SUPPORT TECHNIQUES TO ENHANCE STUDENTS' PROJECT-BASED LEARNING

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ABSTRACT

The purpose of this study is to investigate the impact of using various support techniques to enhance students' learning in a project-based diploma level database management course. Project-based learning is *a systematic teaching method that engages students in learning essential knowledge and life-enhancing skills through a use of authentic question and carefully structured tasks. The project was* divided into three main phases, involving requirements analysis conceptual design and database system implementation using Microsoft Access. Students were assigned into teams of three to four members based on weak-strong selection techniques. This study was conducted for a period of 12 weeks, guided based on an action research design. The initial findings suggest that techniques such as setting ground rules, regular constructive feedback by the lecturer, using templates to assist thinking, peer-evaluation, questioning and self-reflection can enhance learning.

KEYWORDS

Project-based learning, Support techniques, Scaffolding, Group project, Database management, Action research

INTRODUCTION

In this era of rapid technological innovation, institutions of higher learning are faced with the challenge to develop highly qualified and trained graduates. Information systems (IS) education in general has been criticized for not producing graduates with the right set of skills, knowledge and attitude to meet the needs of the global and technological evolving workforce (Archer, 1983; Cardinali, 1988). In a recent survey of recruiters of graduates, 87% of those survey said that teamwork was very important for hiring graduate, 89% of recruiters indicated that communication and interpersonal skills are very important. (Ken *et al.*, 2005) In fact, the IS profession has stress that it needs graduates that are well educated in technical skills and also interpersonal, communication and team-oriented skills. (Ehie, 2002; Cardinali, 1988).

In a traditional approach to teaching there is an emphasis on students acquiring knowledge and less of the development of the above mentioned soft skills. In this regard, project-based learning can be a more holistic instructional approach to help students cultivate knowledge as well as soft skills. (Carlo *et al.*, 2005).

While, there is a longstanding practice in schools for "doing projects," but a lack of a universally accepted model or theory of Project-Based Learning (PBL) (Barrows, 1986) has diluted some of its potential benefits. Diehl *et al.* (1999) argued that authenticity, constructivism, and the importance of learning "new basic skills" were key components in attempting to describe the difference between project-based learning and general models that involved projects. PBL uses challenging questions or

problems, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations. In PBL, the central activities of the project must involve the transformation and construction of knowledge on the part of students (Bereiter & Scardamalia, 1999). If the activities of the project represent no difficulty to the student or can be carried out with the application of already-learned information or skills, the project is an exercise, not a PBL project. In addition, PBL incorporates an authentic (not simulated) problems and where solutions has a clearly defined end product.

The potential benefits of PBL are well documented. For example, PBL when compared with a traditional curriculum found students in PBL was associated with better assessment of content knowledge (Penuel & Means, 2000; Stepien et al., 1993), higher levels of student engagement (Belland, et al., 2006) and increase in student motivation to learn (Bartscher et al., 1995). Students who have engaged in PBL reported improvement in critical thinking (Mergendoller et al., 2006), problem-solving capabilities, attitude towards learning and self esteem (Tretten & Zachariou, 1995).

Although PBL has numerous benefits, many instructors have found its implementation to be challenging. For examples, instructors may feel that projects take longer time than anticipated, classrooms may be disorderly, difficult to identify the level of support needed by students, to identify the appropriate technology to incorporate as a cognitive tool, and hard to design authentic assessments (Marx et al., 1997). In addition, instructors often find it difficult to develop authentic problem scenarios that can develop students' inquiry skills and find it hard to facilitate multiple student groups that have varying abilities (Sage, 1996).

From the perspective of the students, they may face difficulties associated with initiating inquiry, directing investigations, consolidating their learning and managing time (John, 2000). Hence the effectiveness of project based learning as an instructional method may depend to a great extent on the incorporation of a range of supports implemented by instructors to help students in their learning (John, 2000). This is what this study sets out to do which is to understand whether the support techniques employed helped students in their PBL experience.

RESEARCH AND COURSE DESIGN

This action research was conducted for a period of 12 weeks. Data was captured in the form of teacher observations and reflections, student reflection, and student-created artefacts in order to assess the effectiveness of the technique implemented. The multiplicity of various data sources allowed for triangulation to promote validity.

The focus of this study is on a required Database Management course for a Diploma in Information and Communication Technology. Thirteen students took this course and they were required to undertake a project that spans over 12 weeks. Students were divided into three different teams of three to four students in a group whereby they were selected based on the weak-strong selection technique so that academically weaker students would gain the advantage of working with their academically stronger peers (Jones & Birtle, 1999).

Each group gathered user requirement, perform conceptual database design and database system implementation using Microsoft Access. They were required to find a company to gather requirement as it is important for students to experience practical issues of working on a project team in response to an anthentic business problem. This is important as argued by Ehie (2002) and Cardinali (1988) there is a need to strike the right balance between technical and business knowledge which has become a key concern for most Information System curricular designers. When students were asked to reflect on using real company to gather information, all students in one way or another pointed it helped them improve their confidence and communication skills. They also appreciated the opportunity to learn how organisation works in the real world. This is captured in one of the students' reflection *"through interview we can learn soft skills; we learned how to conduct interview and able to understand how database can be used in a company."*

Each group was required to draft a project proposal for review by the instructor to ensure that the project has an appropriate scope to be completed in 12 weeks. After the proposal was approved, students began with Phase 1 of the project which is requirement analysis and conceptual design which took a total of 5 weeks whereby they were required to prepare interview questions and produce an Entity Relationship Diagram (ERD). Phase 2 is the relational database mapping which took 4 weeks whereby students were required to produce a relational scheme and perform normalization. Phase 3 is the database implementation phase which used 4 weeks whereby students were required to use MS Access to implement the solution designed. In this phase self-directed learning on a form topic in MS Access was incorporated and students were expected to find appropriate resources to assist in their learning with the role of the lecturer being a facilitator. The reason to incorporate this model is to give students more opportunities to further develop their life-long learning skills which are a necessity for any Information System professional due to the rapid and continually changing nature of the industry.

FINDINGS AND DISCUSSIONS ON TECHNIQUES USED

During the whole project, various support techniques were employed in order to enhance students' project-based learning. Those techniques are:

Setting Ground Rules

The instructor at the start for the project, asked each group to discuss and agree on the group ground rules .Ground rules are known as norms or acceptable behavior within a team and may comprise task related rules as well as social rules (Patterson *et al.*, 2005). Some of the ground rules covered by the students were such as play an active part in the team, attend meetings that have been arranged, be punctual for meetings and penalty imposed for members who did not attend.

When students were asked to reflect on ground rules, many commented that it was a good technique and it put majority of the students in a situation to attend the project meetings. As commented by one student *"it helps me always come for meeting although I am busy"*. However, there were two students who did not take the ground rules seriously and were absent for some of the meetings initially. Noticing this, the instructor reminded both students to take the ground rules seriously as their attitude would affect the whole group project performance. After that incident, the instructor noticed that both the students showed improvement in their attendance and group discussion. When both students were asked to reflect on

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ground rules, one of them commented "I *regret that I did not follow the ground rules which made me fail to understand the project clearly initially*". As for the instructor, she found that implementing ground rules brought positive effect toward team morale and. The instructor did not receive complaints from other student as all members in the team worked well with one another .This is further supported by Driskell *et al.* (2006) whereby he claimed that setting ground rules is important for collaborative knowledge sharing, managing personalities, and monitoring and maintaining the team's cohesion.

Formative Assessment with Scaffolding

Within the context of this support technique, each group was required to submit the draft project work according to the deadline set by the lecturer. In total, the instructor asked students to submit three drafts for constructive feedback by the instructor at multiple checkpoints during the project. At the checkpoints, each group was asked to discuss their work with the instructor and feedbacks were given. Feedback by the instructor focused on triggering thinking that can help students identify opportunities for improvement. This technique is effective because if the assessment is done only at the end of a project, it is too late for formative purposes, precisely because it is at the end, so there is no opportunity to use its results for feedback to improve performance of the students involved (Black, 1994). Furthermore, a comprehensive review of research studies on feedback showed that feedback improved performance in 60% of students (Kluger & DeNisi, 1996). When students were asked to reflect on the technique of using feedback, many students claimed it helped them realise their mistake and take corrective actions earlier. As one student reflected in his log *"It can help increase project quality as we can modify mistake early."*

During the feedback session, questioning was an important element to serve as an intervention strategy to help students learn. Questioning is an effective soft scaffolding technique which refers to aid provided as and when required by the students while solving the problem. This includes asking various types of questions that prompt students to clarify, elaborate, paraphrase or justify their responses (Strachan, 2007; Taylor, 1986). Most of the type of questions asked by the instructors were "what", "why", "when" and "how" questions. Examples of such questions used are "Do you think these interview questions are enough to find out about the company business processes?", "How much do you know about the system you are studying and where can you obtain more information?"

From the perspective of the instructor, the project quality this semester is much better as compared to previous semesters with the implementation of formative assessment. This is because the instructor was also able to find out the weaknesses in each student's learning and find ways to patch up these weaknesses before it became too late. For example, during one interim review session with students, the instructor managed to find out that few groups still had problems understanding the project requirement. After the incident, the instructor spent one more hour clarifying the project requirement again to individual groups that had problems.

The implementation of deadlines at multiple checkpoints was also one of the good strategies implemented as all groups managed to hand-up the project on time. This was evident from the instructor's reflection *"I was very happy as students handed out project on time and the quality of the project is much higher as compared to previous semester"*. When students were asked to reflect about this experience, they

pointed out that it forced students to meet deadlines set and improve their project quality. Consider what one student had to say about deadlines:

"If without deadline I think all the project process would be affected. For students, deadline is like a warning, no warning means not important."

Another student commented:

"It does improve the quality of our work and it is good because we didn't have much to do at the end of the project due to the good time management."

In addition, the instructor gave a lot of exercises at the end of each chapter as a formative assessment technique. Students were required to work on these exercises on their own or with their friends. The answer for each of the exercises would then be discussed with the whole class. This technique helped the instructor to know earlier students' weaknesses in each chapter so that corrective action could be performed before it was too late. All thirteen students appreciated this technique as all commented it helped them to understand the lesson better and apply the knowledge to the project. One student even commented *"I think this subject is like Maths, if without exercises we will suffer in our project badly"*

Using Template to Assist Thinking

Another support technique used was a template to assist student to prepare for the interview. This template was used to help students to organize, understand information and build up on student own cognitive coaching skills (John, 2008). The template instructor used consisted of 3 columns which were "what you know", "what you need to know" and "interview question". This was used to help student simulate their thinking in order to prepare their interview questions. When asked to comment on the technique all students found the technique useful to assist them in coming out with the appropriate interview question. One student commented *"if not for template, we totally had no idea what we want to ask"*. Reflecting on the technique, the instructor found that it was effective in helping students to obtain more accurate information after thoroughly understanding the problem, rather than superficially understanding the situation. However, many groups were confused between "what you know" and "what you need to know". Realizing the confusion because the students had not been previously exposed to such learning activities, the instructor solved the problem by giving an example on the board and performing a lot of prompting to make sure each group was on the right track. When asked to reflect on the template used, one group commented *"The template is difficult but it provided us with a guide towards producing the interview questions."*

Peer Review

At the end of the project, each group member was required to submit a confidential evaluation that evaluated each group member's participation and contribution on the deliverable and their own self-evaluation. Finally, students and instructor's assessment were then combined to determine the students' grade. When there is a consensus on the lack of the group member's contribution, points were deducted from that member's grade. When asked to reflect on this technique, one student wrote *"it pushes member to contribute and work together, eliminating free-rider"*. This is in accordance to Harahan & Isaac (2001), who claimed that self and peer assessment as an advocate to overcome problems of the "free riders".

As for the lecturer, she found that peer-review helped to improve the quality of members' work. This is observed by the instructor whereby she found during group discussions, group members were checking each other's work and giving constructive comments for improvement. This is reflected by one student in his log *"Through peer review by my members I improved my work through their comments."*

Presentation

At the end of the project, each team was requested to prepare a twenty minute presentation of their work to be presented to the instructor and all the classmates. Students appreciated the opportunity as it allowed them to listen to and learn from other team's presentation. As commented by one student *"It helped me improve my understanding while other members were presenting"*. After each presentation students were rigorously questioned on all aspects of the project and during the questioning session the instructor took greater care in selecting questions and other prompts to ensure that the responses made by students actually helped them in their learning process. Examples of some of the questions are "Why were these from controls being used in designing this form?", "How would you redesign this, given the mistake I pointed out earlier?" When asked to reflect on the questioning technique during the presentation, students commented it helped them realize their mistake. One student commented *"I learned my mistake during the Q&A session by the lecturer and my classmates"*.

Furthermore, having presentations forced students to learn more as they needed to be well prepared for it. The instructor observed some students were trying to clarify some of the missing links that they still could not understand with their group members in order to prepare for the presentation. When the lecturer asked student's feedback on the presentation activity a lot of them commented, it helped them improve their soft skills and improve their knowledge on database because they did a lot of revision in order to prepare for the presentation. As recorded in student log *"presentation helped me to improve my knowledge on database because you need good quality work and understanding to avoid presenting the wrong thing"*

Reflections

At the completion of the project, students were asked to reflect on what they had learned, how well they collaborated with the group and how they handled their learning. This is according to the good practice of project based learning which allows student to do reflection (Micheal, 2002) as it helps learners develop the capacity to identify their strengths and weaknesses and direct their study to areas that require improvement (Boud *et al.*,1985). As one student wrote in his reflection *"It helped me realize the weaknesses and mistakes I have done during the whole project for better improvement"*.

CONCLUSION

The group projects were definitely a worthwhile experience for students and the instructor. Students appreciated the opportunity to use a real life problem based project and the opportunity to learn from group members. The project allowed students to learn and apply database concept and also experience the practical issues of working on a real project for a real client. As for the instructor, the group projects provided the opportunity to know each of the students better and build corrective actions wherever necessary. Through this research, it has been demonstrated that various support techniques such as formative assessment with

scaffolding, setting ground rules, using templates, presentation, and reflections helped to improve the student learning in PBL. However, in order to implement the support techniques, instructors would need to spent more time and effort in the whole PBL process. Ultimately, the success of PBL depends to a large extent on the use of various support techniques provided by the instructors to students during the whole project based learning process.

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