Collaborative learning in Computer Programming Courses using E-Learning Environments

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Abstract — The success of collaborative learning in academics lies in making students solve problems easily thus exhibiting better performance in computer programming courses. This paper outlines the potentialities and barriers of e-learning environments when used in a learning context. Conventional classroom setup which is physical in nature can be extended to a virtual e-learning environment where collaborative learning is encouraged among student community. An E-learning environment helps the learners to interact among themselves thus providing a convenient learning style. The study was carried out in a higher educational institution with post graduate students of Computer Applications. The objective of the study is to identify the variables that influence knowledge sharing and collaboration in e-learning environments. The study concludes that e-learning environments provide improved work quality, communication, enhanced learning and effective knowledge sharing.

Keywords — E-learning; Knowledge Sharing; Collaboration; Productivity

I. INTRODUCTION

Generally, current-day students prefer to collaborate with peers and find computer programming more attractive than. Collaborative learning technologies have unique potential to transform the educational system, by building an easy to adopt learning environment to students. This paper discusses how e-learning creates a platform for students, enabling effective learning support in programming courses in Indian educational setting. An e-learning environment is a method of delivering learning materials to students via the web. These systems include assessment, student tracking, collaboration and communication tools.

The paper is aimed to systematically and comprehensively assess the relevant literature or studies in E-learning environments. A controlled experimental setup can be planned by having a set of competent students. Appropriate programming laboratory courses where there is a need for the students to self learn most of the times may be chosen for the study. Students may be made to work in a regular laboratory set up where they work individually during laboratory sessions. They are introduced to an E-learning environment where collaborative learning is made possible among the entire group of students. The students are allowed to register themselves in the E-learning portal. All the required reference materials and instructions will be uploaded in the portal by the course instructor in advance. The course instructor interacts with the students virtually via the portal. Experiences of students working in this environment can be captured in order to study the effectiveness of knowledge sharing and collaboration. The experiment can be conducted for different batches of students for various laboratory courses. Student learning can be evaluated by the mentors based on various metrics. The experimental results of the study can be analyzed using statistical software.

From the study results, several factors like student preferences, productivity improvement, enhanced learning and knowledge sharing, can be analyzed. The suitability of E-learning environments for different kinds of computer laboratory courses can also be taken into consideration.

II. REVIEW OF LITERATURE

Throughout the world, several experiments have been conducted in various universities to analyze the efficiency of E-learning environments. Various metrics like development time, quality of work, trust, morale, willingness to share knowledge, cost, effort were considered [5][3]. The study outcome reveals that students who used collaborative learning strategies benefited from the information and knowledge transfer process [12].

The E-learning environments have been evaluated by measuring the student engagement, participation and
achievement of goals [6]. No comparisons have been drawn between students learning in a regular lab setting and E-learning environments so far. The unsettled nature of the findings has led us to carry out this work in Indian educational setting and explore the results.

A study has been conducted to compare two learning environments with high levels of collaboration [7]. The study investigated the differences between collaboration methods in two summer enrichment classes for students. In another study, investigations on the utilization of virtual machines for teaching information security skills in both group and individual settings were conducted. The results showed that collaborative learning had a significant positive impact on student learning experiences [4].

The potentialities and barriers of 3D immersive virtual environments when used in a learning context have been studied [9]. The study concludes that the use of virtual environments allows students to participate in richer interactions at times that are more convenient to their work/study patterns. The information found in virtual classrooms can be used for planning, problem solving activities, homework and essay writing and this way of organizing is essential for creating more student-centered learning environments [10].

Learners in virtual environments tend to feel more confident, open, participatory, creative, understanding and seem to participate in training sessions. Also, the possibility of providing online tutorial session allows reaching a larger number of learners [11].

A. Research gaps

- Few studies in Indian educational context have been reported so far in collaborative learning techniques.
- Study of students who work individually on a computer and collaborate within the group using E-learning tools were not conducted systematically and have not been analyzed using data mining tools.

Collaborative learning and working is gaining popularity nowadays. If the study confirms that the adoption of collaborative learning environments improves the work quality, reduces time taken to do a laboratory exercise and increases the knowledge and programming skill, the technique can be used as pedagogy in the educational environments. Collaborative learning will be very appropriate for today’s students preparing for tomorrow’s careers in an increasingly technical and culturally diverse society.

III. PROPOSED METHODOLOGY AND FRAMEWORK

The significance of collaborative learning was realized when students faced difficulty in developing applications on their own as their knowledge and learning capabilities were different altogether. The students took a lot of time to learn programming concepts and software tools while learning individually. Generally students belong to different categories such as slow learners, average and fast learners classified based on their learning capabilities. While adoption and application of programming language was found easy and simple in most of the cases, situations were also evident among the group members who found it challenging to learn programming. In order to address this particular problem, this paper attempts to study the outcomes of experiential learning from using collaborative learning strategies in computer laboratory courses.

A. Study Objectives

1. Explore and suggest ways and means to enhance a collaborative learning culture among students.
2. Assess how technology can enhance peer interaction and facilitate knowledge sharing among the students in collaborative learning environments.
3. Examine the effectiveness of knowledge sharing in E-learning environments in Indian educational setting.

B. Theoretical Framework of the study

To facilitate systematic research, a process framework with apt interfaces was developed as shown in Fig 1. In order to create an awareness about the study, a pre experiment can be carried out, where a presentation can be given by the researchers to the students. A controlled experimental setup can be planned by having a set of competent students and problems.

C. Methodology of the study

Experimental research is done in this study which enabled the researcher to test the hypothesis by examining the relationships between independent and dependent variables in programming laboratories. It refers to the conceptual framework within which the experiment is conducted.

Fig.1. Theoretical Framework of the study
The following research hypothesis has been formulated for the study:

H0: There is no association between knowledge sharing through e-learning environment and the student’s level of learning.

H0: There is no association between knowledge sharing through e-learning environment and the student’s productivity.

H0: E learning environments neither improve the work experience nor the productivity of students.

D. Study Variables

The independent variables represent the cause for the effect in any study. The effect in the research is learning efficiency and the cause is the learning methodology. Thus, the independent variable suggested for the research is learning methodology. A dependent variable is what we measure and what is affected during the study. The dependent variable responds to the independent variable. As per the hypothesis formulated, the dependent variables identified are knowledge sharing, level of learning, work experience and overall productivity.

E. Sampling

Population is the totality of all the elements that have homogenous characteristics for the purpose of conducting a research study. Sample is a sub group of the definite target population that possesses the information for which inferences are to be made. The samples considered for the study includes students and their sub groups who are enrolled for programming courses. Samples shall be drawn from students who undergo computer programming courses as a part of their curriculum. A sample of 60 to 70 students shall be considered. The study has been conducted for six laboratory sessions each of two or three hour duration for two different programming laboratory courses.

The techniques used for the study will be participant observation, questionnaires, assessment and interviews. Real-time monitoring of the students performance on lab experiments can be used to assess how different types of environments help students perform better on different types of tasks in comparison to individual effort. The productivity improvement will be assessed using various metrics like problem solving, alternative solutions, programming skills, knowledge sharing aspects and communication skills. The data collected during the study can be analyzed and visualized using analytical tools.

Students will think critically and freely discuss and clarify their doubts while working in E-learning environments [8]. They can upload and download necessary materials and collaborate anytime anywhere. An E-learning environment helps them to have a greater control of their work and also make them more responsible. Collaborative learning is thus an excellent knowledge management strategy that leads to research in this area.

IV. RESULTS AND DISCUSSIONS

Appropriate statistical and data mining tools were used to analyze the collected data.

A. Students perceptions on E-Learning Environment:

The inference from TABLE I indicates that E learning environments enables knowledge sharing to a greater extent. The mean distribution of the study variables are shown in Fig.2. The collaborative attitude for proactive learning among the students was found to be relatively high during the laboratory sessions. It was also observed that during e-learning sessions, the students were more attentive and exhibited an increased initiative and positive attitude towards learning. The distribution of ratings given by students for various parameters is shown in Fig. 3.

TABLE I. STUDENT’S PERCEPTION ON E-LEARNING ENVIRONMENT

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usefulness</td>
<td>4.50</td>
</tr>
<tr>
<td>Overall productivity</td>
<td>4.17</td>
</tr>
<tr>
<td>Responsibility</td>
<td>3.02</td>
</tr>
<tr>
<td>Peer support</td>
<td>4.35</td>
</tr>
<tr>
<td>Knowledge sharing</td>
<td>4.80</td>
</tr>
<tr>
<td>Collaborative skills</td>
<td>4.12</td>
</tr>
<tr>
<td>New learning</td>
<td>3.72</td>
</tr>
<tr>
<td>Level of satisfaction</td>
<td>4.05</td>
</tr>
<tr>
<td>Reduced errors</td>
<td>3.75</td>
</tr>
<tr>
<td>Future Adoption</td>
<td>4.25</td>
</tr>
</tbody>
</table>

Fig. 2. Mean distribution of study variables
B. Correlation between variables:

The results of correlation are exhibited in TABLE II, TABLE III and TABLE IV. It can be observed that the highest correlation of 0.35 (using kendall method), 0.38 (using person and spearman method) was found for the knowledge sharing and work experience and was found to be significant since the students have expressed that e-learning seemed to be very useful during laboratory sessions. The next highest correlation was found with reference to knowledge sharing and the productivity obtained with a correlation value of 0.34 (kendall method), 0.38 (spearman method) at 0.01 level of significance. Thus, the productivity is expected to improve for those students who have found working in e-learning environments useful.

C. Association between knowledge sharing and level of learning:

The association between perceived knowledge sharing and learning was tested through Pearson correlation test. The test details and the results are given in TABLE V. The hypothesis formulated is as follows:

\( H_0 \): There is no association between knowledge sharing through e-learning environment and the student’s level of learning.

The test results of Pearson correlation tests indicates a positive correlation between knowledge sharing through e-learning environment and the student level of learning thereby eliminating the assumptions put forth by the null hypothesis.

D. Association between knowledge sharing and productivity:

The hypothesis formulated is as follows:

\( H_0 \): There is no association between knowledge sharing through e-learning environment and the student’s productivity.

The results of the Pearson’s test for the variables kshare and prod are shown in TABLE VI. The test statistics results also acknowledges to the fact that the e-learning environment increases the productivity level of the student.
E. Association between work experience and productivity:

The hypothesis formulated for the same is as follows:

H₀: There is no difference in the work experience gained by students who use an E-learning environment and their productivity.

<table>
<thead>
<tr>
<th>TABLE VII. PEARSON’S CORRELATION BETWEEN WORK EXPERIENCE AND PRODUCTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data: my_data$wexp and my_data$prod</td>
</tr>
<tr>
<td>t = 3.4662, df = 124, p-value = 0.0007259</td>
</tr>
<tr>
<td>alternative hypothesis: true correlation is not equal to 0</td>
</tr>
<tr>
<td>95% confidence interval:</td>
</tr>
<tr>
<td>0.1290069 0.4487850</td>
</tr>
<tr>
<td>sample estimates:</td>
</tr>
<tr>
<td>cor</td>
</tr>
<tr>
<td>0.2972076</td>
</tr>
</tbody>
</table>

The results of the Pearson’s test for the variables wexp and prod is shown in TABLE VII reveals that the significance value is less than 0.05, thus rejecting null hypothesis and supporting alternative hypothesis. Also, it can be proved that there is an association between the work experience in e-learning environment and the productivity of the student.

F. Association rules for the Data Set

Mining association rules look for appealing relationships among items in a given data set [2]. It is intended to identify strong rules discovered in databases using some measures of interestingness. Association rules are created by analyzing data for frequent if-then patterns and using the criteria support and confidence to identify the most important relationships. Support is an indication of how frequently the items appear in the database. Confidence indicates the number of times the if-then statements have been found to be true. Association rules x => y convey that the occurrence of x has a positive influence on the occurrence of y [1]. The association modeling exercise not only helps the researcher to predict those items that are likely to co-occur but also to envisage the intensity of relationship between them. The association between the attributes knowledge sharing, learning, productivity and willingness for future adoption were explored by applying the apriori association mining algorithm, as exhibited in TABLE VIII. The high level of confidence implies that the association rules have helped in arriving at certain decisions. It can be inferred from the rules that the aspects of knowledge sharing in collaborative e-learning environments and student productivity have a constructive influence on the willingness of future adoption, with a high level of confidence at 0.968.

<table>
<thead>
<tr>
<th>TABLE VIII. STRONG ASSOCIATION RULES GENERATED FOR THE DATA SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kshare =&gt; [learn] (confidence: 0.864)</td>
</tr>
<tr>
<td>kshare =&gt; [learn, wexp] (confidence: 0.820)</td>
</tr>
<tr>
<td>learn =&gt; [wexp, prod] (confidence: 0.818)</td>
</tr>
<tr>
<td>kshare =&gt; [prod] (confidence: 0.960)</td>
</tr>
<tr>
<td>[kshare, prod] =&gt; [willing] (confidence: 0.968)</td>
</tr>
<tr>
<td>[wexp] =&gt; [willing] (confidence: 0.891)</td>
</tr>
</tbody>
</table>

V. CONCLUSION

As the significance of collaborative skills has been recognized to a greater extent in contemporary teaching and learning environment during recent ages, the knowledge sharing through collaborative e-learning environments are taken up for the study. The results of the experiments conducted to implement e-learning as a pedagogical tool was also explored and presented herewith. Overall, this empirical study has justified that e-learning environments provide potential space to enhance collaborative skills for conducting programming laboratory courses effectively.

REFERENCES


