AC 2009-858: ASSESSMENT OF THE WORLD WIDE WEB AND TECHNOLOGY-ENHANCED LEARNING AT MIAMI UNIVERSITY

Mysore Narayanan, Miami University

DR. MYSORE NARAYANAN obtained his Ph.D. from the University of Liverpool, England in the area of Electrical and Electronic Engineering. He joined Miami University in 1980 and teaches a wide variety of electrical, electronic and mechanical engineering courses. He has been invited to contribute articles to several encyclopedias and has published and presented dozens of papers at local, regional , national and international conferences. He has also designed, developed, organized and chaired several conferences for Miami University and conference sessions for a variety of organizations. He is a senior member of IEEE and is a member of ASME, SIAM, ASEE and AGU. He is actively involved in CELT activities and regularly participates and presents at the Lilly Conference. He has been the recipient of several Faculty Learning Community awards. He is also very active in assessment activities and has presented more than a dozen papers at various Assessment Institutes. His posters in the areas of Bloom's Taxonomy and Socratic Inquisition have received widespread acclaim from several scholars in the area of Cognitive Science and Educational Methodologies. He has received the Assessment of Critical Thinking Award twice and is currently working towards incorporating writing assessments that enhance students' critical thinking capabilities.

Assessment of World Wide Web and Technology Enhanced Learning at Miami University

Abstract

At Miami University, *Distance Education* has become a reality in the area of four year mechanical and electromechanical engineering technology B.S. degree completion programs. At present, both the programs have been accredited by ABET. Successful implementation of distance education is a great accomplishment in an era when we are searching for different ways to better serve the needs of non-traditional students. This new learning environment utilizes and encompasses a variety of modern technologies that include World Wide Web and I.V.D.L. (Interactive Video Distance Learning). In addition, certain instructors utilize a variety of well structured independent internet activities known as "Research Reports" and "Tech. Topic Term Papers." Basically, the principle has been to encourage faculty utilize modern technological innovations in their educational methodologies to supplement, enhance and expand student learning beyond the boundaries of the traditional classroom. In this paper, the author tries to describe his accomplishments at the School of Engineering and Applied Science at Miami University of Ohio.

Introduction

Researchers have shown that systematic use of technology actually helps instructors address perceptual dimensions of learning. Technology should not be viewed just as a growing trend; rather it must be intelligently implemented as a valuable instructional tool that can accommodate diverse learning styles of 21st century students. (Watkins, 2005). It is important to acknowledge that students learn better when alternative modes of information processing are made available at college campuses. Dr. Walter B. Barbe, a nationally known authority in the fields of reading and learning disabilities has shown that perceptual modality styles provides an indication of an individual's dominant learning mode. The degree of processing speed, accuracy and retention that an individual is able to accomplish when encountering information depends upon to what extent the medium in which information presented matches his or her learning style. (Barbe & Milone 1980 and 1981). In this presentation, the author describes how he has implemented Barbe's ideas into his classroom activities and created different learning environments for engineering students.

Leading scholars in the area of *Cognitive Science and Educational Methodologies* have concluded that it is essential that students need to be taught in a learning environment that enables them to acquire problem-solving skills. The 21st century workplace does not need employees who have just mastered a particular body of

information, instead it prefers to have liberally educated workforce who have mastered written and oral communication skills in addition to acquiring knowledge in their chosen discipline. (Saxe, 1988; Senge, 1990; Sims, 1995). Educators should not allow the students to wonder whether they have been learning anything that would actually serve them in the workplace, upon graduation (Barr & Tagg, 1995). It is also important to recognize that state legislatures have introduced demands for outcome assessment (Magill & Herden, 1995). In this paper, the author outlines and discusses three important ideas that are frequently cited in literature.

They are:

Project Based Units

Instructional Systems Design and

Principles of Good Practice

Project Based Units

Intel Education informs that:

Authentic project work puts students in the driver's seat of their own learning. It is important that instructors take advantage of curriculum developed by teachers in a large collection of Unit Plans that integrate technology. Models of meaningful classroom projects that integrate instruction in thinking skills along with tools and strategies for developing one's own exemplary technology-supported learning are always encouraged. They focus on three areas:

1. *It is important to learn how project-based units can effectively engage students in meaningful work and promote higher-order thinking.*

2. *It is necessary to see how questions and ongoing assessment keep project work focused on important learning goals.*

3. *One needs to gather ideas from a collection of exemplary Unit Plans and design one's own technology-rich teaching plan*

(http://www.intel.com/education/designprojects/)

The author has attempted to utilize these principles when he assigned 'research reports' and 'tech. topic term papers' to students. The author assigns about ten such assignments per semester aimed at providing the students an opportunity to 'discover' a topic on their own.

Instructional Systems Design

The principle behind a well structured *Instructional Systems Design* is to ensure that the *subject matter content* is effectively integrated with the *presentation* format. The task in front of the facilitator will be blend the content and presentation in theory as well as practice. Modern technology provides ample opportunities for the instructors to experiment on innovative ideas that can lead to effective classroom instructional strategies. Instructional Systems Design (ISD) was made popular by Walter Dick and Lou Carey whose famous quote is: *"You can't provide a solution until you know what the problem is."* In this presentation, the author outlines how he has successfully created and implemented certain learning modules that help address certain criteria specified by ABET (Dick & Cary, 1996).

One can conclude that learning has taken place when the instructor observes a change of learner behavior (Keefe, 1988). This learner behavior must be the result of what has been experienced in the process of instruction (Pascarella & Terenzini, 1991). One can also recognize that the learning style of an individual student only by observing his/her overt behavior (Keefe 1987). It is also important to identify that in order to develop a sense of agency, student affairs professionals must possess four dimensions of learning that specify desired outcomes: cognitive competence, intrapersonal competence, interpersonal competence, and practical competence (Baxter Magolda, 1999).

At Ohio State University in Columbus Ohio, ***Technology Enhanced Learning and Research*** *(TELR) reports directly to the Office of the Chief Information Officer (CIO). At the heart of TELR is the TELR Design Team, a team of highly skilled professionals comprising instructional technologists, visual and web designers, web programmers, accessibility specialists, and researchers. The team provides Ohio State's academic community and its external partners with scalable, end-to-end eLearning and visual communication solutions.* (*http://telr.osu.edu/)*

TELR's mission is to champion the enhancement of teaching and learning through the thoughtful integration of innovative instructional technologies, strategies, and research. TELR opens new realms of possibilities in transforming learning environments for faculty, staff, and students, both on campus and at a distance. In a concerted effort to support these endeavors, TELR encourages exploration and innovation in the use of instructional technologies, provides guidance and solutions in visual and instructional design, expands instructional technology research, and builds partnerships locally and globally. (*http://telr.osu.edu/)*

Utilizing real-world problems as a stimulus for student learning is not at all new and has been in practice for a very long time. Problem-based learning has been defined as minds-on, hands-on, focused, experiential learning. (Wilkerson & Gijselaers, 1996). A problem-based curriculum is significantly different from the traditional discipline centered curriculum. (Woods, 1994). Instructors are considered to serve as problem-solving colleagues assigned with the responsibility of promoting interest and enthusiasm for learning. Instructors are also encouraged to act as cognitive coaches who can nurture an environment that can support open inquiry. (Barrows, 2000).

It is important that the aims and objectives of problem-based learning are reflected in every aspect of the learning environment created. Problem-based curriculum should document accomplishments at the upper levels of Bloom's Taxonomy Triangle. (Boud & Feletti, 1991). Scholars in the area of cognitive science and educational psychology have identified four features that clearly separate a problem-based curriculum from a traditional, topic-based curriculum. (Nickerson, et. al. 1985).

In this presentation, the author describes how he has utilized the four features in their Senior Design Capstone Course. He also presents analyses of the feedback data he obtained and suggests guidelines for further improvement. The four important components of assessment are shown in Figure 1 and Figure 2 indicates the procedure followed by the author while carrying out this study (Narayanan, 2007 & 2008).

Principles of Good Practice

Authors, Alexander W. Astin, Trudy W. Banta, K. Patricia Cross, Elaine El-Khawas, Peter T. Ewell, Pat Hutchings, Theodore J. Marchese, Kay M. McClenney, Marcia Mentkowski, Margaret A. Miller, E. Thomas Moran and Barbara D. Wright developed a document in 1996 under the auspices of the AAHE (American Association for Higher Education) Assessment Forum with support from the Fund for the Improvement of Postsecondary Education with additional support for publication and dissemination from the Exxon Education Foundation. These nine authors have generated a list of nine principles that the authors have reproduced below (Narayanan, 2007 & 2008).

American Association for Higher Education
Principles of Good Practice for Assessing Student Learning

1. **The assessment of student learning begins with educational values.** Assessment is not an end in itself but a vehicle for educational improvement. Its effective practice, then, begins with and enacts a vision of the kinds of learning we most value for students and strive to help them achieve. Educational values

should drive not only *what* we choose to assess but also *how* we do so. Where questions about educational mission and values are skipped over, assessment threatens to be an exercise in measuring what's easy, rather than a process of improving what we really care about.

2. **Assessment is most effective when it reflects an understanding of learning as multidimensional, integrated, and revealed in performance over time.** Learning is a complex process. It entails not only what students know but what they can do with what they know; it involves not only knowledge and abilities but values, attitudes, and habits of mind that affect both academic success and performance beyond the classroom. Assessment should reflect these understandings by employing a diverse array of methods, including those that call for actual performance, using them over time so as to reveal change, growth, and increasing degrees of integration. Such an approach aims for a more complete and accurate picture of learning, and therefore firmer bases for improving our students' educational experience.

3. **Assessment works best when the programs it seeks to improve have clear, explicitly stated purposes.** Assessment is a goal-oriented process. It entails comparing educational performance with educational purposes and expectations -- those derived from the institution's mission, from faculty intentions in program and course design, and from knowledge of students' own goals. Where program purposes lack specificity or agreement, assessment as a process pushes a campus toward clarity about where to aim and what standards to apply; assessment also prompts attention to where and how program goals will be taught and learned. Clear, shared, implementable goals are the cornerstone for assessment that is focused and useful.

4. **Assessment requires attention to outcomes but also and equally to the experiences that lead to those outcomes.** Information about outcomes is of high importance; where students "end up" matters greatly. But to improve outcomes, we need to know about student experience along the way -- about the curricula, teaching, and kind of student effort that lead to particular outcomes. Assessment can help us understand which students learn best under what conditions; with such knowledge comes the capacity to improve the whole of their learning.

5. **Assessment works best when it is ongoing not episodic.** Assessment is a process whose power is cumulative. Though isolated, "one-shot" assessment can be better than none, improvement is best fostered when assessment entails a linked series of activities undertaken over time. This may mean tracking the process of individual students, or of cohorts of students; it may mean collecting the same examples of student performance or using the same instrument semester after semester. The point is to monitor progress toward intended goals in a spirit of continuous improvement. Along the way, the assessment process itself should be evaluated and refined in light of emerging insights.

6. **Assessment fosters wider improvement when representatives from across the educational community are involved.** Student learning is a campus-wide responsibility, and assessment is a way of enacting that responsibility. Thus, while assessment efforts may start small, the aim over time is to involve people from across the educational community. Faculty play an especially important role, but assessment's questions can't be fully addressed without participation by student-affairs educators, librarians, administrators, and students. Assessment may also involve individuals from beyond the campus (alumni/ae, trustees, employers) whose experience can enrich the sense of appropriate aims and standards for learning. Thus understood, assessment is not a task for small groups of experts but a collaborative activity; its aim is wider, better-informed attention to student learning by all parties with a stake in its improvement.

7. **Assessment makes a difference when it begins with issues of use and illuminates questions that people really care about.** Assessment recognizes the value of information in the process of improvement. But to be useful, information must be connected to issues or questions that people really care about. This implies assessment approaches that produce evidence that relevant parties will find credible, suggestive, and applicable to decisions that need to be made. It means thinking in advance about how the information will be used, and by whom. The point of assessment is not to gather data and return "results"; it is a process that starts with the questions of decision-makers, that involves them in the gathering and interpreting of data, and that informs and helps guide continuous improvement.

8. **Assessment is most likely to lead to improvement when it is part of a larger set of conditions that promote change.** Assessment alone changes little. Its greatest contribution comes on campuses where the quality of teaching and learning is visibly valued and worked at. On such campuses, the push to improve educational performance is a visible and primary goal of leadership; improving the quality of undergraduate education is central to the institution's planning, budgeting, and personnel decisions. On such campuses, information about learning outcomes is seen as an integral part of decision making, and avidly sought.

9. **Through assessment, educators meet responsibilities to students and to the public.** There is a compelling public stake in education. As educators, we have a responsibility to the publics that support or depend on us to provide information about the ways in which our students meet goals and expectations. But that responsibility goes beyond the reporting of such information; our deeper obligation -- to ourselves, our students, and society -- is to improve. Those to whom educators are accountable have a corresponding obligation to support such attempts at improvement.

Paul Nolting & Hunter Boylan

Dr. Paul Nolting, Title III Coordinator at Manatee Community College Bradenton, Florida 34207 has compared

Student Learning Styles of Developmental Math Students to *Faculty Learning Styles.*

In his publication Dr. Paul Nolting concludes:

> *"It would be a mistake to think that the only problem under prepared students have is their knowledge base (McCabe, 2003). The idea of learner-centered education is that students must make a connection between the content and their perception of learning (Perin, 2001). To help students better understand their learning, some institutions have attempted to help students define their own learning style by giving them different learning styles inventories."*

Dr. Paul Nolting also comments that:

> *"By identifying student learning styles and dissemination styles, then students have a better chance to identify with a delivery method that most closely aligns with their ability to learn (McCabe, 2003). Also faculty would have a better understanding on how their students learn in order to modify some of their delivery methods."*

Hunter R. Boylan is the Chairperson for American Council of Developmental Education Associations. In his book,

What Works: Research-Based Best Practices in Developmental Education,

Dr. Boylan gives tips for accommodating diversity through instruction (Boylan, 1999 & 2002). His tips are to train faculty in alternative forms of instruction if they are expected to use diverse instructional methods, administer a learning styles inventory to students as a regular assessment process, share the learning styles information with the faculty to encourage faculty to accommodate dominate learning styles and that students learn best when they have a visual representation and can manipulate objects associated with the concepts (Narayanan, 2007). Using these suggestions math faculty can have a positive effect on student learning. (Appalachian State University's NCDE: National Center for Developmental Education)

Research by Dr. Hunter R. Boylan indicates that there are 86% visual learners, 11% auditory learners and 3% tactical-concrete learners. (Boylan 1999 & 2002). The author has tried to correlate his data with those of Dr. Boylan. The author has previously published (Narayanan, 2007) a comparative study of his results and those of Dr. Boylan. However, in this study, the author utilizes a variety of instructional tools to communicate with students who may have different learning styles. Whenever appropriate, the author helps the students with descriptive

handouts and solution to some selected problems. *"Blackboard"* is used in addition to instructor generated *CDs.* Assessment of selected *"Primary Traits"* was carried out using Washington State University's Critical Thinking Rubric. (http://wsuctproject.wsu.edu/ctr.htm)

Implementation and Assessment

At Miami University, the author has tried to implement ideas from these scholars into practice using modern technology. This includes the World Wide Web, I.V.D.L. (Interactive Video Distance Learning) in addition to regular and routinely used audio visual techniques. The author utilizes a variety of instructional tools (Lectures, Audio-visual aids, Power Point Presentations, Tutorials, Problem-solving sessions, written research reports, peer group discussions, etc.) to communicate with students who may prefer to have different learning styles. The author also recommends that students utilize the resources that are readily available at the university, such as *Library. Writing Center,* etc.

Figure 1 shows the four important components of assessment. Appendix A shows the rubrics that were used to carry out assessment. The author used a rubric that is very much similar to *Washington State University's Critical Thinking Rubric* while administering grading. The data obtained was tabulated using a Likert Scale. The author has collected data pertaining to other *"Primary Traits"* and is in the process of analyzing and arriving at conclusions (Narayanan, 2007 & 2008).

Conclusions

Appendix B documents the data collected using a bar chart. It must be noted that it is highly desirable to achieve mode values of 5 on all the seven characteristics; however this is probably unrealistic in an undergraduate environment. This is a bar chart for the entire population of the course (Total of 32 Students). The author realizes that this sample size is relatively small. He has plans to deploy these ideas in other classes as well. Furthermore, the author is in the process of accumulating and gathering data over a number of years so that he is able to track the increasing awareness about the learning process in students. It is easily seen from the bar chart that some characteristics show a respectable mode values of 4. However, there is room for improvement on other characteristics.

An in depth analysis of the bar chart indicates the following:

1. Identification of problem on hand has scored a 4 which is an acceptable rating.
2. There is room for improvement in the second category that pertains to context.

3. Much more effort is needed while the student develops hypotheses.

4. Data analysis shows a respectable mode value of 4.

5. A mode value of 2 indicates that more progress is to be made in this area.

6. Conclusions and communication must be improved to record at least 4.

7. A score of 3 indicates that students need to understand what is expected of them.

The author understands that the students need to be provided more exposure and help in several areas such as development of hypotheses, communications, context, interdisciplinary perspectives, etc. The author plans to bring in some *'outside experts'* in these areas as guest lecturers in order to provide necessary and appropriate guidance to the students. This will be accomplished when the author is assigned to teach the same class next time.

Washington State University's Critical Thinking Rubric has proved to be extremely valuable in documenting the effectiveness of systematic use of technology. This has helped the instructor address perceptual dimensions of learning and thereby giving him proper guidance for moving in the right direction. Such assessment data provides the instructor to make appropriate changes in the manner in which the course is developed and may necessitate changes in Instructional Delivery Styles.

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FIGURE 1: THE FOUR IMPORTANT COMPONENTS OF ASSESSMENT

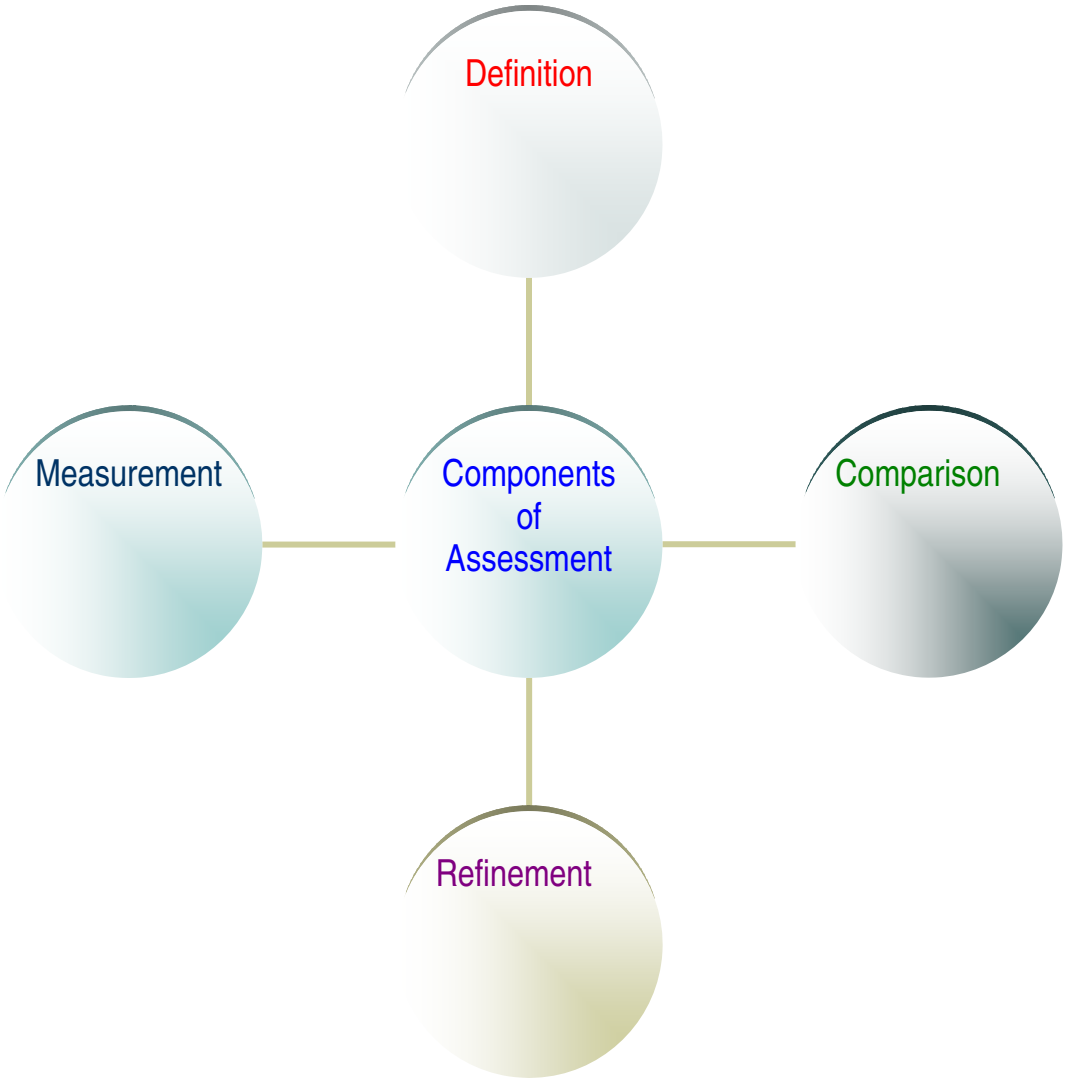
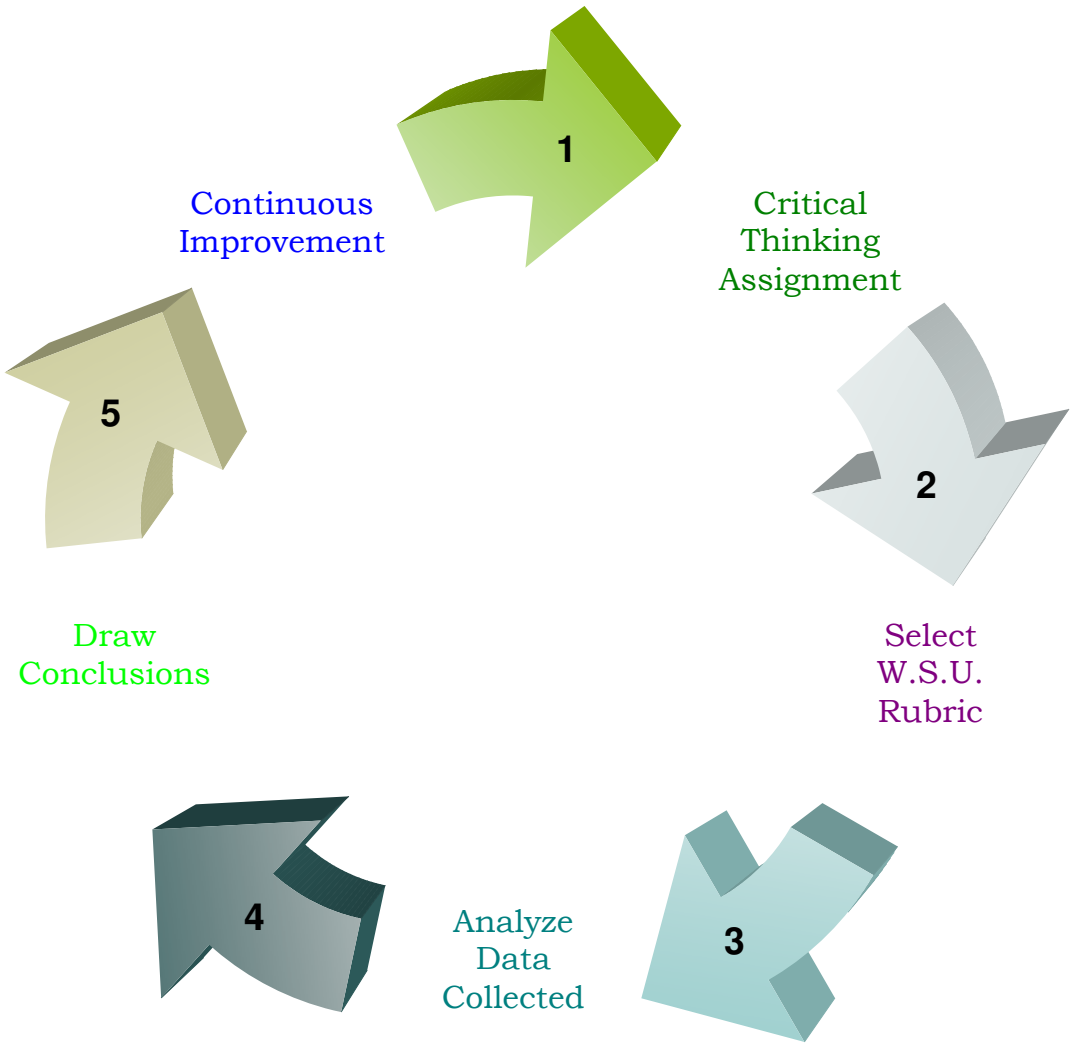


FIGURE 2: ASSESSMENT CYCLE: PROCEDURE FOLLOWED



APPENDIX A: RUBRICS USED TO GENERATE BAR CHART

	Rubrics based on Likert Scale	
5	Has demonstrated excellence. Has provided documentation. Evidence of critical thinking ability. Very good performance	Has analyzed important data precisely. Has answered key questions correctly. Has addressed problems effectively. Has evaluated material with proper insight. Has used deductive reasoning skills. Has used inductive reasoning skills. Has employed problem solving skills. Has discussed consequences of decisions. Has been consistent with inference.
3	Has demonstrated competency. Adequate documentation. Critical thinking ability exists. Acceptable performance.	Data analysis can be improved. More effort to address key questions. Need to address problems effectively. Expand on evaluating material. Improve deductive reasoning skills. Improve inductive reasoning skills. Problem solving skills need honing. Must discuss consequences of decisions. Has been vague with inference.
1	Poor, unacceptable performance. Lacks critical thinking ability.	Absence of analytical skills. Answers questions incorrectly. Addresses problems superficially. Lacks documentation. Inability to evaluate material. Shows no deductive reasoning power. Inductive reasoning power non existent. Poor problem solving skills Unaware of consequences of decisions. Unable to draw conclusions.

http://wsuctproject.wsu.edu/ctr.htm

APPENDIX B: LIKERT SCALE BAR CHART ANALYSIS

1. Identification of problem has scored a 4 which is an acceptable rating.
2. There is room for improvement in the second category that pertains to context.
3. Much more effort is needed while the student develops hypotheses.
4. Data analysis shows a respectable mode value of 4.
5. A mode value of 2 indicates that more progress is to be made in this area.
6. Conclusions and communication must be improved to record at least 4.
7. A score of 3 indicates students need to *understand* what is expected of them.