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Abstract

In order to provide educational quality in Internet-based distance learning, institutions must be ready to offer effective teaching and learning methods. The study proposed a model to measure the quality of web-based courses. On-line educators are still trying to figure out how best to use web-based technology as a way of delivering courses and how web-based tools and learning activities, such as discussion boards, e-mail, group projects, virtual chats, interaction among classmates, interaction between instructor and students, and so on, influence students' learning. Key components that on-line developers and educators can use in their pedagogical process of Internet-based environments to promote student satisfaction and learning effectiveness are instructional and design strategies, use of web-based tools and activities, and student participation. Results from the statistical test of 161 on-line students in the Industrial Management program at Central Missouri State University indicated that graduate students accessed the course a greater number of times than undergraduates did and students with better grades accessed the course more often than students with poorer grades did. While it is no surprise that the number of times accessing the course can be a significant predictor of success in online course delivery, the researchers were intrigued by the significance of the relationship.

I. Introduction

The growth of distance education, in particular Internet Based Distance Learning (IBDL), has rapidly increased in the past few years. Varieties of commercial Internet infrastructure software for e-learning, known as web-based tools, provide multiple techniques of course design and delivery, which change the way instructors interact with students. As public access to the Internet has increased, so has the demand for on-line education. Quality in IBDL is being discussed in educational circles, media, and businesses, and quality measurements vary from institution to institution. Instructors teaching on-line programs are still trying to figure out how best to use this technology as a way of delivering courses and how the importance of web tools such as discussion board, e-mail, group projects, virtual chats and so on influence students' learning.

Due to new and various types of technological tools in web-based environments, parallel with several internal and external factors involved, the on-line course designers and instructors have their own pedagogical processes which may or may not provide high quality in education. Most of us are in the experimental period and we are learning to efficiently utilize these technologies. There is no one best solution that can fit all problems. As educators in the new era of e-education, we must think what we can do to design and teach the course utilizing the full capacity of web-based tools and other available resources. It is time to evaluate the quality of what we have proposed to students and what we can do to improve our instructional strategies. The study examined a proposed model to measure quality of instructional design and the use of web-based tools that lead to students' satisfaction and learning effectiveness in web-based environments. The study used ISO standard for education, Chickering and Gamson's seven principles for good

practice, and the Sloan Consortium's quality framework as guidelines in conducting research with on-line students at the post-secondary level.

II. Policy Framework And Good Practice

The Internet-based course is quickly becoming the prevalent method of distance education; likewise, there are a growing number of policy issues and good practices in this arena. Several accredited institutions and many researchers have provided good practices in distance learning which educational organizations, on-line educators and developers can use in their design, teaching, and delivery of courses in web-based environments. In post-secondary institutions, some policy frameworks and good practices directly related to distance education that is worth noting follow:

A. BSR/ASQ – Z1.11

BSR/ASQ – Z1.11 American National Standard education and training institutions provide guidelines for education (American Society for Quality, 2000), of which most parts can be applied web-based distance learning. Primary issues of Z1.11 used in this study are: 7.3 design and/or development - the assessment conducted to identify potential or actual performance requirements, 7.6 control or measuring and monitoring devices – methodologies used for verification of products to ensure interested party satisfaction could include surveys, simulations, measurement and monitoring, and 8 measurement, analysis and improvement. Z1.11 standard for education, topic 7.3.2 design and /or develop guidance, suggests that the design report should include the following:

- skills and knowledge to be taught which should be consistent with the analysis report.
- assessments and evaluations that should be consistent with the objectives and standards.
- instruction strategies appropriate for the given objectives.
- selection of an appropriate medium or combination of media for effective and efficient use in the delivery system.

B. Chickering and Gamson's Seven Principles for Good Practice

Several studies (Lang, 2000; Testa, 2000; Cole 2000) referred to Chickering and Gamson's Seven Principles for Good Practice in Undergraduate Education, first published in March 1987, as a guideline to set up the pedagogical process in distance education. These good practices include:

Good practice encourages student-faculty interaction. The contact in and out of class between student-faculty is an important factor in student motivation and involvement (Chickering and Gamson, 1987). Lang (2000) also supported that the students would perform at a higher level when they know that the instructor is concerned about their individual performance.

Good practice encourages cooperation among students. Students can increase their learning skill by collaboration with other students, and the use of emerging and Internet technologies enhances students' collaboration and cooperation.

Good practice encourages active learning. Chickering and Gamson (1987) stated that learning is not a spectator sport. Students learn by not only sitting in class, listening to teachers, and memorizing lectures, but students must communicate with others and apply knowledge to their daily lives, effectively relating it to what they have learned.

Good practice gives prompt feedback. "The timely feedback from the instructor reinforces or redirects learning upon the appropriate pathways" (Lang, 2000, p. 173). Instructors can provide feedback to students via discussion board, email, telephone, chat room, and so on.

Good practice emphasizes time of task. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty (Chickering and Gamson, 1987). Using some specific software can help in quality of work; PowerPoint and Microsoft Word can increase efficiency of both instructors and students (Testa, 2000).

Good practice communicates high expectations. There are specific examples that teachers can do to increase students' drive to learn: expect students to actively participate by setting standards, celebrate in-class success by student name and/or study group, suggest extra readings or reference sources that support key points, and provide corrective feedback and state what you liked or did not like (Lang, 2000).

Good practice respects diverse talents and ways of learning. Testa (2000) summarized the good practice from Chickering and Gamson's work that "Many roads lead to learning. Different students bring different talents and styles to college. Brilliant students in a seminar might be all thumbs in a lab or studio; students rich in hands-on experience may not do so well with theory. Students need opportunities to show their talents and learn in ways that work for them. Then they can be pushed to learn in new way that do not come so easily" (p. 243).

C. Sloan Consortium – Quality Framework

The Sloan Consortium, a consortium of institutions and organizations committed to quality online education, established a quality framework including five main elements and their goals:

Element 1: learning effectiveness. Quality of learning online is demonstrated as at least as good as the quality the institution provides in traditional programs.

Element 2: cost effectiveness. Institutional business practices generate and support stable, high quality educational programs and expansion to meet needs.

Element 3: access. All learners who are qualified and motivated are enabled to succeed and complete a course/degree/program through online access to learning in any discipline.

Element 4: faculty satisfaction. This element includes three main activities: 1) sustain and increase faculty participation in online teaching, 2) expand and deepen faculty awareness of and satisfaction with online teaching, and 3) integrate faculty

online and face-to-face with online purposes and practices.

Element 5: student satisfaction. Satisfaction of learners who complete a course can be measured by 1) level of interaction with faculty and other students, 2) learning outcomes matching the course description, and 3) adequacy and appropriateness of technology and support (Mayadas, Bourne, & Moore, 2002).

This quality framework can assist educational organizations, on-line educators, and developers in some ways to put these quality pillars into practice and measure progress towards the learning goals. A more complete version of the quality framework and details of each item are available online at: http://www.sloan-c.org/effectivepractices (2002). Furthermore, a recent study, "Benchmark for Success in Internet Based Distance Education", listed 45 benchmarks that were essential for quality IBDL and grouped them into seven categories: 1) institutional support, 2) course development, 3) teaching/learning, 4) course structure, 5) student support, 6) faculty support, and 7) evaluation and assessment (IHEP, 2000).

D. The Study's Framework and Essential Components

The discussions above are issues for large policy areas as well as particular practice for distance learning. The framework of this study and methodology are established from the Z1.11 standard: items of the design reports; the two main quality indicators from the Sloan Consortium's quality framework: students' satisfaction and learning effectiveness; and Chickering and Gamson's seven principles for good practice. Figure 1 shows how essential components; instructional and design strategies, use of web-based tools and activities, and students participation, can enhance the quality in on-line courses delivery.

Belanger and Jordan (2000) addressed a key consideration for the success of distance learning environments is that learning objectives can be met using different delivery technologies. With the differences of students' learning style, some may do better with one learning method over another. As we experience the function of commercial courseware, there are quite a lot of possibilities for students to enrich their learning process in web-based environments.

III. Quality Measurement In Web-based Environments

In order to determine the appropriate instructional and design strategies as to how web-based tools can be used to measure student progress, the study was conducted and the following research questions, hypotheses, and methodology were created.

A. Research Questions and Hypotheses

1. As identified by on-line students, what are the levels of satisfaction with the course delivery format and instructional tools?
2. Which items of the web-based tools did students perceive to be highly effective to their understanding of course content?
3. Are the means of number of times students access to the course the same for ranks (undergraduate and graduate) and the same for students in grade levels: A, B, and C and lower?

To answer research question 3, the hypotheses were set and tested to see if a relationship exist between student accesses to the various standard components identified in the development template and the final success of the student as measured by the final course grade.

H_{01}: There is no significant difference in the mean number of times accessing the course between undergraduate and graduate students.

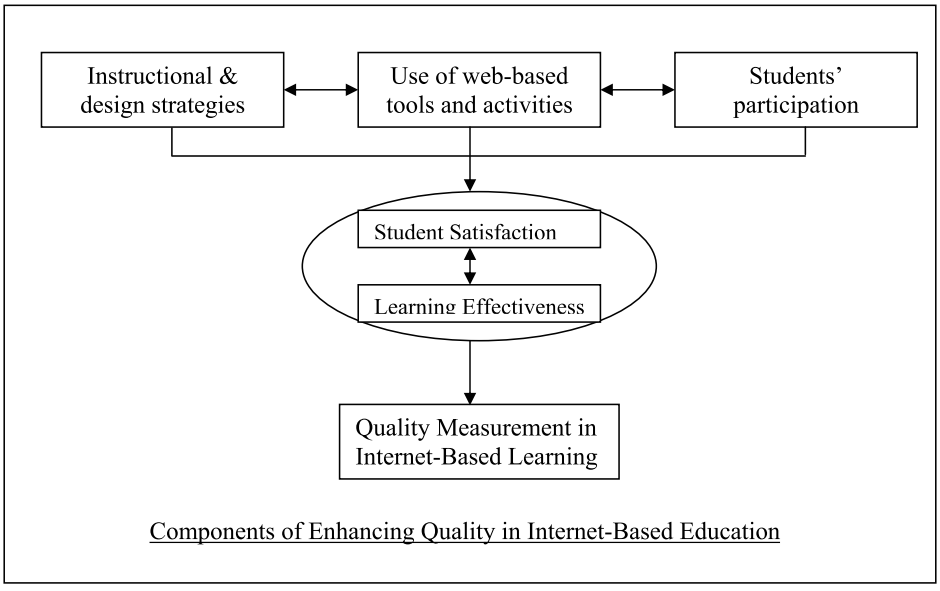
H_{02}: There is no significant difference in the mean number of times accessing the course between three grade levels: A, B, and C and lower.

H_{03}: There is no significant difference in the means of number of times accessing the course and rank (undergraduate or graduate) for the three grade levels.

B. Methodology

The sample population was comprised of 161 students who completed and received final grades in an on-line Industrial Management program at Central Missouri State University (CMSU) in fall 2002 and spring 2003. The study gathered data from the Blackboard system for seven (7) courses in the Industrial Technology Department involving 81 undergraduate and 80 graduate students. Blackboard software allowed the

Figure 1. Components of Enhancing Quality in Internet-Based Education



instructor to track student accesses to each component area described in the development template. This allowed the instructor to collect the total accesses for each student to each area of study, (e.g. Announcements, Course Information, Course Documents, Communications, Discussion Forums, Virtual Chat, External Links, and Student Tools).
In addition, an on-line quality assurance survey addressed students' perception of various web-based tools and the quality of the on-line instruction and instructor. The on-line questionnaire was divided into three sections:

1. Demographic data related to the on-line student's characteristics.
2. Rating satisfaction with course instructions and instructor's performance on quality of on-line courses, using a five-point scale ranging from 1 through 5.
3. Rating the effect of web-based tools and learning activities on quality of on-line courses containing discussion boards, virtual classroom chats, email, and the Blackboard system.

Data from the returned surveys were recorded and summarized using the Blackboard report option. Microsoft Excel was used to numerically code the data before loading into the Statistical Package for Social Science (SPSS); the responses were added for each of the independent and dependent variables. SPSS and two-way ANOVA were utilized as the statistical tools to determine the relationship among variables: students' final grades (dividing into 3 groups: A, B, and C and lower), students' rank (undergraduate and graduate), and number of times accessing the course. The .05 level of confidence was established to determine whether the observed value was significantly different from the expected value.

C. Findings - Essential Components

The results from the on-line survey were from one hundred and thirty five (135) respondents who completed the web-based courses and filled out the on-line questionnaire yielding an 83.85% response rate. The first section reported the demographic characteristic of the sample. The respondents included sixty-four (64) undergraduate students (47.4%) and seventy-one (71) graduate students with 70% of this combined total of 135 being male students. The largest percentage of respondents was in the 21-25 year old age (45.18%) and respondents with ages over 41 were 14.18%. Respondents reported their types of careers as: 42.54% student, 31.34% working in industry, and 11.94% working in education. Nearly fifty four percent of the respondents were taking an on-line course for the first time, and 48.89% had experienced their first on-line course exclusively utilizing Blackboard. The largest group enrolled in the course because it was required in a major at 80.7% and students with overall GPAs above 3.5 comprised 53.7%. Moreover, the 28.9% of respondents spent an average of 2-3 hours per week on the course. The study's findings are grouped into 3 categories as follows:

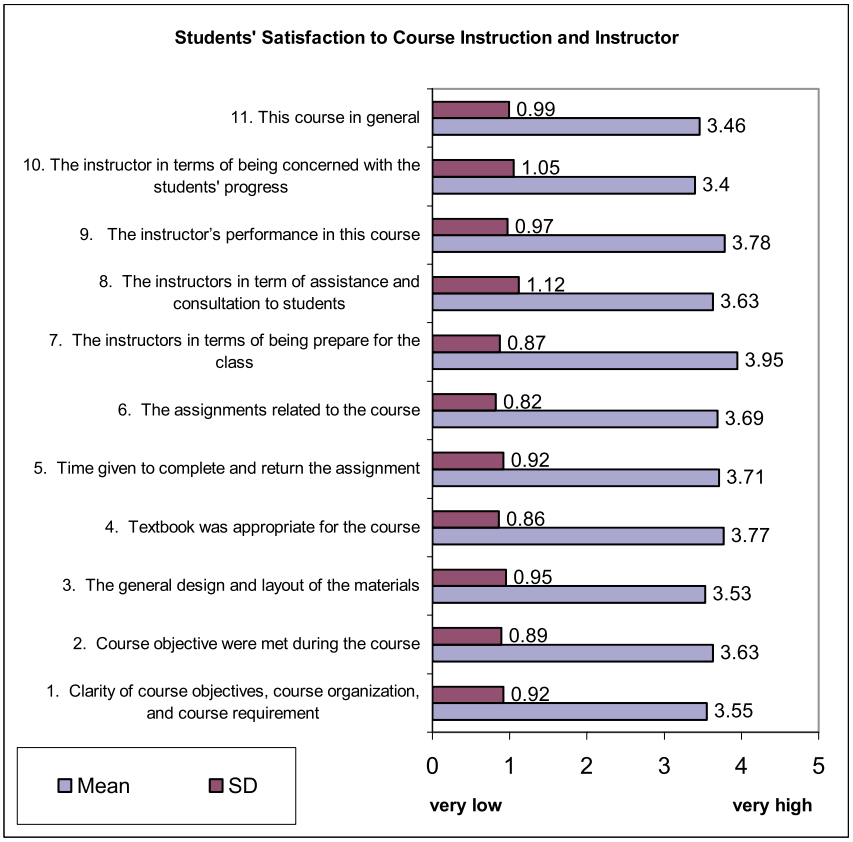
1. Instructional & Design Strategies

Research question One related to survey questions 11-22, which asked students to rate their satisfaction with the course instructions, material presented, and the instructor's performance. There were 11 items in this category including:

- Clarity of course objectives, course organization, and course requirement.
- Course objective were met during the course
- The general design and layout of the materials
- Textbook was appropriate for the course
- Time given to complete and return the assignment
- The assignments related to the course
- The instructors in terms of being prepare for the class
- The instructors in term of assistance and consultation to students.
- The instructor's performance in this course
- The instructor in terms of being concerned with the students' progress
- This course in general

Overall, the mean scores on these statements ranged from 3.40 to 3.95 (out of 5.00). Results showed that students

Figure 2. Students' Satisfaction to Course Instruction and Instructor



provided the highest positive response for the instructors in terms of being prepared for the class (mean = 3.95) and the lowest mean for the instructors in terms of being concerned with the students' progress (mean = 3.40). Figure 2 *(see page 5)* presents values of mean and standard deviation of all 11 items.

2. Use of Web-Based Tools and Activities

Research question Two related to survey questions 22 – 32, which asked students to rate their level of satisfaction with the web-based tools that contributed to their understanding of course content. There were eleven items in the category of activities and web-based tools including:

- The use of virtual chat
- The use of chat archives
- The use of discussion board
- The use of E-mail
- The use of case study
- The use of group activity
- Interaction among classmates
- Interaction with the instructor
- The format of material presented
- The Blackboard system was easy to navigate
- The use of Internet and World Wide Web

The mean scores on these statements ranged from 3.04 to 3.88. Results showed that students highly agreed that the Blackboard system was easy to navigate (mean = 3.88). The lowest mean was the use of group activity with a mean value of 3.04. Figure 3 presents values of mean and standard deviation of all 11 web-based tools.

3. Students' Participation

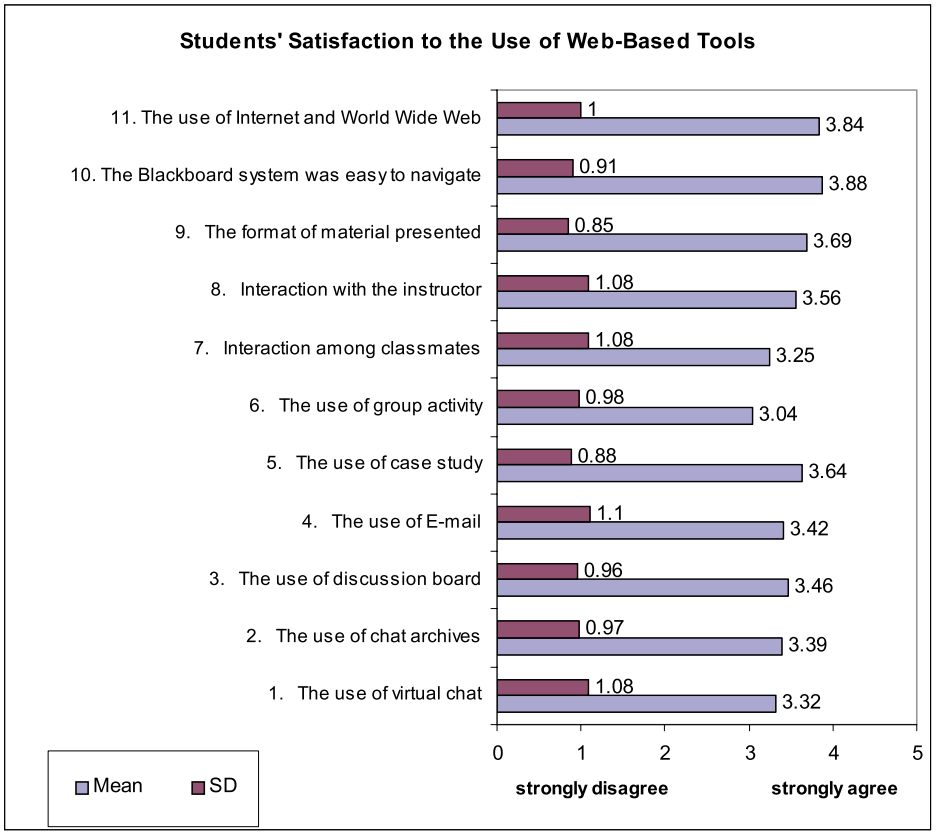
One of the advantages that web courseware offers to the course designers and instructors is to manage the activities of a course in progress. McCormack and Jones (1998) explained how to track student progress and performance with an indication of course participation. The course tracking allows the instructors to view statistics on individual pages of content. "The resulting information could be used as part of student assessment, as a justification for increased resources, to discover if the student has fulfilled a prerequisite, or to identify concepts with which students are having difficulties" (p. 300).

Research question 3 and three hypotheses were set up to help on-line instructors to understand the relationship between students' achievement and students' participation. Results of the statistical tests from 161 samples presented that there were different means of number of times students' access to the course between undergraduate and graduate students and the differences for students in grade levels: A, B, and C and lower. Details indicated the following:

- In Table 1, the F statistic for the main effect rank is 4.371. The observed p-value yields a significance level of 0.038, so the first null hypothesis is rejected at the .05 level. The mean of the number of times students access Blackboard was not the same for undergraduate and graduate students. Graduate students had a higher marginal mean than undergraduate students did.
- In Table 1, the F statistic for the main effect grade level is 7.395. The observed p-value yield a significance level is 0.001, thus the second null hypothesis is rejected at the .05 level. The mean of number of times students access Blackboard was not the same for students with different grade levels: A, B, and C and lower. Students with "A" grades had a higher marginal mean than students with "B" grades. Likewise, students with "B" grades had a higher marginal mean than students with "C or lower grades" See Figure 4.
- In Table 1, the F statistic for the interaction between students' rank and final grades is .106. The observed p-value yield a significance level is .899, thus the third null hypothesis is not rejected at the .05 level. Therefore, there is no interaction between the two variables; the effect of students' rank on number of times accessing Blackboard seems to be similar for students with grades A, B, and C and lower.

Table 2 shows the means and numbers of students in each group. Results of

Figure 3. Students' Satisfaction to the Use of Web-Based Tools and Activities



the statistical tests from 161 samples presented that graduate students accessed the course a greater number of times than undergraduates and students with better grades accessed the course more than students with poorer grades did. These 161 undergraduate and graduate students and their average number of times accessing Blackboard were 1729 times (n = 161, mean = 1729.76): students with final grade A (n = 86, mean = 2071.86), with final grade B (n = 49, mean = 1464.76), and with final grade C and lower (n = 26, mean = 1097.62).

IV. Conclusion And Discussion

The above findings show that the students with better grades had a higher number of assesses to the courseware. The number of times students access the course can be a significant predictor of students' achievement in online courses. In evaluation of the instructors and the effectiveness of web-based tools from the survey, students seemed to be satisfied with the instructors in terms of being prepared for the class with the highest mean value (3.95) in this group. However, they rated the instructors' concern with the students' progress lowest with a mean of 3.40. This may indicate that the instructors have had good preparation for presenting materials and teaching, but they might not provide enough feedback to students' progress.

The Blackboard platform for delivery of on-line courses in the Industrial Management program at CMSU seemed to be user-friendly for students and the use of the Internet and World Wide Web were highly supportive of students in their understanding of course content. Students also perceived that the use of case study and interaction with the instructor would help them in learning and understanding the course content. Nevertheless, students likely think that "interaction among classmates" and "the use of group activities" were less helpful tools in their learning. This was in contrast to "Good practice encourages cooperation among students", one of the Seven Principles of Good Practices by Chickering

Table 1. Analysis of Variance between Subjects Effects

Source	Df	F	Sig.
Corrected Model	5	9.605	.000
Intercept	1	200.414	.000
Rank	1	4.371	.038*
GRADE	2	7.395	.001*
RANK * GRLEVEL	2	.106	.899*
Error	155		

a. R. Squared = .237 (Adjusted R Squared = .212)
**p < .05

Figure 4. Estimated Marginal Means of Number of Times Accessing Blackboard

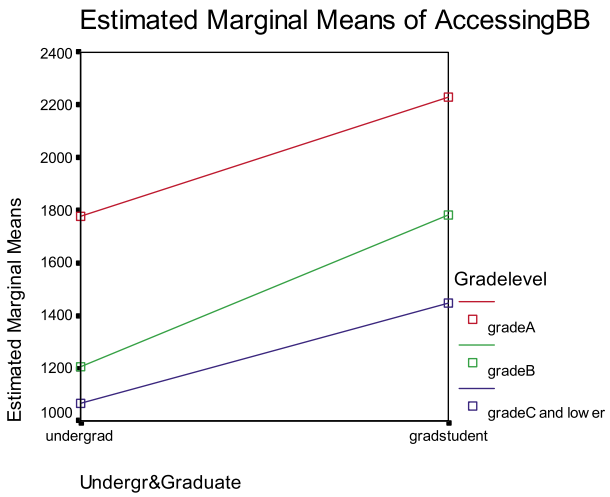


Table 2. Mean of Number of Times Accessing the Courses Grouped by Rank and Grade Level

Grade Level	Mean	N
Undergraduate Students		
Grade A	1779.33	30
Grade B	1206.59	27
Grade C and lower	1068.33	24
Total	1377.75	81
Graduate Students		
Grade A	2228.57	56
Grade B	1781.59	22
Grade C and lower	1449.00	2
Total	2086.16	80
Total		
Grade A	2071.86	86
Grade B	1464.76	49
Grade C and lower	1097.62	26
Total	1729.76	161

Note. Grade A (scores 90.00% or above), grade B (scores 80.00% - 89.99%), and grade C and lower (scores 79.99% or lower).

and Gamson. There might be several reasons that students did not seem to like to participate with classmates, for example, insufficient instructors' encouragement, lack of good instruction in group activities, or less interest in working with others because of no face-to-face interaction.

The quality measurement and evaluation makes sense only if it is put to some uses, especially product and process improvement to meet customers' satisfaction. McCormack and Jones (1998) addressed, "the greatest benefits of Web-based classrooms occur via a pedagogy that most effectively uses the characteristics of the technology to increase the quality of the learning experience" (p23). The researcher recommends the following items to improve the quality of on-line courses based on the above findings.

- Instructors should consider the ways to provide more feedback to students' progress. The actions can be shown by several means, such as providing response on the web site or in the Discussion Board, sending frequent e-mails to students, discussing projects with students via telephone conferences, and opening more opportunities for questions and answers in the class virtual chat.
- Based on the statistical results, high achieving students (better final grades) were more likely to participate in Web-based courses. Instructors may use the number of times accessing the course for grading criteria in participation.
- Students seem to be satisfied with the course materials format and the use of the Blackboard platform. However, instructors should provide clear instructions for using these items and how they work at the beginning of the semester because this tool may be quite new to some students.

Key components that on-line educators can use in their pedagogical process of Internet-based distance learning to promote student satisfaction and learning effectiveness are 1) instructional and design strategies, 2) use of web-based tools and learning activities, and 3) students' participation, as shown in Table 3.

V. Recommendations For Further Study

It is likely that the research findings derived from this study will lead to a better understanding of the utilization of web-based tools in an Internet-based distance environments. It also proposes ways to evaluate and measure qual-

Table 3. Components and Tools Used in Quality Measurement in On-line Learning

Components	Elements and Key Actions	Tools used in Quality Measurement
Instructional & Design Strategies	• The system (courseware) is easy to navigate. • The general design and layout of materials within the course contribute to students' understanding. • The course objectives are met during the course. • The instructions in using the Internet and World Wide Web for searching information are provided. • The assignments are related to the course. • The instructor prepares for the class and follows-up students' progress. • The textbook is appropriate for the course.	• Survey students' satisfaction using a questionnaire, interview, email, and telephone. • Check the completeness of course materials using a checklist. **Mean value calculation can be used to compare the level of quality in each item.
Use of Web-Based Tools and Activities	• Group project and discussion: PowerPoint presentation, paper, poster, and so on. • Assignments for individual: writing, reading, viewing video clips, searching information via the Internet or on-line library, and research paper. • Case study and problem solving • Virtual chat activity • Quizzes, mid-term and final exams • Interaction among classmates • Interaction between instructor and student	• Survey students' satisfaction using a questionnaire, interview, email, and telephone. • Grades • Discussion and comments among classmates **Mean value calculation can be used to compare the level of quality in each item.
Students' participation	• All areas of participation include communication, course contents, assignments, students' tools, and so on. • Students' rank • Group projects' participation	Track number of accessing and check percent of frequency in participation. ** Analysis of variance (ANOVA) and some other statistical tools can be used to compare the level of students' participation.

ity of course instructional design and instructor's performance. The results of the evaluation process may be helpful to continuously improve the quality of on-line programs. The following items are recommendations for further study.

- This study should be replicated with a larger population and wider range of university on-line programs. A larger population of respondents would further allow more complex levels of statistical analysis.
- Further research may focus on the factors affecting students' satisfaction with working in group activities. Is it reasonable to believe that on-line students perceive "interaction among classmates" as a less helpful tool in their understanding of course content?
- Further research may focus on evaluating more web-based tools that highly contribute to students' understanding of course content and students' achievement. This will assess the effectiveness of utilizing web-based tools to support Internet-based distance learning in higher education environments.

VI. References

American Society for Quality (2000). Draft standard: guideline for education (BSR/ASQ – Z1.11-2000). http://standardsgroup.asq.org.

Belanger, F. & Jordan, D. (2000). Evaluation and implementation of distance learning: technologies, Tools and techniques. Hershey, PA: Idea Group Publishing.

Chickering, A. & Gamson, Z. Seven principles for good practice in undergraduate education. Winona, MN: Winona State University, Seven Principles Resource Center, 1987.

Cole, R. A. (Ed.) (2000). Issues in web-based pedagogy: A critical primer. West Port, CT: Greenwood Press.

Lang, F.M. (2000) Distance learning: designing new frontiers. UMI Dissertation Services. (UMI No.9976885).

Mayadas, F., Bourne, J., & Moore, J. C. (2002). Introduction. In J. Bourne & J. C. Moore (Eds.), *Elements of quality online education* (pp. 7-12). MA: The Sloan Consortium.

McCormack, C. & Jones, D.(1998). Building a web-based educations system. NY: John Wiley & Sons, Inc.

Testa, A. M. (2000). Seven principles for good practice in teaching and technology. In R. A. Cole (Ed.), *Issues in Web-based pedagogy* (pp. 237 – 244). West Port, Connecticut: Greenwood Press.

The Institution for Higher Education Policy (2000). Quality on the line: Benchmarks for success in internet-based distance education. Washington, DC. Retrieved on: March 2001, Available at: http://www.ihep.com/Pubs/PDF/Quality.pdf

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