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At Cross-Purposes with a Developmental Mathematics Course: Perceptions of Students on the Use of MyMathLab

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Abstract

This study examined student perceptions of web-based coursework in a developmental mathematics course. Researchers utilized qualitative and quantitative methods to analyze student responses regarding self-efficacy, content delivery options, and impact on mathematical understandings. Research indicates a positive perception of the impact on concept attainment with some reservations concerning content formatting.

The completion of an undergraduate college degree in the United States has become, for most people, a prerequisite for future personal and career success. As students of diverse backgrounds begin undergraduate coursework in ever-increasing numbers, colleges and universities must make efforts to meet the needs of a changing student population. With increased enrollment come students with varied preparation levels. Many of these students will require focused support to become successful college program graduates. According to the U.S. Department of Education's National Center for Education Statistics (NCES), more than one third of the nation's entering college freshmen will require remedial coursework to prepare them for college-level mathematics and English courses (NCES, 2003). As a result of an open admissions policy, Texas community colleges and state universities have a greater number of students requiring remedial courses than private colleges (THECB, 2002). Students entering with academic deficiencies are more likely to be underprepared in mathematics than in reading or English (NCES, 2003). The initial developmental mathematics courses, therefore, become the gatekeepers to success for a large and varied population of aspiring college-level learners (Trusty & Niles, 2003). Postsecondary institutions are moving quickly to identify and implement effective instructional models, strategies, and delivery systems to adequately address the needs of these underprepared students.

Purpose of the Study

The purpose of this qualitative study was to explore the perceptions of developmental mathematics students enrolled in an Intermediate Algebra course at a regional state university in northeast Texas regarding the use of the MyMathLab web-based homework program. The study followed a case study ethnographic approach to investigate the student experience with the web-mediated homework component of the course.

Overview

Policymakers at colleges and universities may differ concerning the appropriate components of an effective developmental mathematics program, but they do not debate its necessity. In 2003, the NCES reported that in the fall of 2000, 71% of postsecondary institutions offered remedial or developmental courses in mathematics. The improvement of mathematics education and student mathematics achievement has long been an area of concern in the United States. An increase in the number and rigor of high school mathematics courses required for graduation has effected positive change in some regions of the country, but many students still exit high school unprepared for college-level mathematics (Donovan & Wheland, 2008). As Adelman (2006) stated, the attrition rate doubles for students not completing college-level mathematics credit by the end of the second enrolled year. Although persistence through two or more developmental mathematics courses may be difficult for students to achieve, recent research has

demonstrated the positive effects of remedial coursework on student retention (Bettinger & Long, 2006).

Postsecondary institutions must balance the evidence supporting developmental coursework's effectiveness with the cost of providing those additional services. As the number of students requiring developmental courses increases, colleges and universities must expend additional resources to provide programs with necessary funding. New faculty must be hired, more classrooms must be allocated, perhaps even new departments must be created - all within an economic climate in which each expenditure must be validated for its effectiveness (Hall & Ponton, 2005). The costs for remedial coursework are not borne by the university alone. Students from lower-income families are more likely to require developmental coursework, and they can least afford the added costs of required developmental courses (Donovan & Wheland, 2008). The costs of developmental work become even more significant if the courses do not lead to college-level credit and student retention.

A majority of students enrolled in developmental mathematics courses share general characteristics that are not common to the traditional college population. According to Boylan (1999), developmental students have little support from home, work at least 30 hours per week to support themselves, and 41% are older than 24. A growing number of underprepared students come from minority populations, and many have had minimal college-related academic success (Texas Higher Education Coordinating Board, 2005). A large percentage of developmental students are first-generation college students who view college as a route to a better way of life (Boylan, 1999). As Pascarella, Pierson, Wolniak, and Terenzini (2004) reported, first-generation college students tend to confront several disadvantages as they face the unfamiliar territory of a college campus. They lack basic knowledge about the postsecondary educational setting, including course expectations and degree plans, and as a group they have a greater challenge transitioning from high school to college. These students are not as academically persistent as the traditional college student, and they are much more likely to leave a four-year university before the end of the second year (Pascarella, Pierson, Wolniak, & Terenzini, 2004). Trenholm (2006) stated many younger developmental students enrolled today are members of the demographic group known as the millenials. Millenials are comfortable using technology in all phases of their lives, and they possess an expectation for convenience and control of their environment (Trenholm, 2006). These students are not as likely to be successful learners in a passive learning environment where they are required to withhold interaction for an entire class period (Montis, 2007).

The achievement of developmental students in mathematics courses may be more directly impacted by the students' attitudes towards the subject itself. Hauk and Segalla (2005) addressed four assumptions made by college students about mathematics: (1) mathematics is computation without contemplation; (2) mathematics must be completed quickly; (3) mathematics problems have one correct answer and one correct solution process; and (4) the teacher is the source of mathematical learning, not the student. Belief in these precepts can hinder mathematical achievement and foster negative perceptions of mathematics at any level of instruction (Hauk & Segalla, 2005). Warton (2001) suggested that student behaviors toward achievement in math courses are shaped by two factors – their beliefs about mathematical tasks and their beliefs about their own

abilities to be successful. Bandura (1997) defined this personal capacity to act successfully is defined as self-efficacy. Hall and Ponton (2005) found a significant difference between the mathematical self-efficacy levels of freshmen students enrolled in Calculus I and developmental Intermediate Algebra, with the Calculus students exhibiting higher mathematical self-efficacy than their developmental peers. Individuals with lower self-efficacy levels believe they do not have the skills required to complete assigned mathematical tasks. Since these self-efficacy levels may be based on prior negative experiences with mathematics, exposure to mathematics with positive outcomes becomes a strategy to build mathematics self-efficacy (Hall & Ponton, 2005). Taylor (2008) suggested these findings underscore the need for structured developmental interventions addressing student confidence and self-efficacy.

The stakes are high for students taking developmental courses, and for the institutions serving them. An unsuccessful program to support developmental learners results in unacceptable retention, dropout, and failure rates. More importantly, the students face serious limitations on their future career options. Duranczyk and Higbee (2006) described this situation as a denial of access to a full future for the traditionally underserved developmental population. Taking their unique characteristics into account, researchers and practitioners are developing and implementing alternative strategies of programming and instruction to meet the particular needs of students enrolled in developmental mathematics courses. The Texas Higher Education Coordinating Board's Statewide Developmental Education Plan for 2010-2011 (2009) stated, "Texas needs to implement innovative projects that are effective in addressing students' diverse needs, accelerating their progress toward college and career readiness, and improving overall student outcomes" (p. 2). The plan identified differentiated instruction as one of six core areas of focus in the next biennium (THECB, 2009). Chamberlin and Powers (2010) presented evidence of the promise of clearly identified learning objectives and differentiated instruction in developmental mathematics. Montis (2007) used guided notes effectively to improve student achievement in developmental College Algebra courses. Students utilizing trained mentor-tutors at a university Math Center increased both mathematics achievement and mathematical self-confidence (Duranczyk, Goff, & Opitz, 2006). Trenholm (2006) identified "inefficiencies of the didactic lecture" (p. 51) as a symptom of the disconnect between technology-savvy students and lecture-heavy coursework. Taylor (2008) found college students using a computer-based algebra program exhibited lowered anxiety levels, more positive attitudes toward mathematics, and academic achievement equivalent to that of students enrolled in lecture-based sections.

Building on these isolated successes, and taking advantage of the familiarity of students with current technology, the use of technology applications in instructional methodology is spreading through developmental mathematics programs. Colleges and universities are creating technology-assisted developmental courses that exist along a continuum from the use of graphing calculators to augment instruction to fully online distance learning. Kinney and Robertson (2003) described new models for instructional delivery made possible by the prevalence of technology. They stated the goal of incorporating technology into developmental mathematics is not to identify and implement one particular instructional model that meets the needs of all students, but to

offer choices in learning mathematics for students with varied preparation levels and learning styles. Perez and Foshay (2002) identified six best outcomes of computer-assisted instruction with developmental learners, including an improved mathematical self-efficacy. Their study of students using the PLATO computer-assisted learning system supported that result. Although cost-effective on the surface and attractive to time-strapped students, developmental courses taught completely online raise serious concerns. For example, students enrolled in those courses are twice as likely to withdraw as students enrolled in traditional lecture-based courses (Zavarella & Ignash, 2009). Their research suggested the majority of these students withdrew when the courses presented unexpected challenges. A study conducted by Trenholm (2006) and Kinney and Robertson (2003) supported a combination of teacher-directed and computer-mediated instruction as preferable to a fully online, self-paced methodology.

Since mathematical self-efficacy remains an important component of student achievement in mathematics, student perceptions of mathematics instruction and instructional methods must be taken into consideration, particularly as developmental programs introduce technology into the instructional delivery system. The research of Lesh and Rampp (2000) described students' perceptions that using a computer to do mathematics will help them understand the concepts. Students also believed that computer-based courses would take less time to complete. Hauk and Segalla (2005) identified the importance of the developmental students finding purpose in the tool and its application. If students perceive that a mathematical task and the tools associated with it are useful, and that they are able to successfully address the task, they are more likely to persist in their efforts (Liaw, 2002). Liaw found this to be true for today's students working in a web-based environment. Hauk and Segalla's 2005 research of computer-assisted mathematical learning stands as one of few recent investigations in the field of student perceptions concerning developmental mathematics and technology. They found a computer-mediated model of classroom teacher-directed developmental mathematics instruction paired with web-based homework encourages positive student self-efficacy and a more positive attitude toward the mathematics itself.

Statement of the Problem

The search continues for an effective instructional method or methods to meet the particular needs of the growing population of incoming college students requiring remedial coursework. The increasing use and availability of technology resources makes the integration of technology-based interventions in developmental mathematics courses attractive to program developers and students alike. The limited research on the effectiveness of a variety of computer-based strategies has demonstrated the promise of these practices. These studies have focused primarily on academic achievement. Yet, even with the understanding that mathematical self-efficacy is directly linked to student persistence and mathematical achievement, not much research has investigated the student perspective of specific technology-mediated instructional approaches. A better understanding of this perspective will provide guidance in ensuring successful developmental programs are created to serve these underprepared students.

Research Questions

By studying the responses of Intermediate Algebra students at a state university in northeast Texas, this research explored the following questions:

1. What is the student's level of comfort in using web-based technology in a mathematics course?
2. What unexpected challenges occur while utilizing the MyMathLab courseware?
3. How does the MyMathLab homework course component affect student mathematical understandings?
4. What aspect of the MyMathLab courseware do students perceive as most beneficial?
5. How do the MyMathLab homework assignments supplement the lecture-based classroom instruction?

Significance of the Study

Postsecondary institutions are striving to provide appropriate and effective instructional methods to aid underprepared students on their pathways to collegiate success. The use of technology-based resources represents a promising instructional practice, especially for a population that is increasingly reliant upon technology in their daily lives. The development and implementation of these web-mediated remedial courses must be guided by the perspectives and attitudes of the students themselves. Through an increased understanding of student perceptions, instructors of developmental courses need to use the results of this study to differentiate instruction using appropriate technology resources. In addition, the developers of web-based mathematics courseware may become aware of student perceptions of their products. An improvement of the courseware itself could increase student motivation and persistence in their web-based homework efforts.

Method of Procedure

The method of procedure for this study followed a mixed method research design to explore the perceptions of developmental mathematics students towards the MyMathLab web-based homework program. Student responses to an online survey questionnaire gave the researcher an opportunity to gather data within a limited time frame. In addition, the use of both ranked questions and open-ended prompts enabled a more meaningful examination of student perceptions.

Selection of Instrumentation

The study utilized a cross-sectional survey design to collect data from students currently using the MyMathLab program for web-based homework assignments in a Math 131 Intermediate Algebra course. The Google Docs application was used to develop the survey questionnaire. The questionnaire included 28 questions selected to elicit student responses corresponding to the study's research questions. Nineteen questions are designed in a closed format with a five-point Likert-style rating scale, using an extent of agreement scale from Strongly Disagree (1) to Strongly Agree (5). Five additional survey questions utilized the same ranking format with a follow-up elaborating probe that prompted the student to explain his/her previous response. The questionnaire included four open-ended prompts to allow free student response. The open-ended queries provided students with the opportunity for free expression of their perceptions concerning the prompts provided.

Selection of Participants

This study of student perceptions of the MyMathLab homework component focused on students enrolled in the developmental course Intermediate Algebra (Math 131) at a regional state university in northeast Texas during the spring semester. This represents a purposeful homogenous sampling of the population most directly affected by the MyMathLab aspect of the course. Students enrolled in the course have not met the university's criteria for enrollment in for-credit mathematics courses that satisfy university degree requirements. Students can meet those criteria by scoring at a particular level on the mathematics portion of the THEA examination, scoring at a given level on the COMPASS test, or successfully completing developmental mathematics courses such as Intermediate Algebra. Students who are not successful in Intermediate Algebra after two semesters currently face a year-long suspension from the university.

At the time of the study 167 students were enrolled in six Intermediate Algebra classes at the university targeted by the study. Of these students, 18 were enrolled in a fast-track class that combines concepts of Intermediate Algebra and College Algebra. The perceptions of this group of students were not addressed in this study, since their use of the MyMathLab program was not limited to the Intermediate Algebra content.

The remaining 149 students were enrolled in an on-campus Intermediate Algebra class using MyMathLab for web-based homework only. The four instructors of these five Math 131 classes utilized lecture-based lessons as their primary instructional methodology. Each instructor was responsible for the development and maintenance of her own MyMathLab homework assignments, following the guidelines set by the course coordinator that the web-based homework should count for ten percent of the overall student course grade. Some instructors also used the MyMathLab program to deliver online quizzes; this application of the program was not addressed in this study. Intermediate Algebra instructors were given initial training of at least two hours in the use of the MyMathLab program.

The researcher contacted the coordinator of the Developmental Mathematics Program to gain primary permission to conduct the study. Students in the targeted

Intermediate Algebra classes were contacted by email through their instructors with the opportunity to participate in the study. The email invitation to volunteer for participation included the Google Doc link; the informed consent document stood as the initial page of the study's survey instrument (Appendix A). The informed consent document included information concerning the purpose of the study, the nature of the study's questionnaire, the use of the study's results, and confirmation that participation in the study was voluntary. Students were instructed to signify their participation or their decision not to participate as the first response on the online survey. Of the 149 students targeted by the study, 58 students participated by completing the study's online questionnaire. Their responses formed the database for the study's analysis of student perceptions.

Collection & Analysis of Data

Intermediate Algebra students who chose to participate in the study were given a time frame of ten days to complete the study's online questionnaire. Student perception data was accumulated automatically using the Google Docs spreadsheet application. Survey question answers in the rating format were assigned coding numbers of 1 through 5 corresponding to the scale rating value, with a Strongly Disagreed response coded as a 1 and a Strongly Agreed answer coded as a 5. Resulting ratings were presented as percentages. The mean of the accumulated responses was calculated for each of these closed questionnaire items as a method to discover group perceptions described by the data. Student responses to the open-ended prompts and elaborative probes were analyzed to identify broad themes evident in the data. Results of the closed-question coding and the open-question theme identification were combined to develop a description of the student perceptions of the MyMathLab homework component.

Findings

Results of the student survey were examined to identify student perceptions concerning the web-based homework component of the developmental mathematics course. The responses to each survey item were linked to the related research question. In the data analysis of the closed survey questions, student responses of 1 and 2 were coded as Disagree, responses of 3 were coded as Neutral, and student responses of 4 and 5 were gathered and coded as Agree. In addition, response means using the students' responses of 1 through 5 were calculated for the Likert-type survey questions. Percentages for each coded response category for each survey item, along with the response mean for that item, are presented in the tables for each research question. The full statement of each survey question can be found in Appendix A.

Research Question 1

The study's initial research question addressed the comfort level of students in the use of web-based technology in a mathematics course. The first three survey questions beyond the informed consent statement investigated this aspect of the study (data analysis

of these questions appears in Table 1). Student responses reflected a moderate to strong agreement with the survey queries concerning comfort using computers and the user-friendly nature of the MyMathLab program, with response means of 4.53 and 4.00 respectively. The survey question dealing with a preference for MyMathLab homework over paper and pencil homework, however, brought a more mixed response. The lower mean of 3.71, along with the significant percentage of students disagreeing with the statement, bears further investigation.

Students who favored using MyMathLab cited several reasons for their preference. Students liked the instant feedback for a right or wrong answer that MyMathLab provides, as well as the step-by-step instructions available for help in solving problems. "I like the immediate feedback, knowing whether or not I am on the right track" was the response of one student. The ability to rework problems after viewing examples appealed to many students also. One student participant appreciated that aspect of the program because "it helped me learn the material a lot better and at my own pace." Even though many students used paper and pencil to work out the assigned problems, many reported that working homework on MyMathLab was faster and easier since showing all the steps in a solution process was not required.

Students preferring paper and pencil homework to MyMathLab assignments provided several reasons for their survey responses. Many stated that they have to use paper and pencil to complete the web-based assignments so the extra step of entering the answers into MyMathLab was just that – an extra step. A majority of students in this group mentioned the narrow notation parameters of answers accepted by the MyMathLab program; the program "does not always except [sic] a correct answer when it isn't in the same format that the software wants." Several student participants described their concern about understanding and retaining the mathematical concepts they were studying. One student suggested "it is easy in math lab to "cheat" which is not really cheating, but you can basically follow along with an example, do the problem, and not really learn anything." Others explained their preference for direct feedback from the instructor. Some participants described their tendency to forget online assignments. One participant explained, "I found it easy to miss assignments because I was not forced to turn them in to my instructor."

Table 1
Comfort in Using Web-based Technology in Mathematics Course

Item	Disagree	Neutral	Agree	Mean
Comfortable using a computer	5%	10%	85%	4.53
Found MyMathLab to be user-friendly	8%	19%	73%	4.00
Preferred MyMathLab over paper and pencil homework	26%	16%	58%	3.71

Research Question 2

The study's second research question concentrated on the unexpected challenges students encountered in using the MyMathLab courseware. Data associated with the two closed survey questions linked to this research question appear in Table 2. A vast majority of students reported that the program's different resources were easy to access and to use, with a response mean of 3.98 for that survey item. Students who added comments on this topic reinforced the ease of navigation through the program's components.

Almost half of the participants did not fall into agreement that it was easy to enter answers into the MyMathLab program. Students in that group characterized the program as "very picky", "frustrating", and "terrible - you think you have the right answer and on paper you do but in the system you don't because it has to be the way MyMathLab wants the answer". One participant fumed, "If you forget to click one thing, and then submit, it can make the whole question wrong, and then you end up doing a whole new problem. I absolutely hated that." Students did not agree with being denied complete credit for a correct answer if there was a notation difference. For example, an answer submitted with two binomial factors in one order would be counted as incorrect when the reverse order was counted as a correct response. In addition, several students suggested that the process of inputting mathematical symbols added to their time on task. "It takes much longer to add in all the symbols and other various parts of the answer that you can spend more time doing that than working the problem," explained one participant. According to student survey responses, the answer formats accepted by the MyMathLab program also differed on occasion from those acceptable to their instructors.

Given the opportunity to freely identify any challenges encountered using MyMathLab, several themes emerged in the responses of participants. A majority of students responding to the survey question stated that the correct submitting of their answers was the greatest challenge they faced with MyMathLab. "Entering the answer the way MyMathLab wanted" was necessary to successfully complete the online assignments. Other students cited their issues with time management as the reason for not getting assignments completed before the due dates. One student participant admitted that one challenge was "getting the homework done on time – the dates they need to be done can be a bit overwhelming at times." Students also noticed that it was difficult to deal with MyMathLab input formats because "sometimes the symbols and signs are difficult to put in the right place at the right time."

Table 2
Unexpected Challenges While Using MyMathLab

Item	Disagree	Neutral	Agree	Mean
Easy to enter answers in MyMathLab	32%	14%	53%	3.30
Easy to use different parts of MyMathLab	12%	19%	69%	3.98

Research Question 3

The third research question of the study focused on student perceptions of how the MyMathLab homework affects their mathematical understandings. Participant responses to the two closed survey items addressing this research question are shown in Table 3. With 57% of students in agreement with the first of the two survey items, a majority of study participants expressed that they understand math concepts better after using MyMathLab to complete homework assignments. Students were not asked to compare their level of understanding to mathematical comprehension gathered using traditional paper and pencil homework components. However, the lower response mean of 3.59 reflects a significant number of student participants who responded with neutrality or disagreement with that survey statement. In response to the second survey item for research question 3, a large percentage (69%) of students agreed that the time spent on MyMathLab assignments was beneficial to them. The response mean for the survey statement was 3.97, revealing a higher neutral response from participants.

Comments offered by the participants included appreciation for the MyMathLab's step-by-step help in solving problems. Most felt that the program's examples offered an opportunity to see the solution process repeated. One student observed "it was like there was a tutor in the room with you." Other students valued the opportunity to schedule and pace their own learning. One participant was pleased that "I could come back to the problem later if I was flustered." Several student responses suggested that they viewed the web-based homework component as an extension of class instruction, best expressed by the student comment: "I was able to understand what the teacher taught after reviewing it on my math lab." However, a number of students identified the following concern: "the way the problems are worked on MyMathLab does not always coincide with what was taught in class."

Table 3
Effect of MyMathLab Homework on Mathematical Understandings

Item	Disagree	Neutral	Agree	Mean
Better understanding of math concepts	21%	22%	57%	3.59
Time spent on assignments was helpful	12%	19%	69%	3.97

Research Question 4

This research question sought to identify aspects of the MyMathLab courseware that students perceived as beneficial to them. In closed questioning, fifteen of the program's components were to be ranked by students as not very helpful, somewhat helpful, or very helpful. Students could also specifically indicate that they did not use a particular feature of the program. The data analysis for the component rankings are displayed in Table 4. Ten of the fifteen MyMathLab features scored high in helpfulness to a majority of student participants: the immediate feedback on a problem's answer, the Help Me Solve This option, the View an Example option, the ability to review homework after completion, the ability to see assigned homework and due dates, the ability to see homework grades, the opportunity to return to an unfinished assignment, the chance to rework questions as needed, the Ask My Instructor email option, and the ability to see course announcements. The five remaining MyMathLab components were not utilized by a large portion of the participant group, including the opportunity to view video instruction, to access the textbook online, to access free real-time tutors, and to complete sample quizzes and tests.

In one of two open-ended survey questions addressing this research question study participants identified and explained which MyMathLab program component was most beneficial to them. Many students selected the ability to view step-by-step examples using the View an Example option of MyMathLab. One participant stated, "This allowed me to follow along as I worked my problem and see where I was going wrong." Viewing examples, as well as the Help Me Solve This resource allowed students to build confidence in solving problems by reviewing the process required in a logical sequence of steps. The ability to rework problems until a correct answer is reached was also appreciated by many students. One student expressed "this was beneficial because I did not have to worry about not getting the points for a problem and I was able to work a similar problem to help me understand." Other students identified the ability to view the "fantastic" video lessons as a plus, including the student who responded, "Viewing videos was the most helpful because it talk [sic] me through each step." To a lesser extent, the MyMathLab features of being able to view assignments and their due dates and being able to contact the instructor directly with a question
were considered most beneficial.

Asked to identify which MyMathLab components were least beneficial, students responded less frequently to the second of the two open-ended survey queries. Many students simply stated that every aspect of the program they had used had proven helpful to some extent during the course of the semester. Participants who specifically indicated a least beneficial feature of the program selected the access to the online textbook and the video instruction options. The online textbook was deemed either a challenge to use - "I couldn't even find it!" - or was considered unnecessary – "I took notes during classroom instruction which used as reference when needed." Several students mentioned that they did not deem the Ask My Instructor feature particularly helpful, since they were "able to find my answer through the other resources" or could use alternative methods to contact the instructor for help.

Table 4
Helpfulness of MyMathLab Features

Feature	Not very helpful	Somewhat helpful	Very helpful	I did not use this
Immediate feedback	7%	31%	55%	7%
Help Me Solve This	2%	24%	67%	7%
View an Example	2%	29%	66%	3%
Access to textbook	7%	23%	41%	29%
Review assignment	3%	35%	50%	12%
Assignment lists	0%	24%	72%	3%
Grades	0%	23%	72%	5%
Return to assignment	0%	23%	71%	7%
Rework questions	2%	15%	72%	9%
Video section instruction	7%	21%	45%	28%
Real-time Tutor Center	5%	13%	34%	43%
Sample quizzes and tests	9%	28%	33%	28%
Video problem example	9%	21%	38%	31%
Ask My Instructor	3%	18%	52%	28%
Course announcements	2%	21%	60%	16%

Research Question 5

The study's final research question focused on answering how the MyMathLab homework assignments supplemented the classroom instruction for the developmental mathematics course. Three-fourths of the study participants responded in agreement to signal their perception that the MyMathLab assignments matched the classroom instruction. A strong majority of survey respondents agreed that the completion of the

assignments improved their understanding of the topics taught in the course. Data analysis of these two closed survey items are shown in Table 5. The response means of 4.23 and 3.81 respectively echo the strong agreement to the first survey item and a higher neutrality value for the second item.

Participants were given the opportunity to comment on their understanding of mathematical concepts following the MyMathLab assignments. A few students expressed that they understood topics best when they were taught in a live classroom setting. One expressed the frustration of working online independently: "After MyMathLab, if I had a question or didn't feel very confident in the assignment, I just went on to the next question, so I felt the same." Several students suggested that the online assignments reinforced their understanding of the concepts. One student described how the MyMathLab homework helps "because yes you can learn it in the classroom but at the same time you need more work to improve on your focus and skills." More than a few participants cited the program's ability to provide examples and step-by-step processes outside the classroom setting allowed them to capture concepts more fully. "There are many ways through MyMathLab to get clarification as to how to work the problems," stated one student.

Table 5
MyMathLab Assignments as Supplements to Classroom Instruction

Item	Disagree	Neutral	Agree	Mean
Assignments match classroom instruction	12%	9%	76%	4.23
Improved understanding of math concepts	15%	21%	64%	3.81

Conclusions & Recommendations

The results of the study provided valuable insights into the perceptions of student participants about the MyMathLab homework component of the developmental mathematics course. Students expressed a high level of comfort using technology to complete their web-based assignments. However, this comfort level did not translate to an overwhelming acceptance of online assignments as the preferred method of homework completion. Many students felt the frustration of converting their answers to a form acceptable to the MyMathLab program. These study results echo the findings of Hank and Segalla (2005) that found students annoyed by the narrowness of solution parameters for web-based homework. Challenges to student success also included a tendency by students to forget online assignments.

From the student perspective, the MyMathLab assignments appeared to have a positive impact on student mathematical understandings. Students reported that the web-based assignments generally supported their comprehension of the topics taught in class.

Some alignment issues did exist as MyMathLab processes differed from those of the classroom instructor. These differences were more challenging to accept for students who have a greater difficulty with mathematical concepts. The ability to view additional examples and the step-by-step process of problem solution, as well as the opportunity to view relevant instructional videos, appealed to a majority of students. Beyond a simple identification of a wrong or right homework response, the MyMathLab program offered guidance in solving similar problems and a chance for students to repeat their work prior to submission. These attributes of the program helped lead students to an improved understanding of mathematical concepts and an increased perception of their own ability to successfully complete the assignments. The participating students deemed almost all of the courseware's components to be beneficial to some extent. However, some potentially helpful features of the MyMathLab courseware were left largely underutilized by the student participants. Overall, the student participants perceived the MyMathLab assignments as a positive provider of support for their success in Intermediate Algebra.

The results of the study lead to recommendations for practice within the developmental mathematics program at the university. With the greatest challenge to success with MyMathLab assignments identified as formatting correct answers, communication with the courseware provider is in order. Awareness of the troubles students are having must motivate the need for adjustments to the web-based homework program. Instructors need to have an understanding of the difficulty students might face in entering their answers correctly. Direct instruction in what is acceptable to MyMathLab might diminish student frustration. Students reported that they forgot online homework assignments to a greater extent than those printed on paper. This finding was an unexpected result of the survey's analysis. To avoid this problem, instructors may provide printed unit assignment sheets or checklists with clear due dates. Specific training for students in the use of MyMathLab resources may open opportunities for additional support when the course instructor is not available.

More importantly, attention must be given to the students who did not feel well served by the web-based approach to homework assignments. A significant group of study participants preferred the paper-and-pencil method of homework submission. For example, students in the Intermediate Algebra course might be offered the option of submitting their assignments on paper rather than through the web-based MyMathLab program. Certainly there are positive and negative aspects of this option. Instructors offering the paper-and-pencil homework choice would face additional time grading and providing appropriate feedback to students. Utilizing this alternative would require timely return of assignments to students to allow them to review their work and to request assistance from the instructor when needed. Students would have to wait for feedback on their efforts, and the immediacy of getting another example to guide their homework would be forfeited. Students preferring the paper-and-pencil method, however, might feel an increased level of comfort as they build a stronger bond with the course instructor through the human interaction of homework submission and review. This comfort might contribute to an improved self-efficacy in understanding mathematical concepts.

Additional research is needed to expand on the understanding of student perceptions of the online learning environment as it relates to developmental mathematics. Research should examine whether there is a correlation between student

views of web-based homework and student demographics such as age, gender, and economic situation. Is there a connection between student opinions of MyMathLab assignments and final grades in the developmental mathematics course? This question has yet to be fully considered. Further research needs to be conducted to identify any instructor characteristics that influence student perceptions of the online coursework. Another limitation of the current study lies in the limited response of students enrolled in the Intermediate Algebra course at the university. A greater survey response would bring a broader vision of the student's point of view concerning web-based homework.

As colleges and universities provide resources for the growing population of students in developmental education, the voices of the students in that group need to be heard. No one approach to instruction or program development will serve the needs of all developmental learners. Instructional delivery systems should be examined from the standpoint of all stakeholders to determine their effectiveness in successfully supporting students. This study of the MyMathLab web-based homework component provides some insight into the student perspective of this aspect of the Intermediate Algebra course. Many students still preferred the more traditional approach of paper-and-pencil homework. However, a clear majority of students recorded positive perceptions of the impact of the MyMathLab program on the development of their mathematical understandings. The voices of both groups of developmental learners were heard here.

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Appendix A

Information about Being in a Research Study
Texas A&M University-Commerce

Student Perceptions of MyMathLab

Description of the Study and Your Part in It

Donna Holt is inviting you to take part in a research study about the use of the MyMathLab program. Donna Holt is a Teaching Graduate Assistant in the Mathematics Department at Texas A&M University-Commerce. Donna Holt is a graduate student at Texas A&M University-Commerce, running this study with the help of Dr. William Holt. The purpose of this research is to explore student perceptions about their use of the MyMathLab program to complete homework assignments in Math 131 Intermediate Algebra.

Your part in the study will be to complete a short online survey about your use of the MyMathLab program associated with your Math 131 course. The survey may be completed online at your convenience within a 7-day time frame.

It will take you less than 30 minutes to participate in this study by completing the survey.

Risks and Discomforts

There will be minimal risks associated with this study, no more than that expected in daily life.

Possible Benefits

The anticipated benefits of your participation in the study will be the contribution of your responses to build an increased awareness of the student point of view about the use of the MyMathLab program. An analysis of the study will be shared in a general way with the instructors of Math 131 and with the Director of the Developmental Mathematics program. In addition, we will seek publication of the study's findings in journals that focus on educational methods in developmental education. The study's results may then serve to inform the practice of developmental educators and thus guide instructional decisions concerning the use of computer-based programs for the completion of homework assignments.

Incentives

As an incentive to improve participation in the study, your completion of the study's online survey will result in extra credit points on one course exam. The same extra credit is available for a non-research activity that involves the same effort and time investment. Please contact your Math 131 instructor for a description of this alternative to the study's incentive.

Protection of Privacy and Confidentiality

We will do everything we can to protect your privacy and confidentiality. Your name will not be associated with your responses or the research findings in any way. All of your responses will remain confidential. Your name and instructor information is gathered only to make sure you get credit for completing the survey if you choose to participate in the study. Any printed materials associated with the research will be stored in a locked file cabinet, and digital study records will be stored on a password-protected computer. Only the researchers will have access to the survey response data collected through the study.

Choosing to Be in the Study

You do not have to be in this study. Participation is voluntary. You may choose not to take part and you may choose to stop taking part at any time without penalty. You will not be punished in any way if you decide not to be in the study or to stop taking part in the study. If you decide not to take part or to stop taking part in this study, it will not affect your grade in any way.

Contact Information

If you have any questions or concerns about this study or if any problems arise, please contact the researcher at

Donna Holt
Department of Mathematics
Texas A&M University-Commerce
903-886-5157
dholt4@leo.tamu-commerce.edu

or the advisor at

Dr. William Holt
Department of Educational Administration
Texas A&M University-Commerce
903-468-6042
Chuck_Holt@tamu-commerce.edu

If you have any questions or concerns about your rights in this research study, please contact the IRB Chair at

Dr. Carmen Salazar
Chair, Institutional Review Board (IRB)
Department of Psychology, Counseling, and Special Education
Texas A&M University-Commerce
Commerce, TX 75429-3011
(903) 886-5634
Carmen_Salazar@tamu-commerce.edu

Consent

By beginning the survey you acknowledge that you are at least 18 years old, have read this consent form, have understood the above information, and agree to voluntarily participate in this research.
If you would like a copy of this form for your reference, you may print this out.

** Required*

I have read the Informed Consent document for the MyMathLab study, and I understand the purpose and nature of the study as it is described. *

- ☐ *I am willing to participate in the MyMathLab study. I understand my rights as a participant in the study. (If you select this box, please continue to the next page to complete the survey.)*
- ☐ *I am not willing to participate in the MyMathLab study. I understand that my decision not to participate will not affect my standing with my instructor or the university.*

Continue »

Math 131 MyMathLab Survey

** Required*

MyMathLab Survey

Please answer each survey question by selecting the best response option or by typing in your response in the space provided.

*Please enter your first and last name. * Example: Josie Smith*

*Please enter the last name of your Math 131 instructor. * Example: Jones*

Before taking this course I was comfortable using a computer.

	1	2	3	4	5	
Strongly disagree						*Strongly agree*

In general I found the MyMathLab program to be user-friendly.

	1	2	3	4	5	
Strongly disagree						*Strongly agree*

In general, I liked doing my homework on MyMathLab instead of doing paper and pencil homework.

	1	2	3	4	5	
Strongly disagree						*Strongly agree*

Please explain your response to the question above.

I understand math concepts better after using MyMathLab to complete my homework assignments.

	1	2	3	4	5	
Strongly disagree						*Strongly agree*

The time I spent on MyMathLab homework assignments was helpful to me.

	1	2	3	4	5	
Strongly disagree						*Strongly agree*

Please explain your response to the question above.

The MyMathLab homework assignments matched the classroom instruction for Math 131.

	1	2	3	4	5	
Strongly disagree						*Strongly agree*

I understand the math topics taught in Math 131 class better after completing the MyMathLab assignments.

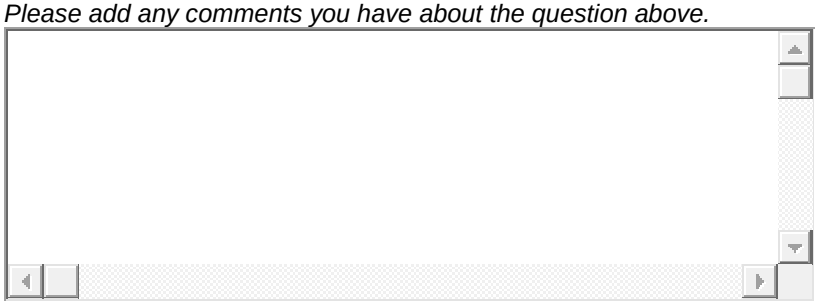
	1	2	3	4	5	
Strongly disagree						*Strongly agree*

Please explain your response to the question above.

In general, I found it easy to enter my answers in MyMathLab.

	1	2	3	4	5	
Strongly disagree						*Strongly agree*

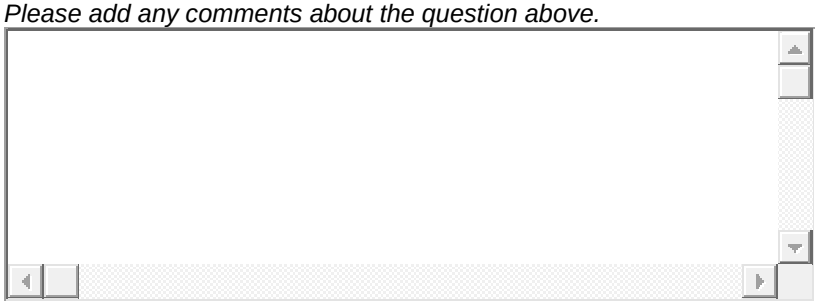
Please add any comments you have about the question above.



In general, I found it easy to use the different parts of the MyMathLab program.

	1	*2*	*3*	*4*	*5*	
Strongly disagree						*Strongly agree*

Please add any comments about the question above.



What challenges did you face in using the MyMathLab program to complete your homework assignments?

Please rate each aspect of the MyMathLab program based on how helpful it has been to you.

	1 Not very helpful	*2 Somewhat helpful*	*3 I did not use this*	*4 Somewhat helpful*	*5 Very helpful*
Immediate feedback on my answer to a problem					
Option to see the problem worked out step by step with Help Me Solve This					
Option to see more problems like this one with View an Example					
Ability to access the textbook online					
Ability to review my homework assignment after I have completed it					
Ability to see assigned homework and due dates					
Ability to see my grades on each assignment					
Ability to start an assignment, save it, and come back to finish it later					
Ability to rework questions as many times as I need to					
Option to view video instruction for each section of the textbook					
Access to the free Pearson Tutor Center					
Option to complete sample quizzes, chapter reviews, and chapter tests					
Option to view a video example for each problem					
Ability to Ask My Instructor about a specific assigned homework problem					
Ability to see course announcements from my instructor reminding me of important information					

Of the aspects of the MyMathLab program listed above that you used during Math 131, which one did you feel was most beneficial to you? Please explain your choice.

Of the aspects of the MyMathLab program listed above that you actually used during Math 131, which one do you feel was least beneficial to you? Please explain your choice.

Please add any additional comments you have about your experience using the MyMathLab program for your Math 131 homework.

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