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Application of Peer Reviewed Journal Articles for Enhancing Technological Literacy

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Reviews

A reviewer commented on the draft

Is it possible to consider the standard deviation of the class performances in the analysis?

Author's Response

Yes. It is possible to consider the standard deviation of the class performances in the analysis. A new paragraph was added in the results and discussion section.

A reviewer commented on the draft

The author(s) have described a methodology for improving the technological literacy of students with their analysis and interpretation of peer reviewed journals. The method implemented is very specific, and does not allow for the "serendipititous" approach-making discoveries by accident.-often found in general database searching. Utilising a general search engines such as Web of Knowledge or Scopus or others often adds to the to wide knowledge which can be found and integrate within the students' technological literacy. The authors should consider alternate techniques of searching various databases to add to the technological literacy of students.
In the last paragraph of the "methodology" the paper would need a more definite description of what specific approach is given to the pre-intervention group compared with the intervention group.

Author's Response

The reviewer's comment is well taken and will be implemented in the next study along with alternate techniques of searching various databases to add to the technological literacy of students.

Please see the new paragraph added in the results and discussion section.

In the last paragraph of the "methodology" a more definite description of what specific approach is given to the pre-intervention group compared with the intervention group is added.

A reviewer commented on the draft

I found interesting this article of how to improve curriculum based on technology literacy. For that reason, more references supporting the study will be desirable. Also, try to expand the methodology with more details (e.g., modules).

Author's Response

Eight more reference supporting the study (will be desirable) were added. The methodology section was expanded with more details on modules.

Application of Peer Reviewed Journal Articles for Enhancing Technological Literacy

Abstract

"The Environment" course was taught in spring 2012 using the peer reviewed journal articles for enhancing technological literacy of the students. At the beginning of the course the students were given a pre-intervention assignment. The students were asked to explore the beneficial and harmful results of using the technology on the environment from the view point of an industry.

The course introduced the students to the application of basic scientific principles (in Physics, Chemistry, and Biology) to the environment. More specifically, the concepts of sustainability, ecology and evolution, population, climate, biodiversity and various industries such as agriculture, forests, and energy were covered in the course.

The course was organized into several modules. For example, in the climate and air resources module, the students were introduced to atmospheric circulation, ocean circulation, climate and weather, air pollution and greenhouse effect and climate change. Students were not usually aware that systems of positive and negative feedbacks and their combinations affect the global warming. There were also many misconcepts among the students about what it means for the earth to get warmed.

The average grade of the pre-intervention group was 67% and that of the post-intervention group was 79%, an 18% improvement over the pre-intervention. The groups were significantly different with a calculated t value of 3.3. The t-test confirmed statistical improvement at significant confidence level with an alpha value of 0.05.

Introduction

Technological literacy is, "an understanding of the nature and history of technology, a basic-hands-on capability related to technology, and an ability to think critically about technological development[1]. It is essential that ordinary citizens are able to make thoughtful decisions on issues that affect, or are affected by, technology." [1]

Scholarly journals are specialized publications. They contain original research and analysis conducted by experts. In these journals every article is reviewed by a panel of experts before it is accepted for publication. All most all the scholarly journals are peer reviewed. The journals are the most accurate and reliable sources for advanced work. Using scholarly journals not only helps the students/users to learn how experts conduct research but also share their findings. Knowing and mastering this process helps the students become critical thinkers and acquire professional expertise.[2]

Edward W. Ernst[3] observed that non-technical curricula needs technical contribution. This need gives an opportunity for students to choose engineering and technology courses. This opportunity is usually ignored because engineering schools fail to provide a wide variety of service courses for non-engineering students. Technology literacy for the 21st century needs an

understanding of mathematics, science, and engineering, which has shaped, if not created, our man-made world.[3]

Ollis and Krupczak advanced the notion that engineering design faculty are well qualified to teach a wide variety of such courses for non-technical majors.[4] According to Ollis and Krupczak, engineering, has a special perspective on technology, equipping engineers specifically qualified to explain technology to the nonengineer. After a thorough review of the attributes of the various groups promoting technological literacy[5], they recommend design faculty as those engineers most qualified for embarking on this endower. Many researchers and authors have recommended various methods and launched discussions on improving curriculum and content based on technology literacy.[6-10]

Objective

The objective of this study is to use the Peer Reviewed Journal Articles for enhancing technological literacy of the students.

Motivation

Science and technology are so pervasive in modern society that students increasingly need a sound education in the core concepts, applications and implications of science[11]. The importance of these topics and their needs provided the authors with strong motivation to pursue this study.

Methodology

Traditionally "The Environment" has been taught using standard lecture format. The course was taught in spring 2012 using the peer reviewed journal articles for enhancing technological literacy of the students. The students were asked to explore the beneficial and harmful results of using the technology on the environment from the view point of an industry. The specific differences between the two methods are shown in Table 1.

The course introduced the students to the application of basic scientific principles (in Physics, Chemistry, Biology) to the environment. More specifically, the concepts of sustainability, ecology and evolution, population, climate, biodiversity and various industries such as agriculture, forests, and energy were covered in the course.

The course was organized into several modules. For example, in the climate and air resources module, the students were introduced to atmospheric circulation, ocean circulation, climate and weather, air pollution and greenhouse effect and climate change. Students were not usually aware that systems of positive and negative feedbacks and their combinations affect the global warming. There were also many misconcepts among the students about what it means for the earth to get warmed.

In the Biodiversity module environmental gradients and disturbances producing landscape biodiversity were explained. In this module how biodiversity enables ecosystems to resist or recover from environmental stresses. In the suitability module a wide variety of sustainable

actions were defined. In this module the students were taught how to estimate and evaluate their own carbon footprint. In the physical systems module the definitions and applications of first and second thermodynamic laws were dealt. In this module the application of environmental competitive exclusion principle is explained with several specific examples.

The number of students in the pre and post intervention groups were 30 (male and female cohorts are 17 and 13 respectively) and 32 (male and female cohorts were 20 and 12) respectively. At the beginning of the two courses the students were tested on the basic principles in Physics, Chemistry and Biology at 11^{th} and 12^{th} grades.

In the pre-intervention group primarily traditional method using lecture intense approach was used. Many students could not be well connected with this method as shown by the class performance

Peer reviewed articles method

Once every two weeks a topic is assigned to the students of the post intervention group. Students were asked to review 5 peer reviewed journal articles on each topic and prepare a report identifying environmental problems in the concerned industry.

In order to find scholarly journals, the students were taught to start with the Databases & Articles section of the library website. The databases listed there can be used to search thousands of journals[2]. When choosing a database, the students were asked to read the description to determine whether the database covers the appropriate journals. Once the student choose a database, he or she should look for a "scholarly journals" option on the search page. Most databases have this option. The student should choose the "scholarly journals" option to limit his or her search to show only journals[2].

The students were asked to write a critique consisting of the solutions to the problems. The list of the topics is given in Table 2. The first 4 topics were taught in the class in detail. However, the 5^{th} topic by design was a new topic that was not covered in the class. By the virtue of experience and training obtained from the 4 topics, the students were expected to obtain the relevant knowledge from five peer reviewed journal articles and complete the deliverables. The reports were graded as shown in Table 2.

Results and Discussion

The pre and post intervention groups scored on the average 69.6% and 70.3% on the test given at the beginning of the semester on basic principles of Physics, Chemistry and Biology. The scores indicate that the groups were comparable in their scholastic record.

The average grade of the pre-intervention group following the standard lecture format was 67% and that of the post-intervention group was 79%, an 18% improvement over the pre-intervention. The groups were significantly different with a calculated t value of 3.3. The t-test confirmed statistical improvement at significant confidence level with an alpha value of 0.05.

He students scored 92% on the average on the 5 reports using the peer reviewed journal articles. The results indicated that they demonstrated highest scholastic performance on the waste management industry and the lowest scholastic performance on environmental toxicology and health industry. It is important to note that these ranks are relative to the course and student mix. Table 3 shows the statistical analysis[12-14] on the five topics of peer reviewed journal articles.

It is interesting to note that the standard deviation for the pre-intervention group ranged from 9 to 13 where for the post intervention group varied from 11 to 16. The average standard deviation was only 16.4% for the pre-intervention group's average value of the five performance indicators where as it was only 14.1% for the post-intervention group. These percentages indicate that the relative variations of the results among the five performance indicators were fairly small.

The method implemented is specific, and does not allow for the "serendipititous" approach-making discoveries by accident.- often found in general database searching. Utilizing a general search engines such as Web of Knowledge or Scopus or others often adds to the to the wide knowledge which can be found and integrate within the students' technological literacy. However, the reviewer's comment will be implemented in the next study along with alternate techniques of searching various databases to add to the technological literacy of students.

There have been cases where eLearning appeared to have resulted in enhanced performance, when in fact the enhanced performance was due to the careful design of the curriculum and delivery of it that led to it (Reviewer's comment). The above identification of the methodologies of both the traditional and Peer Review process for teaching the Technology Literacy program to ensure that the enhanced performance is due primarily to the methodology and not the process employed.

Student comments

The following are the written comments from students.

1. Almost all the students wrote that they would consider using the peer reviewed journal method in other courses.
2. Many students wrote that they had personal involvement in writing the critique containing the solutions to waste management industry in Philadelphia. They mentioned specifically that since they live in Philadelphia they felt that they were personally involved in researching the details from the peer reviewed journal articles on Philadelphia's waste industry.
3. Several students wrote that before taking this course, they were not familiar with the method of using peer reviewed journals for improving their knowledge.
4. The most effective concept contributed to my learning was on the topic "Global Warming." The peer reviewed journal articles broadened my mind on the topic.
5. I went beyond the call of duty and read ten more peer reviewed article on various topics of the course.
6. The take home point in the course was that I personally could contribute to reduce the global warming by following suggestions in the peer reviewed journal articles.
7. I enjoyed working with the students on using peer reviewed journal articles.

8. I loved the nontechnical issues such as ethical issues (that I came across while reading the peer reviewed journal articles) more than the technical ones.
9. My carbon print can significantly be reduced by switching my regular car to hybrid car. I learned this simple but profound point by following peer reviewed journal articles.
10. Peer reviewed journal articles taught me that I need to return the environment back to my children with least damage. This opened my eyes to focus on methods I personally could employ for the same purpose.

The written comments of the students on specific problems such as, increasing disasters, environmental toxicology and human health, biodiversity conservation, nonrenewable energy, environmental pollution, over population, waste management, and global warming were very valuable. They were analyzed and graded. Students have shown their personal contributions on reducing their carbon foot print in the environment.

The authors plan to extend this strategy to three other courses over the next three years. The method presented in this study may be used at other institutions with appropriate modifications in order to prepare the students for improving their technological literacy

Conclusions

The average grade of the pre-intervention group was 67% and that of the post-intervention group was 79%, an 18% improvement over the pre-intervention. The groups were significantly different with a calculated t value of 3.3. The t-test confirmed statistical improvement at significant confidence level with an alpha value of 0.05. In this study it was demonstrated that application of per reviewed journal articles can be made for enhancing technological literacy.

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Table 1 Grading Formula

	Traditional Method Pre-intervention group	**Peer Reviewed Articles Method (Post intervention group)**
	Percent	Percent
1. Assignments	25	25
2. Attendance and class participation	10	10
3. Mid-term examination	25	25
4.Final Examination	40	15
5. Peer Reviewed Journal Articles	0	25
Total	100	100

Table 2 Improvement of the Pre-intervention group over the Post-intervention Group

Peer reviewed article	Pre-intervention Group (%)	Post intervention Group (%)	Improvement (%)	Relative Rank
(1) agricultural and food industries	67	92	37	3
(2) environmental toxicology and health industry	67	90	34	5
(3) waste management industry	67	94	40	1
(4) nonrenewable energy industry	67	91	36	4
(5) water industry (not covered in the class)	67	93	39	2

Table 3 Statistical analysis of Peer reviewed journal articles method

Peer reviewed article	Standard Deviation		t value
	Pre-intervention Group (%)	Post intervention Group (%)	
(1) agricultural and food industries	9	14	3.6
(2) environmental toxicology and health industry	10	13	3.2
(3) waste management industry	11	11	3.4
(4) nonrenewable energy industry	12	15	3.1
(5) water industry (not covered in the class)	13	16	2.7