

ICT-supported Learning in Medical PBL Pedagogy

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Abstract

The utilization of information and communication technology (ICT) has gained a prominent role in teaching and learning. ICT has been proposed to enhance students' learning in a Problem Based Learning (PBL) environment. This study explored the use of ICT in a PBL Medical curriculum and investigated students' feedback on this effort. The data were gathered from ten first year medical students through the use of questionnaire, group and individual interviews. The findings show that the provision and facilitation for the use of ICT increased their interest in PBL, helped recall information, enabled better interaction with group members and enhanced their learning. The paper discusses the implications of the findings on meaningful learning.

Keywords: Information and Communication Technology (ICT), Problem Based Learning (PBL), Medical pedagogy

1. Introduction

Problem-based-learning (PBL) is a student-centered-learning method. PBL focuses on promoting a learning context in which the participants collaboratively learn beyond their potential by internalizing the subject matter and developing higher order thinking. Thus, PBL is often advocated as one of the most powerful pedagogical approaches for effective learning especially in higher education.

The worldwide spread of PBL is attributed to the introduction of this educational method at the Medical School of McMaster University in late 1960s (de Graaff & Kolmos, 2007). The McMaster medical curriculum blueprint for PBL introduced an exciting educational philosophy for medical schools. The impetus was on the application in practice as opposed to storing facts by rote learning. This philosophy promulgates that the student should focus on the patients' complaints. Systematic analysis of patients' problems by students will enable them to formulate questions with regard to the information the students' require to strengthen their prior knowledge and eventually identify their learning needs. According to Barrows and Tamblyn (as cited in de Graff & Kolmos, 2007), PBL paradigm integrates knowledge from different disciplines related to medical problem and this makes students' learning experience more applicable, exciting and meaningful.

The benefits of PBL include critical and creative reasoning, communicating and interacting in meaningful team collaboration, appreciating alternative viewpoints, making reasoned decisions, self-evaluation and self-directed-learning (Nelson, 2005). PBL induces effective adult learning such as active learning, integrated learning, cumulative learning and learning for understanding. Barrows (1996) outlined six original characteristics for the PBL model. Firstly, the learning is student-centered, learning occurs in small student groups, teachers function as facilitators, problems form the original focus and stimulus for learning, problems are vehicles for the development of problem solving skills and the last characteristic is that new information is acquired through self-directed learning.

PBL's potential to enhance meaningful learning will fail without the necessary tools and access to resources. The tools are not restricted to the transformation of nature, but certainly directed towards social and mental activities as well (Dircknick, 2009). According to Vygotsky's (1978) socio-cultural approach to learning, tools fundamentally mediate higher mental functioning and human actions. Dircknick (2009) argued that ICT can be used as a tool to organise information. ICT as a tool has gained an essential and permanent role in present day educational settings. ICT provides a learning infrastructure which acts as an expedient for PBL implementation.

PBL has been adopted, adapted and improved at the Faculty of Medicine and Health Sciences (FMHS) in Universiti Malaysia Sarawak (UNIMAS) since its establishment in 1995. The mechanism of PBL implementation at FMHS UNIMAS has three phases, which are, introduction of trigger, gathering of information pertaining to the learning needs of the trigger and discussion of the newly gained knowledge pertaining to the learning needs of the trigger. The trigger introduction is usually done on Monday morning and the discussion is done on Friday afternoon. Between Monday morning and Friday afternoon, the students are given sufficient self directed learning (SDL) hours to gather information regarding the learning needs of the trigger. The following week, the students encounter a new trigger. It was noted that the students generally spend approximately 1-2 hours on Monday and 2-3 hours on Friday for the face-to-face component of PBL. Although the PBL room is well equipped with ICT facilities, it was found that the students were not engaging the facilities provided. In addition, during the PBL sessions, the students were found busy with some futile activities such as writing on the white board, copying from the white board and personal note taking. We realized that the time spent on these trivial activities can be used for quality discussion session. In order

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to make the PBL process efficient and well managed, ICT-supported learning techniques were utilized and introduced to the students. Therefore, this study was planned and executed to investigate students' feedback on the integration of ICT-supported learning during PBL implementation at FMHS UNIMAS.

2. Methodology

The aim of this study was to discover students' learning experience on using ICT during the implementation of the PBL process. There were 12 PBL groups in this cohort of medical students. As a facilitator, we employed ICT-supported learning techniques in one of these PBL groups. Our priority was to examine the students' perception of their learning experience in using ICT-supported learning techniques. The study employed a mix method approach using questionnaire and semi-structured interview. According to Flynn (2005), the inclusion of qualitative data benefits the richness and validity of gathered data.

2.1. Research site: Faculty of Medicine & Health Sciences (FMHS), UNIMAS

At the FMHS, UNIMAS a PBL group may consist of 9 or 10 students. The students are divided according to several criteria. Mainly, the PBL groups are based on gender, ethnicity, state of origin, Malaysian University English Test (MUET) band scores and academic status. Where possible, attempts are made to distribute an equal number of students according to the criteria mentioned. In the programme's weekly time table, a minimum of 8-10 hours are designated for self-directed-learning (SDL) activities between Monday and Friday. In addition, between the PBL sessions, the students are given pertinent lectures to supplement the PBL curriculum. The medical programme is based on organ-system curriculum. When the students enter the medical programme, they undergo a two day PBL workshop. During the workshop, the students are exposed to the concept of PBL, the roles and responsibility of students in PBL, the roles and responsibility of the facilitators in PBL and the Faculty's expectations. The students are also exposed to a simulated PBL followed by a video presentation of the implementation of PBL in the faculty.

A typical PBL group session comprises of trigger on Monday mornings and discussion on a Friday afternoon. These sessions take place in PBL rooms which are specifically designated for PBL related activities. Each PBL group is furnished with a roundtable format discussion room. In addition, the faculty provides each PBL room with a standard mobile white board, a pull down screen, LCD projector, direct video projector, a four-tier steel locker cabinet and a desktop computer. The students are also able to use free wireless fidelity (Wi-Fi) and their own ICT devices such as laptop, iPad, Tablet PC and smart phones.

2.2. PBL process at FMHS

The PBL process begins with identifying difficult terminologies, followed by gathering of facts and generating ideas and lastly to form the learning needs to bridge the knowledge gap so that the problem is better understood. This activity requires about 1-2 face-to-face contact hours. Normally the students would divide the white board into four columns. The first column for listing difficult terminologies, the second column for facts gathered from the trigger, the third column for ideas generated during trigger discussion and the fourth column for formulating their learning needs. During the Friday PBL discussion sessions, the students would bring teaching and learning aids in the form of anatomical models, charts and other materials to facilitate their discussion. At times students draw on the white board before starting any discussions. The discussion activity generally requires 2-3 face-to-face contact hours. During PBL group sessions, students spend approximately 25% of the overall time looking for meanings of difficult words in dictionary, text books, copying written notes from the white board and personal note taking.

2.3. The study group

In this study, the PBL facilitator demonstrated to a group of 10 first year medical students how to use a MS word file with a landscape page layout orientation to form the four columns. It was aimed to mimic the white board and enable the thought processes to be saved digitally upon completion and ready for sharing via their preferred social media such as Facebook (FB). The instructor also showed the students how to use the mobile digital dictionary, word processing and presentation tools to obtain information related to the PBL process. The use of digital camera or camera function in mobile phones was also highlighted. The social networking platform was encouraged for obtaining and sharing resources. Finally students were exposed to and emboldened to take advantage of the rich experience of Web 2.0 tools such as YouTube, Social Network Media and Dropbox.

2.4. Participants

The study involved ten first year medical students at the FMHS, UNIMAS. These ten students belonged to a cohort of 115 students, who were grouped into 12 separate PBL groups. The groupings were done based on explanation given in Section 2.1 of this paper. These students were exposed to ICT-supported learning techniques from the second PBL session onwards. The small number of respondents is due to the nature of PBL implementation (Lesperance, 2008; Park, 2008).

2.5. Data collection tool

Research instruments used in this study were questionnaire and semi-structured interview. The survey questionnaire contained three sections. Section One consisted of basic demographic data which covered personal information such as gender, school background, year of study and Malaysian University English Test (MUET) band score. Section Two consisted of 17 items which focused on the students' experience in using ICT during their PBL discussions. Each item was followed by a 5-point Likert options which were Strongly Disagree (SD), Disagree (D), Unsure (U), Agree (A), and Strongly Agree (SA). Section Three contained two open ended questions which were aimed to elicit students' detailed information based on their responses to the questionnaire items in Section Two. The questionnaire items were adapted from Hazari et al.'s (2009) study on the use of ICT in teaching and learning. The opinions of two experts were obtained to maintain content validity of the questionnaire and a pilot study was conducted with three second year medical students. Based on the feedback, minor corrections were made and the final version was used in this study. The interview focused on the students' experience in using the ICT-supported learning techniques introduced to them. Besides that, data on the benefits gained and challenges faced were also elicited. In addition, the students were also asked whether they would continue to use and recommend the techniques to their classmates.

2.6. Data collection procedure

The questionnaire was administered to ten first year medical students. Prior to data collection, the ten students had experienced seven PBL sessions. The students were shown and encouraged to use ICT-supported learning techniques from the second PBL session onwards. Before administering data collection, the students were briefed on the aim of the survey and respondents' consent for participating in this study was obtained. It took approximately 10-15 minutes for the students to complete the questionnaire. Upon completion they were interviewed as a group and this was followed by one-to-one interviews based on their responses to the questionnaire items. The questionnaire data were analysed using descriptive statistics and the results are explained with the qualitative data obtained from the interview sessions.

3. Results

3.1. Time

Nine of the ten students (90%) in this group agreed or strongly agreed that the application of ICT in the implementation of PBL was worth their time. Only a small minority were unsure of this matter. Seven (70%) of them also either agreed or strongly agreed that the use of ICT during PBL helped them to save time. The remaining three students (30%) were unsure on this matter. Qualitative data from the interview with the respondents indicate that the students found the use of ICT during PBL was worth their time because less time was spent on copying material from the white board. One of the participants who responded neutral explained that it was not time efficient because the group had to wait for the person who was typing on the keyboard to complete the task. The following are sample excerpts from the interview.

Student A: Using ICT tools has certainly helped us because we do not have to wait until the Scribber finish writing on the board.

Student F: It helps me to save time.

3.2. Effort

Eight of the ten respondents (80%) agreed or strongly agreed that the application of ICT in the implementation of PBL was worth their effort. Only two students (20%) were unsure of this matter. The interview with the respondents indicate that the students found the use of ICT during PBL was worth their effort because it enabled them to be more engaged in the PBL activities. For example, they mentioned that the time saved through the use of ICT enabled them to spend more quality time on the discussions. The following interview excerpts exemplify this point.

Student D: Can see the fruits of our effort.

Student H: We have more time for discussing.

3.3. Interest in PBL

Nine of the ten students (90%) either agreed or strongly agreed that the use of ICT in the implementation of PBL has made them more interested in PBL. One student was unsure of this matter. Qualitative data from the interviews with the respondents explain that the increase in interest was mainly due to the fact that the use of ICT enabled them to access a variety of resources

and share them with their group members easily. In addition, they also explained that the use of these multi resources enriched their learning experience. Below are sample excerpts which support this claim.

Student B: It makes me interested to come to PBL sessions.

Student F: I enjoy using technology during PBL session as it makes our session more efficient and interesting.

3.4. Interact with members

Eight of the ten students (80%) in this study either agreed or strongly agreed that the use of ICT helped them to interact more effectively with their group members during PBL discussion. During the interview, the students explained that the use of ICT during PBL enabled them to be more efficient and free of futile endeavours especially manual note taking. This effort in turn enabled them to share resources effectively and interact meaningfully with group members. The sample excerpt below illustrates this point.

Student E: Make everything easier, no need to write on paper. Just type it and share it on the internet with everyone.

3.5. Opportunity to interact

Six of the ten respondents (60%) either agreed or strongly agreed that the use of ICT gave them the opportunity to interact better with their group members during PBL discussions. Interestingly the qualitative data from the interview with the respondents show that some of the respondents were not quite aware of the opportunity provided through the use of ICT to interact with group members. Three students who responded positively on the item related to the use of ICT in helping them to interact with group members, responded unsure to the item on the opportunity to interact. During the individual interview, the students agreed that the experience of using ICT helped them to interact better with their group members but they were unaware that the opportunity actually presented itself. On the other hand, only one student was aware of the opportunity presented but the student did not seize it. Overall, the consensus was that the interactions among group members were better due to the use of ICT during PBL.

3.6. Task Completion

Seven of the ten students (70%) either agreed or strongly agreed that the use of ICT enabled them to complete their PBL task more efficiently. The qualitative data shows that students were more efficient when ICT was used because the utilization of their personal ICT devices enabled them to participate effectively and efficiently in the process of completing the assigned task. The following excerpt highlights this point.

Student J: Technology helps us a lot in completing the task

3.7. Effectiveness

Eight of the ten respondents (80%) either agreed or strongly agreed that the use of ICT during PBL made their group become more effective. The remaining two students (20%) were unsure on this matter. During the interview the students clarified that they were effective in achieving their objectives during the PBL sessions because ICT enabled them to be resourceful and efficient in gathering the required information. The following excerpt exemplifies this point.

Student F: I gain a lot of information when I do research on the internet. I enjoy using technology during PBL session as it makes our session more efficient and interesting.

3.8. Active participation

Seven of the ten students (70%) either agreed or strongly agreed that the use of ICT during PBL made them become an active participant during PBL. The other three students (30%) were unsure on this matter. The qualitative data obtained through interviews show that the students were more confident during active discussions because the ICT tool provided evidence of their argument. The availability of this information boosted their confidence during discussion. The following sample excerpt below illustrates this point.

Student G: Technology helps me to explain the information more clearly. More resources are used. I feel more confident.

3.9 Achieving objectives

Seven of the ten students (70%) either agreed or strongly agreed that the use of ICT during PBL have helped them to achieve their objectives. Their interview data indicate that the students felt happy that their goals were easily attained when ICT was used during PBL. The feeling of happiness makes the student be more interested in the PBL approach. The following sample excerpt below depicts this point.

Student I: Technology helps me to stay focused on our goals and because of this we are able to achieve our aims easily.

3.10. Enhanced learning

All the respondents (10/10) either agreed or strongly agreed that the use of ICT during PBL enhanced their learning. The interview data also concur with this response. All students indicated that the use of ICT has enhanced their retention of knowledge more efficiently and made PBL learning more meaningful. The following excerpt validates this point.

Student C: I am able to remember better what I have learnt.

3.11. Easy to use ICT

While eight respondents (80%) agreed or strongly agreed that it was easy to use technology during PBL, one of them (10%) was unsure and another (10%) disagreed that it was easy to use technology during PBL. During the interview, the student clarified that it was not easy to use the technology due to unfamiliarity in the initial stage. However, as time passed the student began to be more accustomed to the use of the gadgets in the PBL room. For example, toggling between LCD projector and video projector seemed to be a problem at times and also unplugging the desktop DVI cable and putting in the right port on the laptop was a daunting task, initially. The following excerpt validates this claim.

Student F: Some of the technologies were difficult to use at first but I got the hang of it, its ok.

3.12. The problem faced while using ICT

Only six respondents (60%) agreed or strongly agreed that they did not face any problem while using technology during PBL. On the other hand, three of them (30%) were unsure on this matter and one (10%) indicated having faced difficulty while using technology during PBL. The interview data show that the difficulties faced were solely due to the lack of familiarity with the functionality of the devices and technical problems such as slow Wifi connection which was occasionally encountered while using the technology. The following excerpt provides support for this claim.

Student D: Sometimes the connection is rather slow, making things difficult and frustrating.

3.13 Visualization

Eight of the ten respondents (80%) either agreed or strongly agreed that visualization using technology have helped them to visualise the materials discussed during PBL. The remaining two students (20%) were unsure about the matter. The qualitative data indicate that students were motivated to use ICT during PBL because the tools enabled them to visualize the learning material better and this in turn helped enhance understanding. Students liked to use the whiteboard for brainstorming activity such as mind mapping. They created the mind mapping work as tight as possible on the white board so that a digital photo could be captured and shared with the group members via Facebook. Furthermore, students reported that the materials from e-book, digital textbook and YouTube videos were shared among group members. Textbook drawings, potted specimens and anatomical

models were shown using direct video presenters. This multimedia enriched learning environment also enabled them to retain the knowledge gained through audio and visualization. The following excerpts provide support for this claim.

Student B: The visual aid enhances our memory on the topics discussed.

Student C: It is a good way to explain subject matter or visualizing content that are hard to explain.

Student D: We used to show video on topics of interest and it makes us see things better.

Student G: Technology helps me to explain the information more clearly.

Student I: Technology such as multimedia provide us a better picture of what we are learning. It helps us to retain information longer through the use of pictures and audio.

3.14 Continue using technology during PBL

All the ten respondents (100%) either agreed or strongly agreed that they would continue using ICT during PBL. This is clearly reflected in the qualitative data obtained, where all respondents expressed that they were excited and looking forward for the next PBL. The following excerpt exemplifies this point.

Student H: The technology really help me with learning and I will definitely continue to use them.

3.15 Future Recommendation

While eight of the ten respondents (80%) either agreed or strongly agreed that they would recommend their friends in other PBL groups to use technology during PBL, two (20%) were not sure if they would make such recommendation. During the interview students who were keen to recommend said that the use of ICT may motivate students who dislike PBL because ICT encourages active involvement during PBL. The following excerpt exemplifies this point.

Student C: Students generally tend to dislike PBL but ICT makes it easy for everyone to participate actively so I will recommend to my friends and juniors.

4. Discussion

This study aimed to discover students' opinions on the utilization of ICT-supported learning techniques in PBL learning context. The findings show that the implementation enabled students to save time and effort, enhanced their interest, enabled information retention, provided better opportunities to interact with group members, and work more effectively as a group during PBL. Barrows (1996) highlighted that three of the six characteristics of PBL are student dependent. The three characteristics are learning is learner centered, occurs in a small group and self directed learning (SDL) is the impetus for the acquisition of new knowledge. The findings show that these three characteristics can be enhanced by using tools that make learning more effective and meaningful. Leidner (1995) highlighted that one of the pertinent tools is ICT. In line with this, four forms of ICT were engaged in this study. They were mobile digital dictionary, digital presentation tool, digital photo capture and social networking media. The utilizations of these ICT tools seem to influence the student dependent characteristics of PBL in a positive manner.

Sunchana *et al.* (2005) showed that blended world wide web (www) based learning and PBL collaborative environment was positively affected by the use of technology. Similarly, the participants of this study group exhibited enhanced learning when subjected to the use of ICT during PBL. Castro-Sanchez *et al.* (2012) showed that PBL facilitates learning strategies and study preferences. Castro-Sanchez *et al.* also reported that PBL students' highly rated study preference were linked to learning style of logical, social, physical, verbal and visualization. The present study's findings also show that visualization of knowledge through the use of ICT during PBL enhances their retention of the knowledge learned. Similarly, Blackburn *et al.* (2008) study showed that the use of wireless technology in a PBL class augments students' participation and satisfaction. Likewise, in this study the participants' feedbacks on the use of ICT during PBL discussion, concur with Blackburn's notion. The present study group members said that the utilization of personal ICT devices enabled them to complete the PBL task efficiently, therefore imbuing them with the sense of accomplishment.

Dirckinck-Holmfeld (2009) argued that face-to-face method and computer networks affect the usual time patterns of teaching and learning. It was further explained that teaching and learning environment can be organised more flexibly due to the asynchronous nature of the ICT. The findings of the present study indicated that the introduction of mobile and ubiquitous computing devices have made learning effortless. Moreover, the culture of using ICT during PBL has been extended to non-PBL time and students tend to be involved in diversified resource seeking. This strategy seems to enhance their overall learning experience. The idea of education and access to information taking place anytime, anyplace and anywhere is a reality. The

findings of the present study support Dirckinck-Holmfeld's (2009) argument. The output of synchronous in combination with asynchronous activity among the group members, afford reflective, active, collaborative teaching and learning at all times.

The present study also showed that students use smart phones during the PBL session to capture images, access and share information. Similar findings were also observed in a recent study conducted by Utulu and Alonge (2012). They found that a significant percentage of the students used mobile phones to communicate, interact, obtain information, browse internet and share knowledge anytime anywhere when they were involved in PBL. This shows that utilization of student preferred personal ICT devices should be permitted during teaching and learning processes as they offer active and engaging learning experience for students.

The merging of ICT with PBL has vast potential to serve as a catalyst for educational reform (Dirckinck-Holmfeld, 2009; Moersch, 1995). PBL pedagogy is meant to make students interact and engage in active learning. The findings of this study show that ICT tools enable students to be more resourceful, collaborate effectively and create a rich and meaningful learning environment. Thus, ICT is recommended to be used to facilitate the display of information, to increase access to external digital resources and to increase the dissemination and construction of knowledge during PBL implementation.

5. Conclusion

PBL is often recommended as an effective teaching-learning pedagogy. However, it is often advocated that its potential to enhance meaningful learning will be affected without the necessary tools and access to resources. Thus, this study was aimed to investigate students' feedback on the integration of ICT-supported learning techniques during PBL implementation in a Medical PBL curriculum. In particular, mobile digital dictionary, digital presentation tools, digital photo capture and social networking media were used to enrich the learning experience of PBL students. This study has revealed the positive influence of ICT-supported learning techniques on PBL process. It is not that ICT is a panacea for teaching and learning ills but ICT can certainly help pave the path for active learning to take place. Through active learning the acquisition of knowledge can be made more pleasant and meaningful for students.

In summary, factors pertaining to ICT-supported learning during the PBL process that have a positive effect on learning experience include:

1. Time saving provides effective discussion
2. Enhanced retention of information
3. Efficient and interesting PBL sessions
4. Increase connection or interaction between members
5. Audio together with digital visual aid enrich learning experience

The factors explicated in this study will be useful for facilitators to engage students actively in a PBL learning environment. Diverse pedagogical tactics such as ICT-supported learning will enhance, enrich student learning and assist students achieve their learning goals effectively. Therefore we propose that ICT-supported learning techniques should be encouraged and embedded during the implementation of PBL.

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