of the content that they once had mastered. Although knowledge related to students' deficits in mathematics might guide decisions about course content and placement, it does not inform the teaching process. Pedagogy in developmental mathematics must be informed by theory and research that specifically addresses the learning process.

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This article examines a developmental theory for developmental educators proposed by Wambach, Brothen, and Dikel (2000). This theory unites three basic concepts–self-regulation, demandingness, and responsiveness–and "uses these concepts to organize, explain, and predict useful techniques for practitioners" (p. 2). The theory's concepts were applied to an existing set of developmental mathematics courses in order to evaluate the program. If this theory is useful it should perform the following functions: (a) permit organization of descriptions, (b) lead to explanations, and (c) furnish the basis for prediction of future events (Denzin, 1970). In the discussion section of this paper, these criteria provide a framework for considering the usefulness of this theory to developmental mathematics educators.

Brief Overview of Theory

The theory proposed by Wambach et al. (2000) supports the position that the development of self-regulation should be the goal of developmental education. Self-regulation is defined as self-generated thoughts, feelings, and actions that are directed toward the attainment of one's educational goals (Zimmerman, Bonner, & Kovach, 1996). To support their position, the theory's authors note:

> In a recent review of research on instruction for at-risk students, Stahl, Simpson, and Hayes (1992) set an agenda for teaching developmental students. Central to their agenda is the idea that instructors should strive to help developmental students become independent learners: students who are autonomous, self-regulated, and good strategists (Zimmerman, 1989). (Wambach et al., 2000, p.3)

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Wambach et al. (2000) state that their theory is consistent with the findings of Zimmerman (1989) regarding the development of self-regulation. Further, based on this evidence they predict that students who are self-regulating will be able to adequately identify areas where their skills must improve and seek the means to improve them. They will seek feedback on their performance, monitor their grades, accurately predict their level of skill in mathematics, and use learning support systems when helpful. They will also be aware of institutional rules and the requirements of desired programs, use information about placement tests to select appropriate courses, and make and keep appointments with advisors. These students will acquire the specific skills needed to reach their academic goals. In short, the students will take responsibility for their own learning and other matters related to their academic success.

Wambach et al. (2000) argue that self-regulation develops in social environments that can be described as demanding and responsive (Baumrind, 1967, 1971; Eibl-Eibesfeldt, 1989; Vygotsky as cited in Tappan, 1998). They draw the concepts of demandingness and responsiveness from developmental psychology particularly as it relates to parental behavior. Wambach et al. (2000) note that a factor analyses of parental behavior produces the dimensions of demandingness and responsiveness (Baumrind, 1991). Demandingness, in the context of developmental education, is performance expectations communicated to the students. It includes the difficulty of the course content and conditions under which content mastery is demonstrated. Demandingness, in the context of a developmental mathematics class, is typically operationalized by requiring students to attend each class session, complete assignments on schedule, prepare to participate and contribute in each class, and make use of resources such as the mathematics tutoring center when needed.

Responsiveness is the provision of opportunities for feedback. Responsive environments provide feedback that is timely, personal and explicit, and designed to guide the students' efforts toward mastery. Responsive instructors foster successful student outcomes and self-regulation by being attuned and supportive and by promoting the development of the student as a learner. Feedback is delivered to students when an instructor provides assessment opportunities, works with them in class or during office hours, and includes useful written comments when grading assignments.

Wambach et al. (2000) also argue that their theory is consistent with Keller's (1968) instructional model called the Personalized System of Instruction (PSI). A substantial amount of research supports the validity of this instructional approach (Kulik, Kulik, & Bangert-Drowns, 1990), which demands that students must study material and take tests on the material until they are able to demonstrate mastery. PSI provides students with a responsive environment because students receive individual or group help as needed before moving on to the next unit. Finally, Wambach et al. (2000) describe how the use of PSI in their introductory psychology course has "enabled students to take control of their own learning, develop a sense of self-efficacy, acquire good study habits and skills, and persist until successful" (p. 10). This theory draws upon existing research and provides a framework that describes how the concepts of self-regulation, demandingness, and responsiveness can be united to enhance student outcomes in developmental education.

Developmental Mathematics Program

The developmental mathematics program discussed is housed in a college that operates

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under the following mission: to develop in at-risk, underprepared college students the educational skills, knowledge foundation, and disposition for continued learning that will permit them to transfer to degree-granting colleges and to pursue degree programs with a reasonable probability of success. About 900 developmental students are admitted annually, and most transfer to a degree-granting college at the university in about a year and a half. The developmental mathematics program offers primarily noncredit bearing introductory and intermediate algebra courses. Each course is offered through two different formats (a) computer-mediated instruction and (b) lecture.

In the computer-mediated courses, the instruction is delivered primarily through interactive multimedia software from Academic Systems Corporation (2000). The software explains the concepts and skills, incorporates problems and questions for students to attempt, and provides detailed feedback to guide students' learning. During class the instructor–who does not lecture–and teaching assistant move about the room to ensure that students are able to receive individual assistance upon request. Students are able to work at their own pace in class but are expected to complete homework assignments and take exams according to a set schedule. This instructional approach is similar to PSI in that the material is divided into short units and students move through the instructional material at their own pace during class; however, a mastery approach is not used.

In the lecture courses, the instructor presents and discusses the content, provides opportunities for students to work collaboratively, and provides feedback to students as they work on activities. These students are also expected to complete assignments and take exams according to a set schedule.

A mathematics placement exam, written by the mathematics faculty, is used to provide students with a recommendation for the course level–introductory, intermediate, or college algebra–in which the student should initially enroll. Students also take an institutionally developed inventory containing items related to computer-mediated and lecture learning environments to assist them in selecting the course format—lecture or computer-mediated—that will best meet their learning preferences. Each year approximately 12 sections of Introductory Algebra and 24 sections of Intermediate Algebra are offered. These courses enroll approximately 1,000 students. To meet the needs of students who place into arithmetic and those who prefer more time to learn elementary algebra concepts, the program also offers three sections of Introductory Algebra Part I and Part II. This sequence splits the regular Introductory Algebra course into a 2-semester sequence and includes topics from arithmetic such as operations with signed numbers, order of operations, and operations with fractions. In each course, class sizes are typically 25 to 35 students. After completing Intermediate Algebra most students enroll in college algebra, precalculus, or introductory statistics.

Application of Theoretical Constructs

The theory focuses on three basic concepts: self-regulation, demandingness, and responsiveness. To develop the first of these constructs, self-regulation, Wambach et al. (2000) advocate placing students in developmental education environments that are demanding and responsive. Therefore, the developmental mathematics program has been evaluated by determining the extent to which demandingness and responsiveness are present in the program. These two constructs–and their possible contributions to the development of self-regulation–are examined.

Demandingness

Wambach et al. (2000) discuss three characteristics of demandingness in a developmental education setting.

1: Standards for excellence and expectations for appropriate behavior are clearly stated and enforced. The program provides all students with syllabi and assignment sheets on the first day of class that detail the course expectations, procedures, assignments, due dates, evaluation measures, and expectations for behavior. Homework assignments require that the necessary work be shown using paper and pencil. We do not accept late homework or give make up quizzes or exams but do drop two homework assignments and the lowest quiz and exam scores to allow for extenuating circumstances. This approach has been designed to ensure students take responsibility for completing the required amount of work on schedule.

To investigate the students' perspective regarding our demandingness related to homework, 30 students who participated in focus groups were asked, "Should we continue to collect and grade homework like we've been doing?" All 30 students marked "yes" for their written response. When asked to explain, students responded with comments such as "It keeps people on track," "Because kids wouldn't do it otherwise," and "Helps you prepare for tests and quizzes." This evidence suggests that the students are aware that they benefit from the demandingness of the requirement to complete homework by a scheduled due date.

Demandingness also stems from the college having a strong developmental education focus. All courses, including mathematics, are structured to place demands on students that promote acquiring the skills and attitudes necessary to be successful in future courses and in the pursuit of academic, career, and life goals. To ensure that students are aware of their progress in reaching academic goals during the semester, students and their advisors receive progress reports after the 6th and 10th weeks of the semester. In the event that a student is not meeting the demands of a course at any time during the semester, an academic alert is sent to the student and their advisor with the goal of assisting the student in overcoming any challenges standing in the way of academic success.

2: Skills courses are challenging and clearly connected to the entire curriculum. The courses offered are challenging; we attempt to teach the necessary content and skills required for the next course and to reach goals set by the National Association of Developmental Education (NADE, 1995) and the American Mathematical Association of Two-Year Colleges (AMATYC, 1995). We seek to develop in students the skills and attitudes necessary for the attainment of academic, career, and life goals as described by NADE by demanding that students attend class, complete assignments on schedule, develop the necessary study skills to be well prepared for exams, and make use of available resources as necessary. Students are challenged to meet the AMATYC standards in part through "activity days" that require students to work in groups on activities designed to promote the AMATYC standards. The activities employ daily checkpoint questions worked in pairs and a curriculum that seeks to develop conceptual understanding in addition to procedural knowledge. The content is clearly connected to the rest of the curriculum in part because we annually review the syllabi, assignments, and textbooks used by the mathematics department to align our curriculum so that it includes the necessary preparation for subsequent courses.

3: Content competence is demonstrated by required reading, writing, and computations. Collectively, these demands require that students be "active" in their learning. Meyers and Jones (1993) state that active learning "involves providing opportunities for students to meaningfully talk and listen, write, read, and reflect on the content, ideas, issues, and concerns of an academic subject"(p. 6). Active learning echoes the AMATYC (1995) standards for the intellectual development of students. These standards include students: (a) acquiring the ability to read, write, listen to, and speak mathematics; (b) expanding their mathematical reasoning skills as they develop convincing mathematical arguments; (c) engaging in rich experiences that encourage independent, nontrivial exploration in mathematics ...; and (d) learning mathematics through modeling real-world situations.

Intervention is meant to be a proactive measure that addresses issues and concerns early and in a positive manner to promote student success.

Through focus groups we have found that students in computer-mediated courses value being active learners and having control over their learning. Because these students are given control over their learning, they must actively engage in reading, writing, reflection, and discussion of mathematics to learn the mathematics. Promoting active learning is a greater challenge in the lecture classes. However, through collaborative learning activities and the daily checkpoint question–a single item related to a recently covered concept or skill on which students work together–students in lecture classes also have opportunities to engage in active learning during the class.

Responsiveness

Wambach et al. (2000, p. 8) discuss four characteristics of responsiveness in a developmental education setting.

1: Responsiveness is exhibited by delivering timely and useful feedback. Feedback is delivered to students when an instructor works with them in class or during office hours and when they include useful written comments when grading assignments. It is also furnished through the software in the computer-mediated courses and by tutors in the mathematics tutoring center. In addition, feedback is provided to students and their advisors through detailed progress reports at the end of the 6th and 10th weeks of the semester. These reports ensure that students and advisors are clearly aware of the student's progress and lead to intervention by the advisor in cases where it may benefit the student. Instructors may also send academic alerts to the student and advisor at any time during the semester when the instructor feels that intervention by the advisor may be in the student's best interest. Intervention is meant to be a proactive measure that addresses issues and concerns early and in a positive manner to promote student success.

Feedback is delivered to students in the computer-mediated classes as they interact with the software. As the software presents and explains new concepts using interactive multimedia, it embeds items into the instruction that require interaction on the part of the student. For example, after explaining the concept of slope, the software will pose several questions related to slope that require input from the student. Students typically use paper and pencil to determine an answer to the question posed, then select the answer on the computer that they believe is correct. If their initial response is incorrect, they receive feedback that "points them in the right direction" but not a detailed step by step solution. With this feedback they can review their work and reattempt the item. After attempting the item a second time students are informed if they are correct or incorrect and provided with a detailed step by step explanation. Feedback of this type is consistent with Kluger and DeNisis' (1996) recommendation that feedback be (a) specific to the task, (b) corrective, and (c) done in a familiar context that shapes learning.

In the computer-mediated classes, students frequently receive feedback on their work from classmates with whom they work informally. Students also have opportunities to obtain feedback from the instructional staff throughout each class period. Students are required to attend regularly scheduled classes, in part so that the instructional staff may provide assistance

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with the mathematics but also so that feedback about progress can be given directly to the student. The software management system records the amount of time that each student works on each section along with the percentage of the work that they have completed correctly, thus enabling the instructor to quickly identify those students most in need of assistance and feedback about their progress.

2: Responsiveness is exhibited when the development of self-regulation is intentionally fostered. Wambach et al. (2000) state: "developmental students should be encouraged to record their progress and identify strategies for improving their performance"(p. 8). These are important steps in the cyclic model for developing self-regulation described by Zimmerman, Bonner, and Kovach (1996). Their model involves four interrelated processes: (a) self-evaluation and monitoring, (b) goal setting and strategic planning, (c) strategy implementation and monitoring, and (d) strategic outcome monitoring.

In our developmental mathematics program the first step of the cycle, self-evaluation and monitoring, is promoted by having students record all of their scores on a grade record form. By monitoring and evaluating their own progress students are encouraged to engage in the second part of the cycle, goal setting and strategic planning. For example, a student who does not successfully complete homework may set a goal of working with a tutor in the mathematics tutoring center at regularly scheduled times, whereas a student in a computer course who does not complete the online quizzes on schedule may set a goal of using open lab times 2 hours per week in addition to attending class. Instructors and advisors often assist students in setting goals and developing strategic plans when they recognize that it can benefit the student.

The third step of the cycle, strategy implementation and monitoring, occurs when the student actually works in the mathematics tutoring center on homework assignments or uses open lab times to complete online quizzes and monitors such attempts to improve personal learning. The fourth step in the cycle, strategic outcome monitoring, occurs when the student focuses attention on the effectiveness of the strategic processes used and subsequent learning outcomes. If a particular strategy has worked well the student may continue to use it, but if a strategy did not work well the student should consider a different strategy. Instructors, and advisors when intervention is requested, facilitate this process by discussing with students appropriate strategies, monitoring student progress, and discussing with students the usefulness of the strategies that they are employing.

3: Responsiveness is exhibited when a wide variety of learners are accommodated. Students may select to study mathematics in a computer-mediated or lecture course. By offering courses through both formats, we are better able to meet the learning style preferences of a diverse group of learners. This is important since there is evidence that instruction that allows students to learn using their preferred learning style can lead to improved student outcomes (Higbee, Ginter, & Taylor, 1991; Lemire, 1998).

In response to a written questionnaire, students enrolled in computer-mediated classes indicated that they preferred to learn in a mode other than lecture and that they wanted control over their own learning. To these students, interactive multimedia software was suited to their learning preferences because it: (a) allowed them to control the pace of the presentation of the content so that they had sufficient time to process the information; (b) embedded frequent items requiring interaction, which they found much more engaging than typical lecture classes; (c) provided immediate and detailed feedback; and (d) presented material with multimedia, which was much more engaging than a chalkboard. Students in lecture classes responded to the questionnaire by indicating that they preferred lecture because (a) they preferred to have an instructor explain the material and to be able to ask questions as the instructor presented, (b) they valued being able to hear the discussions that took place between the instructor and other students, (c) they felt there were more opportunities to work with classmates in a lecture class than in a computer-mediated class, and (d) they simply were not interested in learning math using a computer. Approximately one-third of the students were enrolled in computer-mediated courses.

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Students who are registered with Disability Services receive appropriate accommodations to support their learning. Students also have the choice of enrolling in regularly scheduled day courses or through distance education. Our developmental mathematics students are encouraged to register for regular day courses whereas nontraditional students who cannot attend classes during the day generally enroll in our distance education courses.

4: Responsiveness is exhibited when the program staff gets to know the learners as individuals. Wambach et al. (2000) advocate developmental education classes that are "small enough to allow students and instructors to come to know one another" (p. 8). Even though our classes typically enroll 25 to 35 students, instructors generally get to know their students as learners fairly quickly. Instructors get to know their students by teaching their courses in a manner that fosters discussion and interaction with the students, by encouraging students to use office hours, by providing frequent feedback, and by closely monitoring students' progress. In the lecture courses the instructors frequently have students work in groups which allows the instructor to move about the room and interact with students. In the computer-mediated courses the instructor is available to work with students individually or in small groups the entire class period because they do not lecture.

Discussion

If the developmental theory by Wambach et al. (2000) is useful for guiding decisions in the developmental mathematics program, it should perform the three functions described by Denzin (1970): Does the theory permit organization of descriptions, lead to explanations, and furnish the basis for prediction of future events?

Organization of Descriptions

If the theory is useful, it should provide a mechanism to organize the descriptions of the computer-mediated and lecture courses. The Wambach et al. (2000) developmental theory's three basic constructs provide such a mechanism. The discussion begins by acknowledging that the two course formats share a number of identical attributes. In both formats, expectations are communicated to students through syllabi and assignment sheets that clearly state the course's high expectations, challenging assignments, and significant standards on the first day of class. Also, students are expected to attend each class and complete paper and pencil homework assignments, quizzes, and exams on scheduled dates. If a student does not meet these expectations, the instructor will work with the student to address the concerns and may request intervention from the student's advisor. Demandingness exists in both formats as a result of these expectations.

Responsiveness also exists in both course formats because students receive feedback through interactions with the instructor in class and during office hours, written comments on

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assignments, tutors in the mathematics tutoring center, and advisors. Midterm progress reports and academic alerts are used to provide feedback to students and advisors and lead to intervention when it can benefit the student. Also, in both formats the program attempts to develop self-regulation in students by incorporating the model for developing self-regulation described by Zimmerman, Bonner, and Kovach (1996).

The theory's guiding concepts should also provide a means to organize descriptions that are not common to both formats. In a lecture course the instructor may present and discuss a new concept, expecting students to take proper notes and ask any questions that they may have. The instructor may then ask students to work in groups on a challenging activity that draws upon the material just covered and promotes one of the AMATYC standards. Demandingness exists because students are expected to take proper notes, ask questions, and work with other students to meet a standard of excellence for performance on the activity. In a computer-based course the instructor may be working with one student individually while other students are engaged in using the software or working together. This course is also demanding because the students working independently are required to read, write, compute, and demonstrate competence as they learn mathematics using the software.

The most notable difference in responsiveness between the two formats is that in the computer-mediated courses the instructor is able to work with students individually or in small groups throughout the entire class. This allows the instructor considerably more time than in a lecture course to provide timely and useful feedback, assist students in developing and monitoring strategies for developing self-regulation, and getting to know the students as learners. After examining the computer-mediated and lecture courses, it appears that the theoretical construct provides a means to organize the descriptions of these courses, that is, what happens in the courses and how they are structured, even though on the surface these courses appear very different.

Explanation

Wambach et al. (2000) argue that self-regulation develops in demanding and responsive environments. This element of the researchers' theory can be applied to explain student behavior. In the context of the developmental mathematics program, students who are self-regulating will: (a) record their scores and monitor their grade; (b) set goals of completing assignments on schedule, being prepared for exams, and determining a strategy to meet these goals; (c) implement their strategy and monitor their attempts to reach their goals; and (d) determine the effectiveness of their strategy and consider a different strategy if needed. In both the computer-mediated and lecture classes instructors–and advisors when intervention is requested–work with students to develop self-regulation using this approach. Certainly not all students develop the desired self-regulation. However, there is evidence—as demonstrated through interactions with students and actual student performance—that at least some students do.

The clearest example of the development of self-regulation occurred when, in the middle of the semester, students in two computer-mediated classes were allowed to attend class only 2 days per week rather than the scheduled 4 days per week. Most of the students were able to use the software where they lived, and all had access to open lab times on campus. Students in these courses continued to perform about the same when attending 2 days per week as when they attended 4 days per week.

Students in lecture courses were significantly more likely to withdraw than students in computer-mediated courses.

Through observations of and discussions with students throughout the remainder of the semester, students indicated that this arrangement worked well for them because during the first part of the semester the course structure kept them on track and they developed a sense of the workload and how to manage their time. During the second part of the semester they were able to continue to meet the course expectations because they understood the expectations, workload, available resources, and how to monitor their progress.

When students were asked if they thought that it was more important to have good study habits and time management skills in a computer-mediated class or a lecture class, most students responded by saying it was equally important in both formats. What they added, however, was interesting. Many of the students felt that they developed better study habits and time management skills while enrolled in the computer-mediated class than they would have in a lecture class because they were in control of their learning rather than the instructor.

Prediction of Future Events

When we developed the computer-mediated courses several years ago we had not yet read the theory by Wambach et al. (2000). We were aware, however, that computer-mediated instruction offered tremendous opportunities for "anywhere, anytime" learning and thus a radically different course design than our lecture courses. In the end, however, we closely examined our lecture course structure and drew upon features that promoted student success. We decided, for example, that (a) instructors should develop an assignment schedule with due dates, (b) students would be expected to attend each class even though many would have access to the software outside of class, (c) instructors would need frequent opportunities to assist students in their learning of the mathematics, (d) instructors would provide frequent feedback to students on their progress, and (e) instructors would assist students in developing strategies that promote self-regulation. The expectations that students complete homework assignments and attend class were supported by data showing a positive correlation between homework scores and grades ($R = 0.62$, $N = 710$) and between attendance and grades ($R = .54$, $N = 710$).

Looking back we recognized that we identified aspects of our lecture courses that placed demands on students and provided a responsive environment, then sought to incorporate those attributes into our computer-mediated courses. The expectation was that students enrolled in the computer-mediated classes would perform at least as well as those in the lecture classes. An examination of recent data showed that there was no significant difference on common final exams, completion rates, and pass rates in the computer-mediated and lecture courses. There was no significant difference on the common final exams in Introductory Algebra computer-mediated ($M = 70.12$, $SD = 14.57$) and lecture classes ($M = 70.82$, $SD = 16.61$), $t(233) = .30$, $p = .76$ or in the Intermediate Algebra computer-mediated ($M = 67.19$, $SD = 12.26$) and lecture classes ($M = 68.47$, $SD = 11.61$), $t(336) = 1.02$, $p = .31$. Pass rates revealed no significant differences: in Introductory Algebra, 81% of the computer-mediated and 78% of the lecture students passed with a grade of D or higher, $X^2(1, N = 235) = .24$, $p = .63$. In Intermediate Algebra, 88% of the computer-mediated and 90% of the lecture students passed the course with a grade of D or higher, $X^2(1, N = 338) = .58$, $p = .45$. The pass rate data excluded students who had officially withdrawn or received incompletes. The proportion of withdrawals revealed that students in lecture courses were significantly more likely to withdraw than students in computer-mediated courses according to a chi-square test, $X^2(1, N = 210) = 7.5$, $p < .01$. Data from the previous year found that an

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almost identical proportion (.07) of students withdrew from both computer-mediated and lecture classes.

The pass rates of developmental students who went on to take college algebra or precalculus were also examined. There was no significant difference in the pass rates of students in college algebra who took one or more developmental mathematics courses and those who tested directly into college algebra, X^2 (1, N = 1545) = 2.72, p = .10. Similarly, there was no significant difference in the pass rates in precalculus among students who tested directly into precalculus and those who took one or more developmental mathematics courses, X^2 (1, N = 837) = .12, p = .72. Developmental students who completed intermediate algebra with a C- or higher enrolled directly in precalculus. The lack of a significant difference in pass rates in college algebra and precalculus should be viewed positively because it demonstrates that students who complete developmental mathematics courses are just as capable of passing college algebra and precalculus as those who test directly into those courses.

Because all of the developmental mathematics classes are taught in a manner that is consistent with the Wambach et al. (2000) theory, it is not possible to compare students taught in this manner with a control group taught using a basic "remedial" approach that does not attempt to develop self-regulation nor provide a demanding and responsive learning environment. One possible group of students to contrast with the students discussed previously, however, are the students who enrolled in a correspondence version of the developmental mathematics classes.

Students in these courses use the same materials and assignments as students enrolled in regular day courses. Students are allowed to complete assignments and take exams as they wish. There are no demands placed on the students. The instructor grades assignments and exams as they are received and answers students' questions when asked. However, because there is no face-to-face contact and the instructor does not place frequent demands on the student, virtually no interaction takes place that can be described as "responsive." Also, because students who enroll in the correspondence version are expected to study independently, and there is no face-to-face contact, the instructor does not actively work to assist students in the development of self-regulation. During the past 2 years, 39 students enrolled in the Intermediate Algebra correspondence course. Twenty-six students never completed a single assignment, and only six students completed the course. The correspondence course is clearly void of the development of self-regulation, demandingness, and responsiveness and the outcomes are inferior to those in our regular day courses. Although there are differences in the students who enroll in the correspondence and regular day courses, along with other variables that make such a comparison difficult, the results suggest that the developmental theory by Wambach et al. (2000) is worth considering.

Looking forward, we plan to draw upon the theory by Wambach et al. (2000) as we place a computer-mediated version of our developmental mathematics courses online. Recognizing that distance education courses often have lower completion and retention rates than classes that meet face-to-face (Carr, 2000), we will attempt to incorporate the concepts of demandingness and responsiveness into our courses whenever possible. If this leads to successful outcomes, it will provide evidence that the theory by Wambach et al. (2000) is useful for predicting future outcomes.

The theory holds promise for predicting important design features in distance education courses.

Discussion Summary

The theory by Wambach et al. (2000) shows promise for performing the three functions that a theory should perform according to Denzin (1970). First, the theory provides a useful means for organizing the attributes of the computer-mediated and lecture courses. It also is useful for organizing other attributes of the General College that impact students' experiences in mathematics, such as the mathematics tutoring center and advising staff. Second, the theory by Wambach et al. (2000), when combined with the theory by Zimmerman, Bonner, and Kovach (1996), shows potential for explaining how we can develop self-regulation in our students. Finally, the theory holds promise for predicting important design features in our distance education courses.

Conclusion

When making decisions about how to achieve the goals articulated by NADE and AMATYC, developmental mathematics faculty have to make decisions about a broad range of questions. These include, "What is the best way to teach this topic?", "How will students be provided with feedback and evaluated?", and "Should we include more applications, group work, and problem solving?". Although the literature and experience may suggest a particular answer for each individual question, it is worthwhile to look towards a theory of developmental education to guide the overall direction and philosophy of a program. For the General College developmental mathematics program, the developmental theory proposed by Wambach et al. (2000) holds promise for providing direction in meeting the goals of NADE and AMATYC.

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NADE News: Project Update

By Carol O'Shea, NADE President

Things are moving at a fast clip within NADE! Let me share with you a few of the many projects NADE leadership has been pursuing.

NADE website. As I write this, the NADE website is getting a new look, a new structure, and a new home! If all goes well, the web address should remain the same, though. The new version of the NADE website should be on-line by late fall with some cool new features!

Database integration. NADE has long wished that members could join, renew, check their membership status, and update their contact information at the NADE website. As well, the Association would like to make some membership contact information available on-line to chapter, SPIN, and committee leaders on a restricted access basis. Incremental steps are being taken to make these and other database dreams come true. We'll keep you posted as new database features become active on the website.

Adjunct initiative. At its September Board meeting, the NADE Executive Board will be finalizing and approving the components of its new initiative to connect with adjuncts in developmental education. Realizing that most adjuncts do not have access to professional development funding that would enable them to attend a national conference, NADE will be reaching out to adjuncts in their institutions. Watch for more specific news on this initiative in the near future!

Membership survey. In the fall, members will be asked to complete a survey that will help NADE leaders identify the needs and expectations of the membership. Based on your responses, committees, SPINs, and other units within NADE will be better able to focus their resources and efforts on the services you, the membership, seek. At this point, the hope is to process the survey on-line. We'll notify you when the survey is available.

Future conferences. The stellar success of the Louisville conference (KADE made their goal and will receive a hefty rebate) has encouraged other NADE chapters to consider hosting the annual NADE conference in future years. If your chapter would like to learn more about hosting the NADE annual conference in a future year, please contact Dr. Karen Patty-Graham at **kpattyg@siue.edu** for information.

This much and so much more is happening in your association. It's an exciting time to be a professional developmental educator, and I thank you for the honor of serving you.

Developmental Education: Helping the underprepared prepare, the prepared advance, and the advanced excel!

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