AC 2010-2378: ASSESSMENT OF ENVIRONMENTAL EDUCATION

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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 thirty five papers at various conferences and Assessment Institutes. His posters in the areas of Assessment, 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 assignments that enhance students' critical thinking capabilities.

Assessment of Environmental Education

Abstract

All scholars and educators agree that assessment practices throughout the country are experiencing a state of rapid transition. It is also possible that many techniques used in assessment may not examine how classroom practices have played significant roles in contributing towards specific student learning outcomes. Educational psychologists and leading scholars have also indicated that assessment techniques should actually analyze and examine the interaction between the two key players, namely the student and instructor. Nevertheless, many tools used in assessment of learning often try to document students' knowledge. However, these traditional methods for evaluating teaching typically examine only the instructional practices. These techniques often ignore how those instructional practices have actually contributed toward influencing students' intellectual development. Therefore, one of the main objectives of assessment practices should be to document the desired competency and strengthen students' professional development. Furthermore, it should also promote to instill a desire and motivate an ambition for lifelong learning. Other scholars have also arrived at similar conclusions and have emphasized the importance of creating *learner-centered environments.* In this presentation, the author attempts to outline specific methods to record, report and review assessment data that can help instructors document certain specific aspects of students' learning and educational accomplishments. The author also provides an example for assessing certain chosen aspects of environmental education.

Introduction

Assessment will be productive if the instructional module is well designed to facilitate student learning through a process of discovery. Pascarella and Terenzini (1991) have conducted massive review of research on the development of students in college, and have focused on the consequences of decisions on students' development. They have also called for a new standard of quality, one based on the quality of student development. Pascarella and Terenzini have also concluded that there is an urgent need for a shift in the decision-making orientation of administrators toward *learner-centered management.* The main objective of the instructional module generated by instructors must be to ensure that the subject matter content is effectively integrated with the presentation format (Grasha, 1990, 1996). In other words, the task in front of the instructor would be to blend the content and presentation in theory as well as practice (Gagne, 1992; Briggs, 1991). Here, the instructor assumes the role of a facilitator and effectively utilizes modern technology to experiment on innovative ideas that can lead to new classroom instructional strategies (Tozman, 2004). Furthermore, in order to understand the *process of learning,* one has to examine every aspect of student life (Kolb, 1985). The entire *resource bank* of the university should bear responsibility for creating a new configuration that can help the learning process of the entire student population (Claxton & Smith, 1984).

The author has previously reported on twelve assessment techniques that could probably be utilized in any modern academic environment. Appendix K outlines these twelve techniques (Narayanan, 2004). The author believes that these twelve techniques, combined with the principles of total quality management can guide the instructor through multiple paths for conducting assessment. Barbe & Milone have also concluded that 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). Hobbs Professor of Cognition and Education at the Harvard Graduate School of Education, Howard Gardner has discussed about recognizing the importance of multiple intelligences in an educational environment (Gardner, 1993).

The literature supports our intuitive belief that education in a new learning paradigm will prepare students for the work ahead of them (Cox, Grasha and Richlin, 1997). This indeed helps in raising expectations from the students. Whether it be performance arts like theatre and music, or be it a laboratory setting like physics or biology, student performance can be effectively accentuated by adopting creative instructional lesson plans (Baxter-Magolda, 1992). Furthermore, many of our educational institutions have tried to move away from emphasizing the establishment of a strong knowledge base (Young and Young, 1999). In other words, one can say that declarative *learning* should only be a part of the learning process. It is important to recognize the fact that the *discovery* approach is gaining prominence day by day.

Instructional Modules

Educational Psychologist Lauren B. Resnick, Professor of Psychology and former Director and Senior Scientist of Learning Research and Development Center at the University of Pittsburgh has carried out extensive research and has made notable contributions in the area of cognitive science with particular attention to student learning, instructional delivery styles and assessment (Edgerton, Hutchings, & Quinlan, 1991). Dr. Resnick is the recipient of the 1998 E. L. Thorndike Award from the American Psychological Association. Dr. Resnick who is world famous for her research in the area of assessment, indicates: *What we assess is what we value. We get what we assess, and if we don't assess it, we don't get it.* Most researchers and scholars agree that students must be encouraged to take charge of their own learning responsibilities and organize their educational programs and activities (McClymer & Knowles, 1992).

Moreover, educators are now being asked to demonstrate evidence of successful learning by the student body. It is also important to recognize that state legislatures have introduced and are in the processes of introducing demands for outcome assessment (Magill & Herden, 1998). 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, 1990; Senge, 1990; Sims, 1992). 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 that faculty members aspire to become masters of cognitive studies (Forrest, 1990).   They should be motivated and be driven to develop scholarship of pedagogy and a curriculum structure that can draw upon and embody learning principles (Huba & Freed, 2000).   For example, the Wharton School of the University of Pennsylvania has embarked on a mission to educate students with a broader perspective (Bennett & O'Brien, 1994).   They are encouraging students to become more open-minded and well articulated.   Their objective is to generate a new generation of effective leaders that can make a dent in the global marketplace (Nichols & Nichols, 2001).

The author proposes that learning activities generated based on the principles of Fleming and Mills provide a strong background for the understanding of fundamental knowledge (Fleming and Mills, 1992).   He has presented his findings in his previous presentation at the 114th ASEE National Conference in Honolulu, Hawaii.   In his presentation, the author talked about Instructional Systems Design (ISD), which was made popular by Walter Dick and Lou Carey.   Dick and Carey's famous quote is *"You can't provide a solution until you know what the problem is."*   In other words, primarily, instructors should select a few prominent assessment tasks in their courses (Dick & Carey, 1996, 2001).   It is also important to observe that all course assignments need not necessarily be identified as assessment tasks.   It may be adequate if an instructor can designate one or two tasks from each of the chosen courses (Brookhart, 1999).

Authentic Assessment

Fallon, Hammons, Brown and Wann (Fallon, 1997) define *authentic assessment* tasks are those that

(a) are meaningful to both students and the teacher,
(b) are individual to each student's experience in order to demonstrate his or her achievement,
(c) require students to locate and analyze information as well as to draw conclusions about it,
(d) require students to communicate results clearly, and
(e) require students to work together for at least part of the task.

Moira Fallon and colleagues have also determined that the on-demand and portfolio tasks be co-dependent and supplement each other to achieve *authentic assessment.*   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 (Narayanan, 2010).

Ernest Boyer's research has also motivated the author to experiment on new ideas in the classroom.   This is because, in the nineties, Ernest Boyer argued in "*Scholarship reconsidered: Priorities of the professoriate*" that knowledge is acquired not only through research, but also through synthesis, practice, and teaching (Boyer, 1990).   Boyer's argument has elevated teaching to a level of importance so far not realized.   This is because of the fact that academia always focuses, on research.   It is important to recognize that Ernest Boyer's proposal actually pioneered the *Scholarship of Teaching and Learning* (SoTL) movement.   This has resulted in a number of federally and privately funded efforts to improve teaching in colleges and universities (Atkinson, 2001).

Methodology and Implementation

Assessment of Environmental Education can be carried out using the principles of *VARK* as outlined by Fleming and Mills (Fleming and Mills, 1992). The author has used this technique in many of his previous publications to examine the learning behavior of students. Display and analysis of *VARK* bar chart generated is shown in Appendix F. One advantage of this technique is that the instructor can analyze how the students react to multiple modes of instructional delivery styles (Gardner, 1993). Dr. Hunter R. Boylan, who is the Director of the National Center for Developmental Education at Appalachian State University in Boone, North Carolina, is of the opinion that students fail to do well in college for a variety of reasons. Furthermore, Boylan continues to say that *only one* of them is lack of academic preparedness (Boylan, 2002). Leading scholars in the area of cognitive science and educational psychology are of the opinion that factors such as personal autonomy, self-confidence, ability, study behaviors, social adjustments, diversity and discrimination may also play a vital role in the recorded grades (Astin, 1977, Chickering, 1969 and Sedlacek, 1987). Students must be encouraged to take ownership of their own learning (Mintz, 1998).

The author has used many of these principles in various other ASEE publications as well (Narayanan, 2007, 2008, 2009, 2010).

However, in this particular example, the instructor can chose to deliver four different topics in four different modes. Analysis of *VARK* bar chart generated is shown in Appendix F.

Each delivery can take place during 50-minute lecture class periods.

Topic **V**:   **Visual:**   Visual Aids such as Power Point Slides must be used.

Topic **A**:   **Aural:**   This can be delivered in the traditional lecture format.

Topic **R**:   **Reading:**   Students should be required to read and submit their findings.

Topic **K**:   **Kinesthetic:** Laboratory setting is encouraged that includes demonstrations.

It is important to organize four separate quizzes that can cover all the four topics. Grading should be holistic and the instructor must document his/her observations. No quantitative grade points or percentages must be recorded. It is important to recognize the fact that students must be examined on all the topics, quizzes must be graded and tabulated using a rubric based on *Washington State University's Critical Thinking Rubric*. A matrix for collecting, analyzing and summarizing assessment data is provided in Appendix C.

In addition, the author has provided more details in the following appendices.

The author's recommended approach for gathering assessment data is shown in Appendix A.

Assessment Rubrics, courtesy of Washington State University is shown in Appendix B.

A matrix for collecting data is shown in Appendix C.

A bar chart based on the data collected is shown in Appendix D.

Analysis of bar chart is shown in Appendix E.

Display and analysis of *VARK* bar chart generated is shown in Appendix F.

Hunter Boylan's Data has been compared with author's data in Appendix G.

Suggested Assessment Tools are shown in Appendix H.

Principles of *T.Q.M. are* shown in Appendix I.

Principles of three important models are shown in Appendix J.

Appendix K documents dozen techniques that may be helpful in conducting assessment.

The *ACORN* Model of Hawkins and Winter is shown in Appendix L.

Assessment and Conclusions

In this illustrative example, the author has identified 7 characteristics for demonstration purposes only. Each instructor may choose to select different set of characteristics. Besides the number of characteristics chosen may be more or less depending upon the instructor's needs and necessities. The number can be 10, 15, or more.

The bar chart generated is based on Likert Scale. Please refer to Appendix D.

One can observe from the bar chart that the two "traits"

Characteristic # 1 (Environment: Fundamental Knowledge and Concepts) and

Characteristic # 4 (Depth of Understanding of the Importance of Environment)

both show a respectable mode values of **4**, indicating that the students have had an adequate understanding of the concepts and importance.

However, the following other four other characteristics show mode values of **2** indicating that there is plenty of room for improvement:

Characteristic # 2 (Ability to Address the Consequences Pertaining to Environment)

Characteristic # 3 (Integration with Relevant, Contemporary Environmental Issues)

Characteristics # 5 (Development of Hypothesis Pertaining to Environmental Problems) and

Characteristic # 6 (Identification of Appropriate, Possible Solutions and Context)

However, it is interesting to note that the students are very good in presentation techniques.

Characteristic # 7 (Creative Presentation and Analysis of Data Collected) shows an excellent value of **5** on Likert Scale.

      The author has also has tried to compare his data with those from Dr. Hunter Boylan. 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. His tips are to train faculty in alternative forms of instruction if they are expected to use diverse instructional methods. One must administer a learning styles inventory to the students as a regular assessment process, and then 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 & 2009).

      One can draw the following conclusions from observing the two pie charts, shown in Appendix G. Hunter Boylan's research indicates that 89% of learners are visual, tactical and concrete learners. The author's data also indicates that majority of the student population he studied pereferred to be visual and kinesthetic learners. These type of learners recorded the maximum possible mode value of **5** on Likert scale. Hunter Boylan's research indicates that only 11% of learners were auditory learners. Author's data supports this as well. Auditory learners recorded a low score of **2** on Likert scale.

      The data collected should be viewed from multiple angles. The author believes that it is best understood when a bar chart is or pie chart is generated based on the feedback obtained. The author's experience indicates that the students are indeed much more receptive to the kinesthetic mode of learning. Simply stated, *learners prefer hands-on-training.* The author has also observed that audio-visual aids do indeed help, however, lectures have very little impact. The author understands and agrees that these data may *vary significantly* depending upon subject matter, instructor's delivery styles material content, discipline etc. It is possible that *Kinesthetic Mode* of learning may be preferred by students in scientific as well as engineering disciplines whereas *Reading Mode* of learning may be best suited for students studying English literature.

      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.* This may lead to the conclusion that, in the twenty first century, the way *instructional systems design* is carried out actually plays a very important, useful and productive role in students' learning accomplishments (Kolb, 1985). However, *instructional systems design* must be implemented correctly and in an appropriate manner in order to maximize the benefits the

learners receive.   The author acknowledges the fact that more research is required to examine in detail the yield and benefits to the learning environment.

There are also documented cases wherein students have specifically indicated that they would like to engage in a lively classroom discussion, rather than being simply lectured to (Watkins, 2005).   These lively classroom discussions have shown to allow greater student participation.   Although, some scholars say that such a method puts forth a completely different approach to college education compared to a traditional lecture format (Midgley, 2002).

Therefore, it is important to assess the students' learning capabilities and not just his/her memory (Brown & Cooper, 1976).   In other words, assessment of learning is not a third-party research project or someone's questionnaire; it must be viewed as a community effort or nothing, driven by a faculty's own commitment to reflect, judge, and improve (Marchese, 1991 & 1997).

Hawkins and Winter's **ACORN** model also helps to document ideas and provides guidelines to conquering and mastering change (Hawkins and Winter, 1997). Their model is shown in Appendix L.

All instructors should utilize these helpful hints and build on the knowledge base created by these scholars (Parks, 2000).   Furthermore, faculty involvement is a vital part and it is essential that it be made meaningful and productive (O'Banion, 1997).   A thorough discussion of a philosophy of assessment that plans and outlines the goals should actually drive the institutional continuous assessment plan (Kuh, 1993).

The wealth of knowledge acquired during the execution of an assessment task force is immensely useful while creating a strategic plan for the department, school or university.

Assessment procedural outcomes should eventually lead to implementing recommended improvements and needed changes at the educational establishment.   Here, it is important to stress the fact that the process of developing a continuous assessment plan requires careful planning and thoughtful leadership.   The author would like to quote from Ted Marchese, Senior Consultant at *Academic Search.*

> *Assessment is a process in which rich, usable, credible feedback from an act of teaching or curriculum comes to be reflected upon by an academic community, and then is acted on by that community, a department or college, within its commitment to get smarter and better at what it does.*
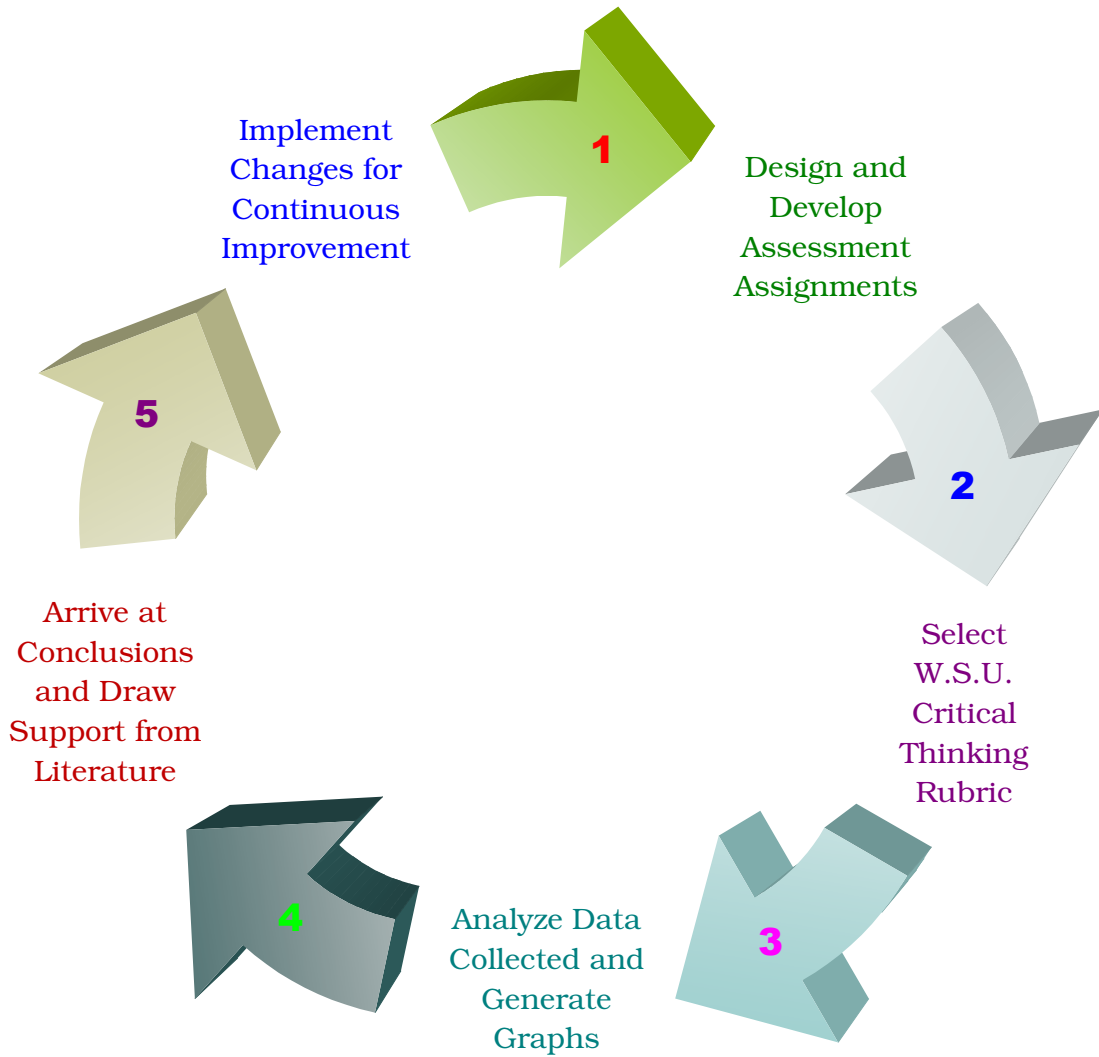>
> *(Marchese, 1997, page 93).*

Assessment is not *collecting*   data.
It is actually about *connecting* data that is already available.

Acknowledgements

APPENDIX A: Recommended Approach for Conducting Assessment

Implement Changes for Continuous Improvement

1

Design and Develop Assessment Assignments

5

Arrive at Conclusions and Draw Support from Literature

2

Select W.S.U. Critical Thinking Rubric

4

Analyze Data Collected and Generate Graphs

3

APPENDIX B: Rubrics for conducting assessment

Rubrics based on Likert Scale	Courtesy of W.S.U., Pullman, WA. 99164

5

Has demonstrated excellence. Has provided documentation. Evidence of Creativity Exists. Very good performance	Has analyzed important data precisely. Has answered key questions correctly. Has addressed problems effectively. Has evaluated with proper insight. Has used deductive reasoning skills. Has used inductive reasoning skills. Has employed problem-solving skills. Discusses consequences of decisions. Has been consistent with inference.

3

Has demonstrated competency. Adequate documentation. Creativity can be improved. 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 Creativity.	Absence of analytical skills. Answers questions incorrectly. Addresses problems superficially. Lacks documentation. Inability to evaluate material. Shows no deductive reasoning power. Inductive reasoning power nonexistent. Poor problem solving skills Unaware of consequences of decisions. Unable to draw conclusions.

APPENDIX C: Suggested Matrix for Collecting Data.

Assessment of Environmental Education											

TOTAL xx STUDENTS #	A	B	C	.	.	.	X	Y	Z	MEDIAN	MODE

THE CRITICAL THINKING RUBRIC
RUBRIC COURTESY OF W. S. U.
WASHINGTON STATE UNIVERSITY
PULLMAN, WA. 99164.
LIKERT SCALE WEIGHT DISTRIBUTION :
(1 : Strongly Disagree; 5 : Strongly Agree)

#		A	B	C	.	.	.	X	Y	Z	MODE
1	Environment: Fundamental Knowledge and Concepts	4	5	3	.	.	.	4	4	4	4
2	Ability to Address the Consequences Pertaining to Environment	3	4	4	.	.	.	4	3	3	2
3	Integration with Relevant, Contemporary Environmental Issues	5	4	3	.	.	.	3	4	5	2
4	Depth of Understanding of the Importance of Environment	4	3	4	.	.	.	3	3	4	4
5	Development of Hypothesis Pertaining to Environmental Problems	3	3	5	.	.	.	3	4	4	2
6	Identification of Appropriate, Possible Solutions and Context	4	2	2	.	.	.	3	4	2	2
7	Creative Presentation and Analysis of Data Collected	5	5	5	.	.	.	4	5	4	5

Sources:

Narayanan, Mysore. (2008). *Assessment of Air Quality Education using VARK Learning Styles.* World Environmental and Water Resources Congress 2008 - Ahupua'A. Honolulu, Hawaii. pp. 1-6, pp. 1-6, doi 10.1061/40976(316)629.

Narayanan, Mysore (2009). *Assessment Based on the Principles of Theodore Marchese.* Austin, Texas. Proceedings of 116th ASEE Annual National Conference. June 24-27, 2009.

APPENDIX D: **Bar Chart Generated based on Collected Data .**
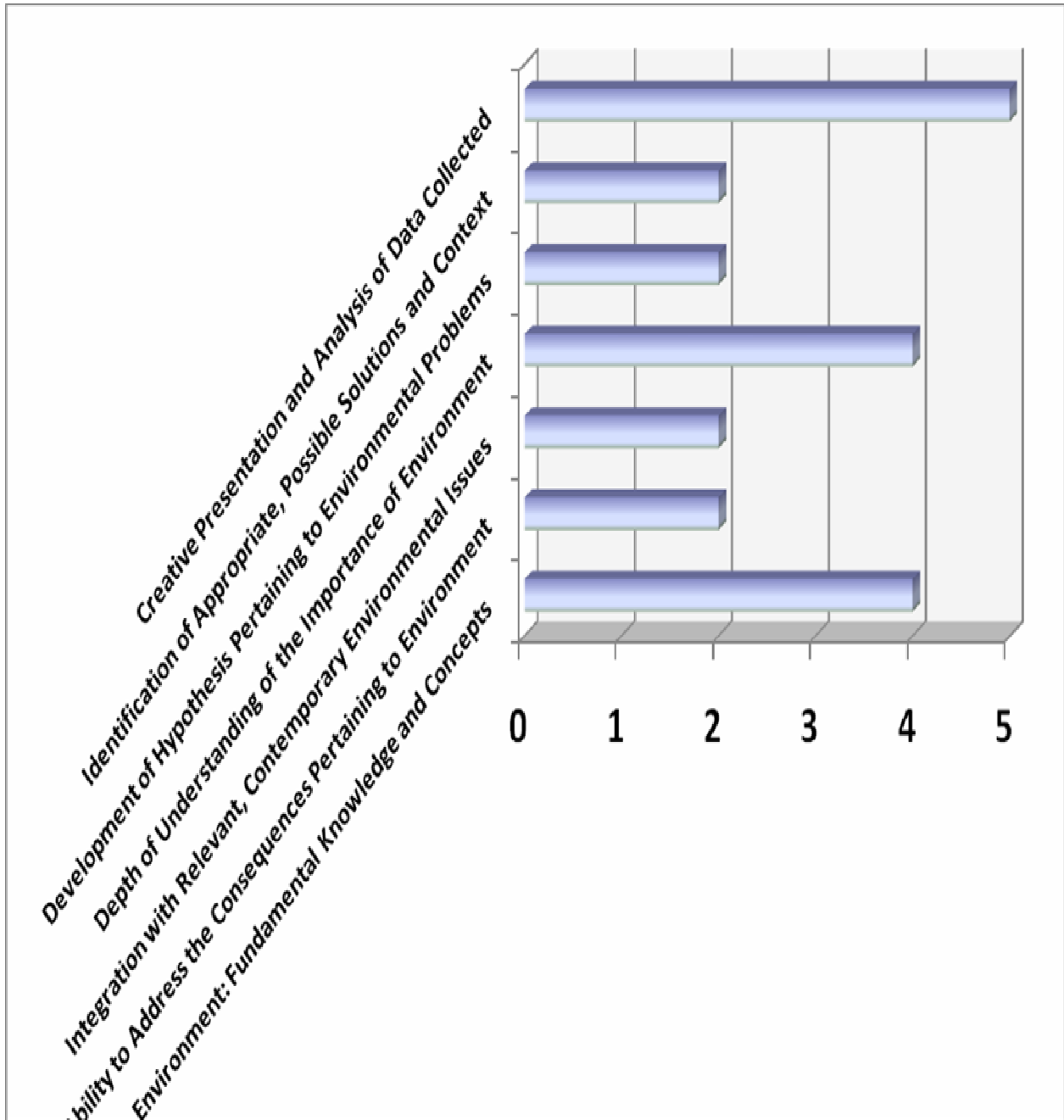
Likert Scale Analysis.

5: **Best Possible Scenario**
1: **Needs Improvement**

APPENDIX E: Analysis of Bar Chart Generated

The bar chart is based on Likert Scale.

One can observe from the bar chart that the two "traits"

Characteristic # 1 (Environment: Fundamental Knowledge and Concepts) and

Characteristic # 4 (Depth of Understanding of the Importance of Environment)

both show a respectable mode values of **4**, indicating that the students have had an adequate understanding of the concepts and importance.

However, the other four other characteristics show mode values of **2** indicating that there is a lot of room for improvement:

Characteristic # 2 (Ability to Address the Consequences Pertaining to Environment)

Characteristic # 3 (Integration with Relevant, Contemporary Environmental Issues)

Characteristics # 5 (Development of Hypothesis Pertaining to Environmental Problems) and

Characteristic # 6 (Identification of Appropriate, Possible Solutions and Context)

It is interesting to note that the students are very good in presentation techniques.

Characteristic # 7 (Creative Presentation and Analysis of Data Collected) shows an excellent value of **5** on Likert Scale.

The author has selected **7** characteristics for illustration purposes only.   Instructors may choose different set of characteristics.   Besides the number of characteristics chosen may be more or less depending upon the instructor's needs and necessities.   The number can be 10, 15, or more.

APPENDIX F: Display and Analysis of *VARK* Bar Chart Generated
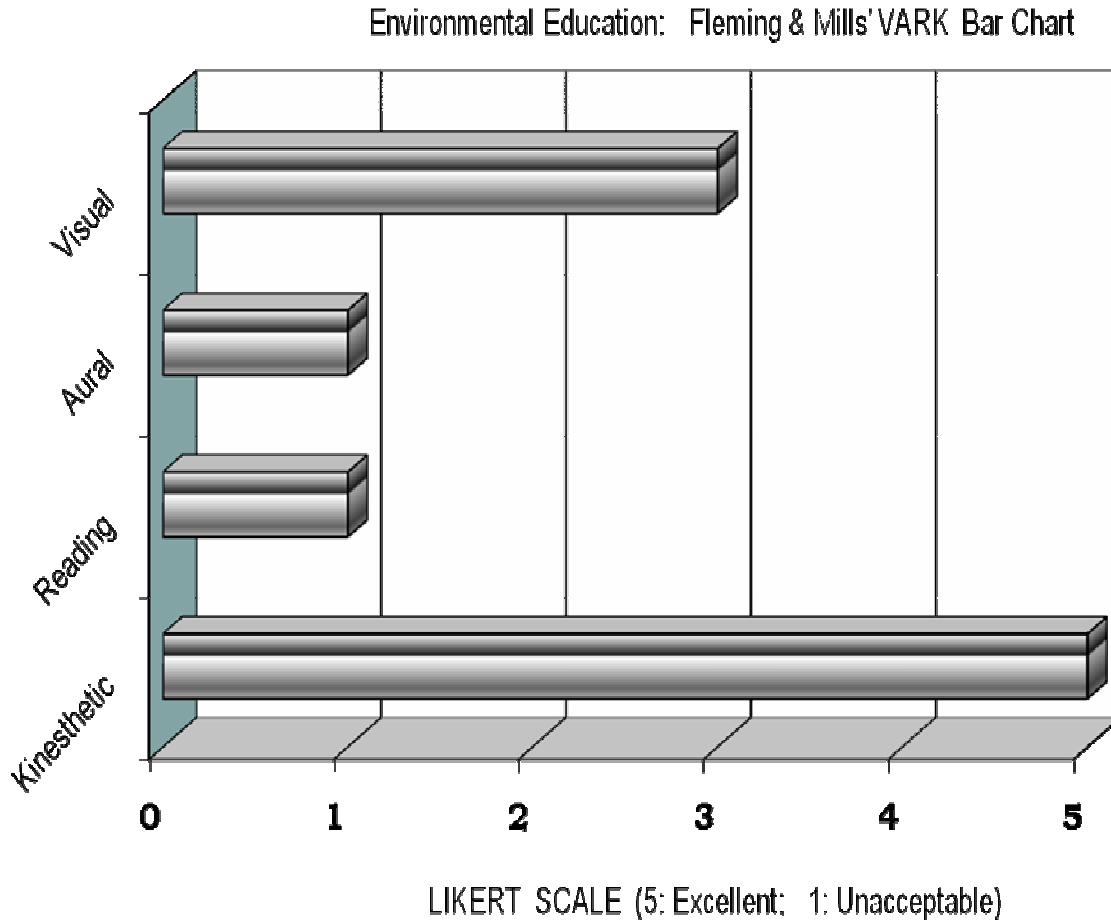
Environmental Education: Fleming & Mills' VARK Bar Chart

LIKERT SCALE (5: Excellent; 1: Unacceptable)

Narayanan, Mysore. (2008). *Assessment of Air Quality Education using VARK Learning Styles.* World Environmental and Water Resources Congress 2008 - Ahupua'A. Honolulu, Hawaii. pp. 1-6, pp. 1-6, doi 10.1061/40976(316)629.

Sources: Narayanan, Mysore (2009). *Assessment Based on the Principles of Theodore Marchese.* Austin, Texas. Proceedings of 116th ASEE Annual National Conference. June 24-27, 2009

APPENDIX F (Contd.): Analysis of *VARK* Bar Chart:

Topic **V**:   **Visual:**   In this format, visual aids were used and as such, the students have shown interest in learning the subject matter and have demonstrated an adequate understanding the topic in question.   This shows an acceptable score of **3** on Likert scale. Attempts must be made to improve this, initially to **4** and ultimately to **5.**

Topic **A**:   **Aural:**   In this format, the subject matter was delivered in a traditional lecture format.   It appears that the students are not very receptive.   It seems that they have not shown keen interest in learning the complexity of the topic, on their own.   Nevertheless, when an actual situation is presented to them, they are unable to analyze the problem in detail on their own. This shows a very unacceptable score of **1** on Likert scale.

Topic **R**:   **Reading:**   This is a format, wherein the instructor asks the students to read and write about a specific topic.   While the students may understand many of the concepts it appears that they are unable to apply the concepts while solving specific problems.   This again shows a very unacceptable score of **1** on Likert scale.

Topic **K**:   **Kinesthetic:** Obviously, this is the best format.   In this format, the instructor can provide hands-on training in a laboratory or provide a demonstration that outlines the principles.   One can observe that the students learn the subject matter fast while conducting experiments.   This shows an excellent score of **5** on Likert scale.
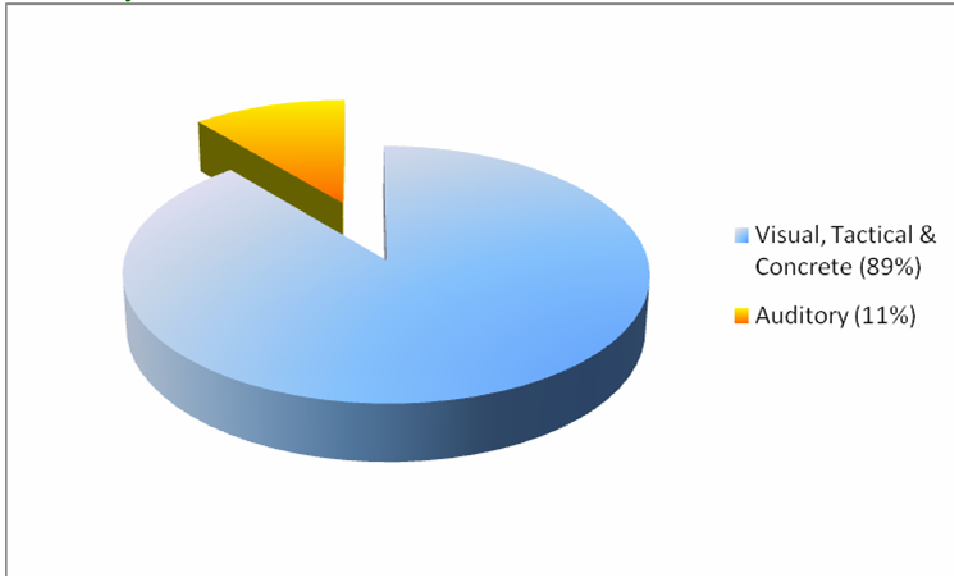
APPENDIX G: Comparison between Hunter Boylan's Research and Author's data

Hunter Boylan's Research

Visual, Tactical & Concrete (89%)
Auditory (11%)

Author's Data

Visual and Kinesthetic (Likert Scale Mode = 5)
Auditory (Likert Scale Mode =2)
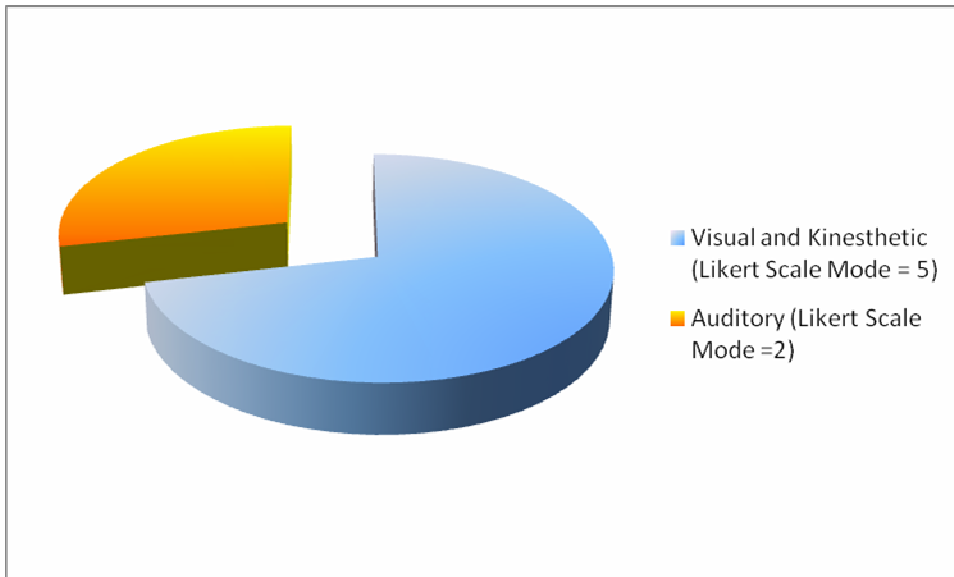
Source:

Boylan, H. R. (2002). *What Works: Research-Based Best Practices in Developmental Education*. Boone, NC: National Center for Developmental Education.

APPENDIX H: Assessment Tools

	Assessment of Environmental Education

	Level of Assessment

Suggested Assessment Tool	High	Medium	Low	None
In-class Closed-Book Examinations				
Take-home Open-Book Examinations				
Detailed Laboratory Reports				
Creative Laboratory Exams				
One-on-one Oral Examinations				
Short Classroom Quizzes				
In-class Multiple-choice Tests				
Problem Solving Sessions & Exercises				
Short, Written Essay Assignments				
Extended Lengthy Writing Assignments				
Classroom Oral Presentations				
Organized, Student-led Seminars				
Inquisitive Research Reports				
Design Project Written Reports				
Computer-based Assignments				
Co-op Work Employer's Reports				
Student's Descriptive Learning Logs				
Student Generated Learning Portfolios				
Students' Poster Presentations				
Individual Student's Projects				
Students' Group Projects				

References : Student Assessment in Higher Education.

A Handbook for Assessing Performance.
Authors : Kevin Cox, Allen Miller and Bradford Imrie 1998 Kogan Page.

Narayanan, Mysore (2007). *Assessment of Perceptual Modality Styles.*   Honolulu: Hawaii.   Proceedings of 114th ASEE Annual National Conference. June 24-27, 2007.
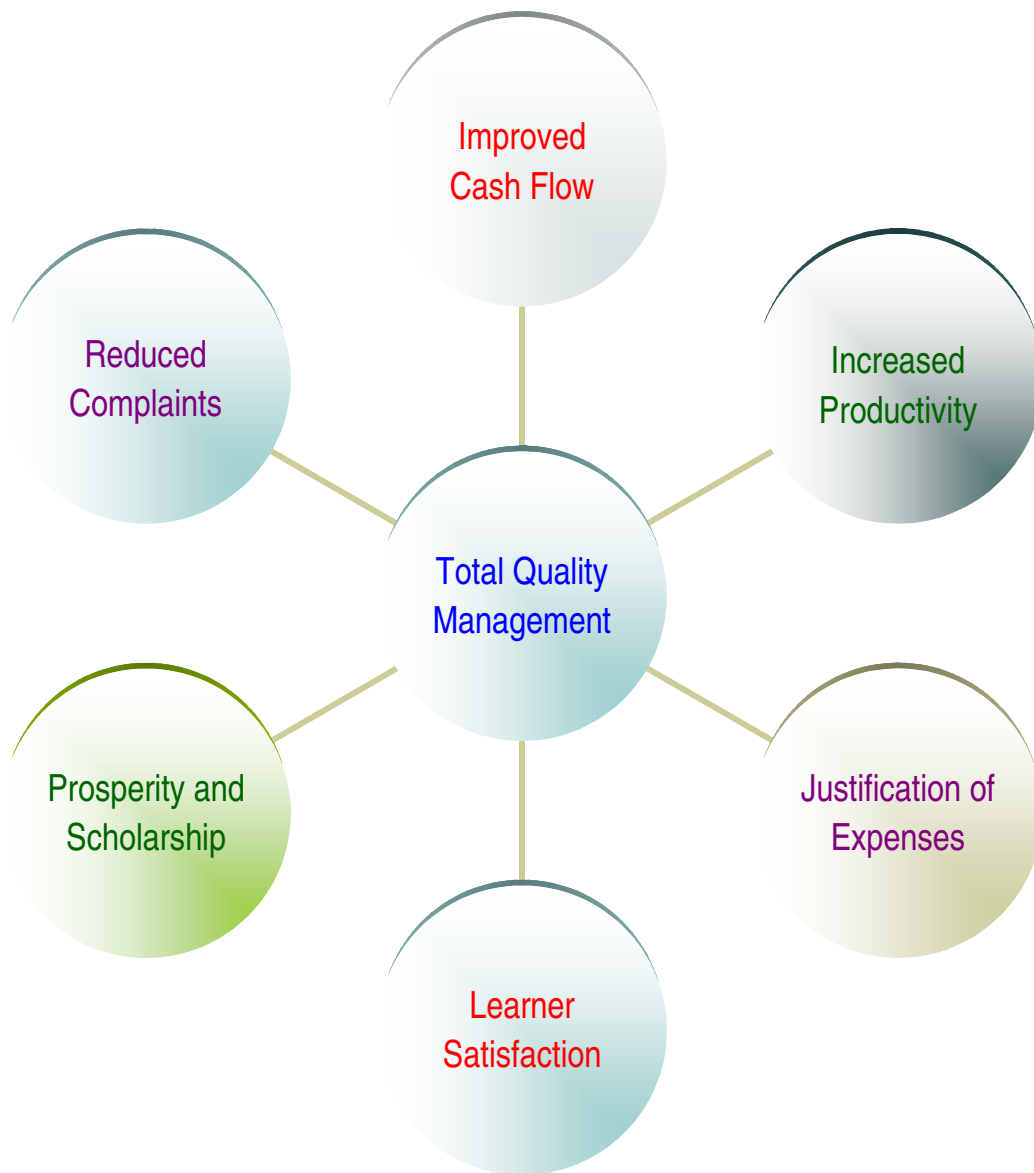
APPENDIX I: Principles of *T.Q.M.*

Inspired by the ACORN model, the author experimented on implementing certain principles of 'Total Quality Management' in the classroom. The author believes that the following twenty principles help the teaching professor in a variety of ways to excel in his or her field.

1. Break down all barriers.
2. Create consistency of purpose with a plan.
3. Adopt the new philosophy of quality.
4. Establish high Standards.
5. Establish Targets / Goals.
6. Reduce dependence on Lectures.
7. Employ Modern Methods.
8. Control the Process.
9. Organize to reach goals.
10. Prevention vs. Correction.
11. Periodic Improvements.
12. Maintain Momentum.
13. Feedback: Communication.
14. Fact – Based Decisions.
15. Exploit Opportunities.
16. Mobilization of Expertise.
17. Drive out Fear.
18. Recognition / Keep Score.
19. Identify Accomplishments.
20. Customer Focus / Results.

Source: 1.   Deming, W. Edwards. (1986) *Out of the Crisis.* Cambridge, MA: The MIT Press.
          2.   Deming, W. Edwards. (1994) *The New Economics.* Cambridge, MA: The MIT Press.
          3.   Jablonski, Joseph R. (1994). Implementing *TQM: Competing in the Nineties Through Total Quality Management.* Albuquerium, NM: Technical Management Consortium, Inc.

Improved Cash Flow

Reduced Complaints

Increased Productivity

Total Quality Management

Prosperity and Scholarship

Justification of Expenses

Learner Satisfaction

APPENDIX J: Three Important Models

The *Concept Mapping Model* utilizes the principles of a learning paradigm (Tagg, 2003).   The principle is to select an appropriate learning paradigm approach, preferably categorize, and assign the needed information into the various components of that chosen paradigm. A model for knowledge acquisition and content delivery can be suggested however, this is normally accomplished utilizing well-established and standardized building blocks of a learning paradigm (Barr and Tagg, 1995).

The *Structured Content Model* may be chosen as an alternative when the instructor finds that the *Concept Mapping Model* may not be suitable.   Here subject matter content can be created independent of presentation format or delivery methodology.   Regardless, this is not completely open-ended and is mainly dictated by the educational objectives and course outcomes (Tozman, 2004).

Probably the most widely used model is the *ADDIE* model proposed by Walter Dick and Lou Carey.   The term *ADDIE* is an acronym for Analysis, Design, Development, Implementation, and Evaluation (Dick & Carey, 2001).

Here, in the *ADDIE* system, the instructor first starts with a *front-end analysis* of the instructional needs and sets the goals to be attained.   Such an analysis tells the instructor about the characteristics of the learner. The learner is expected to bring in some prior knowledge, skill and experience to the course.   This is supposed to provide some clarification to the instructor as to what level the *achievement-bar* can be set at.   For example, the student may enter a *dynamics* course with a sound knowledge of college level *physics*.   This tells the instructor that there is no need for a repeat discussion of   *Newton's Laws of Motion.* The student already possesses adequate background knowledge that is necessary for a first course in dynamics. This is known as the *Analysis* stage.

The *Analysis* stage is then followed by the *Design* stage.   Here the instructor determines the details pertaining to material content to be taught and generates an activity plan.   One may also write specific course objectives based on learner's prior knowledge. The instructor can also outline how new information can be effectively presented to the learners, thereby developing a successful instructional strategy.   The *Design* stage is very important because it involves careful planning that can result in optimum use of classroom time.

The *Development* stage follows the *Analysis* stage.   Here the instructor selects the appropriate audio-visual techniques and integrates them to accomplish *knowledge-transfer.*   One may use traditional lectures, reading assignments, writing projects, laboratory experimentation, group discussions, demonstrations, plant tours, design projects, art displays, sculpture studio presentations, stage performance, etc. Here one may be encouraged produce new material, to

keep up with the *state-of-the-art.* One may generate and evaluate *sample* material. In industry, this is known as *Rapid Prototyping.*

The *Implementation* stage follows the *development* stage and this is where the instructor finally delivers the material to the learner according to the methodology outlined above.   Here the instructor needs to collect adequate data to document that what was *designed* has actually been *delivered.* Feedback data must also be collected here so that the instructor can plan on further improvements.

The final stage is the *Evaluation* stage.   All the assessment data gathered should be evaluated according to the rules set by the scientific disciplines.   The instructor has the opportunity to review data collected and examine the importance of learner's comments. Based on the feedback the instructor may revise certain material content or delivery methodology.   Some authors identify this stage with *seven R's.*   Record, Recollect, Report, Review, Retain, Reject and Revise.

There is also another model called *ASSURE* model, developed by Heinrich, Molenda, Russell and Smaldino (2001).

ASSURE   is an acronym for:

*A*nalyze learner characteristics.

*S*tate objectives and goals.

*S*elect, modify and design materials.

*U*tilize available material in the best possible manner.

*R*equire and record response of the learners.

*E*valuate the data collected for further improvement.

(Source: Narayanan, Mysore, 2010. *Assessment of Instructional Systems Design.* Louisville, Kentucky. Proceedings of 117th ASEE Annual National Conference. June 20-23, 2010.)

APPENDIX K: : One Dozen Assessment Techniques

1. Instructional Effectiveness

Angelo and Cross (1993) have discussed this in great detail in their famous book *Classroom Assessment Techniques.* The principle is to assess whether the course objectives have been achieved by the students. Graded Homeworks, Assignments, Lab reports, quizzes, and examinations document instructional effectiveness to an extent. The process followed in the classroom and effective classroom time management can be and needs to be evaluated by the students.

2. Portfolio Analysis

William Cerbin, Assistant to the Provost/Vice Chancellor for Academic Affairs at the University of Wisconsin-LaCrosse has discussed this method in great detail in his Paper : *The Course Portfolio as a Tool for Continuous Improvement of Teaching and Learning, which* has been published in the Journal on Excellence in College Teaching.   This article explains how to use learning centered course portfolios to improve teaching and learning. The article also provides rationale for using teaching portfolios that focus on individual courses. Further, it also includes a discussion of portfolio of his own teaching (Cerbin, 1993).

3. Assessing Prior Knowledge

Dr. Thomas Angelo discusses techniques for assessing course – related knowledge and skills in Chapter # 7 of the famous book, *Classroom Assessment Techniques.* Angelo and Cross (1993) have provided seven techniques, often called declarative learning. Several, or all of these techniques help the instructors to
assess prior knowledge.

4. Self Assessment

Sally Brown, Phil Race & Brenda Smith discuss the importance of Self, Group and Peer Assessment. In Chapter # 9 of their book : *500 Tips on Assessment,* Brown, Race and Smith provide several techniques for implementation (Brown, Race & Smith, 2010).

5. Group Assessment

Alumni, as a group can and must be surveyed to provide constructive feedback to the department, division and the university. Their cumulative experience in 'real-world' situations will provide invaluable data to the faculty and administrators. Mary Huba and Jann Freed have emphasized several aspects of group assessment and have suggested rubrics and provided interesting examples in their famous book : *Learner-Centered Assessment on College Campuses.* Their objective is to shift the focus from teaching to learning (Huba & Freed, 2000).

6. Peer Assessment

Dr. Craig E. Nelson has been recognized as the "U.S. Professor of the Year" among research universities by the Carnegie Foundation for the Advancement of Teaching in 2000. In November of 1991, he organized and presented a workshop *"Fostering Critical Thinking Across the Curriculum."* This was a very valuable workshop that was organized in collaboration with the 11th Annual Lilly Conference on College Teaching at Miami University, Oxford, Ohio (Nelson, 1991). Peer Assessment must be a part of the *Teaching Evaluations Plan* and must be practiced by almost all the faculty (Nelson, 1989).

7. Established Performance

Dr. Barbara Cambridge, Associate Dean at the Indiana University Purdue University Indianapolis [I.U.P.U.I.] served as the vice president for fields of inquiry and action at American Association for Higher Education. The author has referenced several of her research publications and has observed that it is very valuable to create a record of accomplishment that effectively documents student learning and establish performance levels and criteria (Cambridge & Williams, 1998).

8. Program Reviews

University's internal program review by itself should provide very valuable assessment data to the department. The objective of the review is to judge the quality of a given program as well as its centrality to the University. This internal review should help the department to effectively interact with its sister departments, the division and the University as a whole.

9. Student Feedback

James O. Nichols and Karen W. Nichols have published an extremely useful guide that provides help in this important area. In their book : *The Nichols Guides to Institutional Effectiveness and Student Outcomes Assessment,* Nichols and Nichols have stressed the importance of assessing student outcomes. In any department, students must be encouraged to voice their opinion, discuss their ideas and provide constructive feedback to the faculty and the department as a whole (Nichols & Nichols,2001).

10. Industry Feedback

Peter Schwartz and Graham Webb have examined several case studies and scenarios while reporting on the importance of assessment in their book : *Assessment : Case Studies, Experience In addition, Practice from Higher Education.* Once or twice a year, departments should meet with their *Industrial Advisory Council Members* to obtain valuable insight in to a variety of topics (Schwartz & Webb, 2002). The council should consist of several experts from a wide variety of industries who should volunteer and donate their time and expertise to benefit the faculty, staff and student body of the university.

11. Employer Feedback

Saxe talks about *Peer Influence and Learning* in a paper published in the *Training and Development Journal.* O'Brien and Bennett also talk about *The Building Blocks of the Learning Organization* in a paper published in a journal titled *Training.* Perry also talks about *Cognitive and Ethical Growth* in several of his papers and publications (Perry, 1981). The department should consider employer feedback to be an extremely valuable and effective assessment tool (Saxe, 1990). It is possible to obtain significant feedback data from employers who can assess and comment about students' technical knowledge, interpersonal skills, communication capabilities, etc.

12. Departmental Activities

Novak and Gowin (1999) have stressed the importance of learner interactions in their book *Learning How to Learn.* Donald A. Norman (2006) has also talked about the learner's mental preparedness in the article *What Goes on in the Mind of the Learner.* This article can be found in *New Directions for Teaching and Learning* and provides the reader with important insight about cognitive science research. David Paul Ausubel (1978) has elaborated about the importance of cognitive science in his 1978 book : *Educational Psychology : A Cognitive View.* All these books and publications focus on learner interactions and cognitive research. Therefore, it is important to keep a constant vigil on student learning path. Student activities and accomplishments must be regularly discussed at length in the departmental meetings. Student advising sessions must be facilitated to help them track their progress towards graduation.

APPENDIX L: The *ACORN* Model of Hawkins and Winter

The present day varying economic conditions are highly volatile and the technical skills required by the modern industry is constantly changing.   It is therefore essential and imperative to understand that the role played by colleges and universities is quite different from what it was several decades ago.   The use of 'ACORN' model suggested by Hawkins and Winter to conquer and mastering change, may offer some helpful hints on assessment and for implementing the needed changes at universities and colleges.

Action: It is possible to effectively change things *only* when an honest *action* is taken and an attempt is made to improve quality. Both the Faculty and the students, must join forces and should actually try out to successfully implement new ideas.   Appropriate action is always well rewarded.

Communication: Changes are successful *only* when the new ideas effectively *communicated* and documented in place. The entire workforce comprising of faculty, staff, students and administration should work toward a common goal.   They should have a very structured and clear idea of what their goals and objectives are.   Proper briefing at regular intervals help bridge the *communication* gap not only between the faculty and the students, but also between the students themselves.

Ownership: Support for change is extremely important and is critical.   The administration should buy into this concept wholeheartedly.   Both the administration   and the faculty should accept that changes are essential and that changes are taking place for the betterment of students, management and the university community as a whole. *Only* strong commitment for accepting and implementing   changes demonstrates genuine leadership. Faculty and students must also enjoy the pride of ownership.

Reflection: Feedback from students, industry, faculty and administration helps towards thoughtful evaluation of the changes implemented. *Only* reflection can provide a tool for continuous improvement. Constant updating should always receive priority billing and the entire university should *reflect* on its achievements.

Nurture: Implemented changes deliver results *only* when *nurtured* and promoted with necessary support systems, documentation and infrastructures. The main responsibility falls upon the shoulders of the administration. Faculty, Staff and students can definitely contribute in this area, however *nurturing* requires strong financial and emotional commitment.

Source: Hawkins, P., & Winter, J. (1997). *Mastering change: Learning the lessons of the enterprise in higher education initiative.* London, United Kingdom: Department for Education and Employment.

Source: Narayanan, Mysore (2010). *Assessment of Instructional Systems Design.* Louisville, Kentucky. Proceedings of 117th ASEE Annual National Conference. June 20-23, 2010.

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