

The impact of Problem-Based Learning on the information
behavior and literacy of veterinary medicine students at
University College Dublin

By

Lorna Dodd

Liaison Librarian,

UCD, Dublin, Ireland.

lorna.dodd@ucd.ie

Abstract

Research was conducted on the impact of Problem-Based Learning (PBL) on the information seeking and literacy of veterinary students at University College Dublin. Data was collected using both quantitative and qualitative methods from students, academics and the librarian. Results showed PBL has a significant impact on how students find and use information.

Introduction

The undergraduate veterinary medicine program at University College Dublin is the only such program available in Ireland. In response to recommendations made by the Veterinary Council of Ireland in 1995, the curriculum underwent a major review in 1996 resulting in a new curriculum that commenced in 1999. By introducing new approaches such as Problem-Based Learning (PBL), the new curriculum would be informed by a desire to reduce the emphasis placed on 'shallow learning' and increase the emphasis on 'deep learning'. PBL was introduced into the first and second years of a five year undergraduate programme. The PBL unit is continuous throughout the two years and a grade is allocated at the end of the second. These years are not entirely PBL based. Students attend subject based lectures and practical sessions in addition to the 'Applications & Integration (PBL)' course.

During the academic session, 2004 – 2005, a case study was conducted in order to examine how PBL has impacted the information seeking behavior and information literacy of students, the role of the librarian and the use of library resources. The first of these questions shall be discussed in this paper: What has been the impact of PBL on the information seeking behavior and information literacy of students? This study

was considered timely as the final year students graduating in 2005 were the first to undergo the PBL program.

While there have been many studies on the impact of PBL on libraries,^{1 2 3 4 5 6 7 8 9}^{10 11} there had been no research in this area in Ireland at the time of this research. Although the undergraduate curriculum in the Veterinary School is not a PBL curriculum as such, there is a PBL element and it was anticipated that the inclusion of this would provide the necessary data to examine the impact of PBL on the library and that this could then be compared to that concerning non-PBL activities. It was also anticipated that conducting this study would create a point of reference in the future for others interested in researching the impact of PBL on libraries in Ireland.

At the time of this research, the Veterinary School often operated as a self-contained unit within the university with its own teaching hospital, faculty building and dedicated on site library service. Consequently, the information literacy standards of undergraduate veterinary medicine students has long been informally considered by both academics and librarians as more advanced than the general student population. With this in mind, the question of whether the impact of PBL on the information literacy standards of these students is similar to that described in the literature was an interesting feature of this study.

What is Problem-Based Learning?

PBL is an approach to learning rather than a teaching technique. The emphasis is placed on self-directed learning, encouraging students to be open-minded, reflective and develop critical and active learning skills. ¹²

PBL is based on small groups of students, each with a member of staff as group facilitator. Students are presented with a problem from professional practice. The member of staff ensures that students progress through the problem satisfactorily, identifying what they know, what they need to learn and establishing how they will organize themselves in preparation for the next tutorial. The starting point is the problem, which generates students' learning issues. Students apply their existing knowledge to the problem. By doing this, they identify gaps in their own knowledge. This defines their learning objectives and they then undergo independent, self-directed information seeking and learning. Students then return to the group to share their acquired knowledge and "their increased knowledge contributes to further inquiry" in the next session. ¹³ Consequently, PBL is not about problem solving as such, but uses problems to increase knowledge and understanding.

The Facilitator

The key to PBL is the transformation of the teacher from provider of information to facilitator and the teacher is known as 'facilitator' in a PBL program. Due to this changing role, subject specialists may be poor PBL group facilitators as they are more likely to revert back to lecturing. ¹⁴ Traditional styles of teaching can have a limited

role in achieving the aims of PBL and the inability of staff to change from provider to facilitator of information can often cause problems when introducing PBL.¹⁵

Facilitating the Learning Process

The use of clinical material in learning helps students understand the relevance of scientific knowledge in practice. PBL demonstrates the complementary nature of theory and practice by promoting conceptual understanding, developing reasoning skills and self-directed strategies. Applied knowledge is challenged and evaluated, resulting in the identification of individual learning needs. Skills and knowledge acquired from study are applied back to the problem, evaluating the effectiveness of learning. The newly gained knowledge is then summarized and integrated into the student's existing knowledge and skills.¹⁶

An examination of veterinary medicine students' approach to study was conducted at University College Dublin. Results showed that, in relation to PBL, students display positive associations with 'deep learning' and negative associations with 'surface learning'.¹⁷

PBL and Traditional Teaching Paradigms

When outlining the significance of PBL in educational reform, Margetson emphasizes that higher education aims to "achieve not only lower cognitive qualities such as recall of information, but also higher qualities such as critical reflection".¹⁸ A traditional medical curriculum separates theoretical knowledge and practical

application, encouraging students to compartmentalize their knowledge. While a traditional curriculum places a large emphasis on memorizing information by rote, PBL is “learning for capability rather than learning for the sake of acquiring knowledge”, providing the basis for a “lifetime of continuing education”.¹⁹ Research has shown there is little difference between the knowledge outcomes of graduates of traditional curricula and PBL curricula. However, graduates from PBL curricula appear to have better knowledge retention.²⁰

Literature Review

Even though information literacy is not a main objective of PBL, it is nonetheless an integral concept and students are expected to become lifelong, independent information users. In PBL, students must actively participate and take responsibility for their education. The emphasis placed on independent learning and information gathering promotes values which many librarians have believed in and promoted for years. Students on a PBL curriculum need to acquire information seeking skills that will enable them to manage lifelong learning and respond to demands in a changing environment.²¹

PBL is an activating pedagogical approach to learning which emphasizes the students’ independent information seeking. Staff no longer deliver information to assist the learning process, but support students in independent information gathering.²² One of the basic goals of PBL is that students should be able to identify and retrieve relevant information according to their needs. Key features of PBL such as learning in groups,

the integration of basic sciences into patient cases and self-directed learning are factors that may have an impact on the information behavior of students.²³

Due to the lack of predetermined literature lists set by academics, it is assumed that PBL students are gathering information from different sources.²⁴ In a study of American medical colleges, it was questioned whether “students in the PBL curriculum demonstrate stronger basic information-seeking competencies?”²⁵ Results showed that PBL students used self-selected information resources much more than their traditional counterparts and acquire basic information seeking skills earlier in their academic careers, suggesting that “these skills are important in the independent learning programme”.²⁶

At the University of New Mexico, the PBL Planning Committee identified seven learning objectives related to student’s information skills. These objectives include “information management question formulation; organization and use of the Medical Center Library and its resources and selection of the most appropriate source to retrieve information”.²⁷ All these skills are evident in the independent, self-directed learner and it would appear from the literature that PBL students are more discerning information seekers, with information seeking behaviors and literacy standards that separate them from traditional curriculum students.

Studies have shown that PBL students use the library for longer periods of time; use a wider variety of resources to support their learning and require additional instruction in information seeking skills.²⁸ Rankin’s survey of the literature of PBL and libraries, discusses studies which have found that PBL students not only use the library more

frequently, but also choose information sources such as online databases and journal literature that are typical of independent learners.²⁹ In addition, they acquire information seeking skills earlier, ask more complex questions at the reference desk and show greater ease in locating information than their traditional curriculum counterparts.

Methodology

The methods used for collecting data were chosen because they have been used in other research that explores the impact of PBL on libraries. There was some quantitative empirical data to be collected in addition to qualitative data such as experiences of PBL and attitudes regarding information literacy and information seeking behavior.

Throughout the literature describing studies conducted in other PBL libraries, both quantitative and qualitative methods have been used. This study aimed to collect data from students concerning preferred resources, information seeking competencies and behavior patterns related to library use. Much of this data is empirical. Although there was some data collected from students of a qualitative nature, a questionnaire was the instrument of choice for retrieving data from students. A questionnaire was chosen for two reasons. Firstly, it was possible to reach a large number, therefore obtaining more representative results. Secondly, a questionnaire is a suitable method for collecting the empirical data required. The questionnaire included some open ended, qualitative questions exploring students' attitudes and experiences toward information seeking, PBL and library resources. *(See Appendix I. for student questionnaire)*

Rankin comments on the complex nature of the relationship between information use and use of the library and draws attention to the limitations of quantitative assessment.³⁰ Qualitative methods have been used in Information Science when quantitative methods have been unsuccessful, as a result of growing interest in qualitative methods in Social Science and as a consequence of a shift toward a “user-orientated research tradition in Information Science”.³¹ Qualitative methods are applied to complex phenomena when the purpose is to gather information which can not be expressed in quantities and numbers. This method enables the researcher to obtain a greater understanding of the problem.³² With this in mind and considering the question posed by this research, interviews were used to collect data from both the librarian and academic staff.

Data Collection

University College Dublin is the largest university in Ireland with 13,260 full-time equivalent undergraduate students. The veterinary medicine undergraduate program is made up of 411 full-time equivalent students across five years. Questionnaires were distributed and collected during lectures to all students participating in PBL, 85 first year and 77 second year students, with 108 (67%) responding. This proportion was evenly spread with 70% of first years and 67% of second years responding.

Interviews were conducted with five members of academic staff and the veterinary librarian. All five academic staff were PBL facilitators. Three of these made up the PBL coordinating team for the Veterinary School and two were ‘champions’ of PBL

in the Veterinary School. All interviews lasted 20-30 minutes and were conducted in the participants' place of work using a Dictaphone tape recorder.

Methods of Analysis

To analyze the data collected, two distinct methods were used. Empirical data was analyzed with the use of Microsoft Excel. Qualitative data collected from students' questionnaires and interviews were analyzed using thematic coding.

Material collected from student questionnaires was used to determine whether there is a difference between students' behaviors and activities for PBL in comparison to other work. The data was also used to establish whether there is a relationship between students who feel the library is important to PBL; if they spend more time in the library for PBL and how they value information seeking skills. Common relationships between students who self-select resources were also investigated in relation to how they value information seeking skills in PBL and if they display information literacy skills. These specific relationships were examined in order to identify how PBL affects students' behaviors in PBL and because they were discussed throughout the literature.

Qualitative data collected from student questionnaires and during interviews followed the principles of qualitative analysis. This was done by determining differences related to the questions posed and then building categories, forming the basis of analysis.³³ To identify significant themes, two codebooks of themes were built.

The first of the codebooks reflected themes which emerged from the student questionnaires. These included the additional research required for PBL in comparison to other classes; an increased use of the Internet; the use of a larger range of resources for PBL; difficulties experienced by students during PBL and the use of materials recommended by academic staff in PBL.

The second codebook identified themes that emerged during interviews with academic staff and the librarian. These included the effect of PBL on information use, information literacy and skills; use of the Internet in PBL; differences between PBL students and those in other classes; the role of the facilitator; the success of PBL seen through final year students and the expectations and use of resources in PBL.

The interview with the librarian was used in conjunction with student questionnaires to determine whether there is a relationship between student responses and how the librarian perceives PBL has impacted students' information seeking behavior and information literacy. Data from interviews with academics was then compared to student questionnaires to determine how academics view information seeking skills and information literacy in the PBL process and whether there is a relationship between this and students' behaviors and library use.

Results

Library use in PBL

Half of students said that they spent longer in the library for PBL than for other work. (Table 1) *[Insert Table 1]* Analysis of students' responses showed that reasons for spending longer in the library related directly to the information seeking behavior of students engaged in PBL. Students spent longer in the library for PBL because it "requires more research", because "learning involved is more intensive", because of time restrictions in PBL and because "information is needed from a variety of sources". Therefore, students who spent longer in the library for PBL did so because of the way it has affected how they find and use information.

Staff felt that the library plays a central role in PBL, that "it's critical", stating that "it's fundamental to the success of the program because it is *the* resource." They also felt that PBL encourages students to use the library earlier in their academic career, "... by the time they're in third and fourth year they have an idea how to use the library better than before we had PBL..." and that this has had an impact on students in that they have become competent at using resources much earlier. Staff felt PBL means students have a much greater need of the library and that PBL has been very successful in terms of students learning how to use the library. "PBL forces them to look into sections and shelves they wouldn't have otherwise done" and "in terms of students learning library use, I think it's [PBL] very, very successful."

Importance of the Library

Students were asked how important they consider the library to be in PBL: extremely important, very important, important or not important. (Figure 1) *[Insert Figure 1]* Only six out of 108 students did not consider the library important in PBL, showing that students believed the library played a central role. Students said the library was the main resource for PBL and felt “while other sources e.g. Internet are useful, information gathered from the library is more reliable and often more relevant.” Those who did not consider the library important in PBL also said that “PBL is not important at all”. This group preferred to use other sources, “the Internet often is quicker and easier to use”, and experienced difficulties with PBL. These responses illustrated how those who did not feel the library had an important role in PBL also did not feel comfortable with PBL. However, students who felt the library did have a role to play in PBL had different information seeking behaviors and by using a variety of resources, considering if sources are reliable and searching more they were displaying a standard of information literacy.

A pattern emerged in that amongst students who considered the library extremely or very important, the Internet was considered less useful and, amongst students who considered the library to be of lesser importance in PBL, the Internet was considered more useful. Students who experienced problems seeking information in PBL also had problems with the Internet. Therefore, it seems the Internet was relied upon less by those who considered the library to have an important role in PBL.

Information Literacy and Skills

When asked, 40% of students said that they experienced problems when seeking information for PBL. (Table 2) *[Insert Table 2]* These students suffered from an information or resource overload and had difficulty finding specific information, “it is either too detailed or not detailed enough, as PBL can focus on very specific areas or a whole broad subject area.” Students also experienced problems finding information in the library, had difficulty with library orientation and experienced problems with the Internet when searching for information for PBL, “I am not very efficient or effective when using the net.” This clearly demonstrated that problems occur due to a lack of information literacy. Consequently, sufficient information skills are required so that students can find the necessary material in PBL.

Students were asked how important information skills are in PBL: extremely important, very important, important or not important. Most considered information seeking skills in PBL extremely important, very important or important. (Figure 2) *[Insert Figure 2]* They said having these skills made it easier to find information and saved time. “I need to be able to find very specific information reasonably quickly for the next session.” Students felt information skills are life skills, “as a qualified vet you have to do your own PBL”. They felt that PBL “encourages you to use a variety of sources and enables individuals to develop ability to carry out research independently.” Students said that gaining information skills was the aim of PBL, that they aided the learning process and that “it's pretty much the purpose of PBL to work things out for yourself.”

In contrast, students who said information skills were not important in PBL also said they were not needed, “I think it is a complete waste of time, you just look at information and write down relevant information.” This demonstrated how those who value information seeking skills in PBL were able to search for information more easily. In addition, those who considered these skills important to PBL also recognized they were developing a tool for life-long learning, which was identified in the literature as part of the learning process. Additionally, none of those who spent more time in the library for PBL considered that information skills were not important. (Table 3a & Table 3b) *[Insert Tables 3a & 3b]*

During interviews, a theme regarding the impact of PBL on the use of information, information literacy and skills emerged. Staff considered information skills “the core of it [PBL]” and discussed how PBL increased the need for information skills and made students think about and use information systems. They expected students to “find their own resources” and “learn what type of resources are available”.

It was discovered that no recommended readings were provided in PBL, encouraging students to self-select sources. This was illustrated by results from the questionnaires and reflected in the literature. By having to self-select information, staff believed students’ better understood how to use resources and learnt to become “more selective and discriminatory” regarding information.

Choosing Resources

Students ranked resources 1-9 for non-PBL and PBL work, 1 being the most useful and 9 the least. Resources could be given equal ranking. Figure 3 shows that for non-

PBL work most students (69%) ranked one resource, Short Loan Books, (multiple copy core text books) first. For PBL, a similar amount chose General books (35%), Short Loan Books (32%) and Websites (28%). *[Insert Figure 3]*

A clear majority of students found Short Loan Books most useful for non-PBL work. However, when choosing the most useful resource for PBL, results were much more evenly spread. A similar number chose General Books, Short Loan Books and Websites as the most useful. This demonstrated that while students tended to rely heavily on one resource for other work, for PBL they were much more likely to use a wider variety of sources. This shows how PBL has impacted students' information seeking behavior and supports the literature, as students were expected to gather information from a variety of sources.

Both staff and the librarian expected that resources used by students in PBL would be "very wide ranging". Staff expected students to use many different types of resources "from basic right through to clinical textbooks and even some of the journals."

Information Seeking Behavior

Students were asked how they chose resources for both PBL and non-PBL work, whether they self-select material, use recommended material or do both. While there are no official reading lists for PBL, as group facilitators, individual staff members may choose to recommend material. In addition, other classes provide students with reading lists which could be considered recommended reading.

Most students self-selected material for PBL work and both self-selected and used recommended material for non-PBL work. (Table 4) *[Insert Table 4]* When choosing material, a very small amount of students self-selected material for non-PBL classes while a large majority self-selected material for PBL work. In addition, while 26% used recommended material for non-PBL work only 5.5% said they did the same for PBL. However, the majority of students both self-selected and used recommended material for non-PBL work and a much smaller number did both for PBL.

Students self-selected material for non-PBL work for additional reading, to complement their learning style, and if they “don’t follow the lectures”. Reasons given tended to vary. However, a common pattern was that they related to the individual needs of the student rather than to the assigned task. Most noticeable was that reasons for self-selecting material for PBL work were less varied. Students self-selected material for PBL because they received no guidance from staff and “are not recommended material in PBL” and because “PBL is based on your own initiative – you research information independently”. This demonstrated that students self-selected material for PBL because of the nature of the task and that doing this is part of PBL.

Reasons for using recommended material for both non-PBL and PBL work were often the same. Students used recommended material because they felt it was important to use materials recommended by staff as they “have good experience and know what material is most useful to students”. Students used recommended material because they hold relevance, aid understanding of the topic and reduced time spent searching. This was a distinctly different pattern to the explanations given for self-selecting

material. The reasons for self-selecting material for PBL work differed greatly to those given for non-PBL work. This difference demonstrated that students chose material through self-selection due to the nature of PBL. However, it seems that PBL itself did not influence students when using recommended material.

These results also illustrated that while students were likely to choose material in a variety of ways for non-PBL work, they tended to only self-select much more for PBL. In addition, because students self-selected material for PBL due to the nature of the task, the information seeking behavior of those engaged in PBL was different to those who were not.

The relationship between how students chose material and how important they considered information seeking skills in PBL was examined. (Table 5a & Table 5b) *[Insert Tables 5a & 5b]* Results from those who did not consider information seeking skills important in PBL were most significant. While the majority of all other students self-selected material for PBL work and a small number did the same for non-PBL work, none of these students self-selected material for either non-PBL or PBL work. In addition, a much higher proportion of these students used recommended material for non-PBL work. These results were considerably different from those concerning all other students and showed that those who did not consider information seeking skills important in PBL did not self-select material for PBL work.

When examining the relationship between how students chose material and whether they verified information by checking another source, results revealed a similar pattern as above but were more extreme. (Table 6a, Table 6b & Table 6c) *[Insert*

Tables 6a, b & c] This group was more likely to self-select material for PBL and both self-select and use recommended material for non-PBL work.

Students verified information for reliability, to resolve conflicting opinions, to retrieve up-to-date and accurate information and to aid their understanding. In addition, a large majority of these students mentioned the Internet, questioning the reliability of information retrieved, “you can’t rely on the Net, you need to verify”. This showed that those who verified information by checking another source tended to be more discerning regarding material they retrieve.

These results illustrated that those who demonstrated a higher level of information literacy by checking another source to verify information tended not to rely on recommended material and displayed information seeking behaviors (e.g. self-selecting material) that are more prevalent in PBL. Those who verified information were more likely to self-select material, not only for PBL but also for non-PBL work. In addition, those who did not verify information were more likely to rely on recommended texts. Therefore, behaviors associated with PBL were seen in students who had a higher level of information literacy skills, meaning PBL often requires a certain level of information literacy among students.

Difference between PBL and other Classes

Reviewing the literature revealed that the behavior of students’ engaged in PBL was different from those who were not. Comments from staff and the librarian illustrated how students’ information seeking behavior was noticeably different as a result of

PBL. Interviewees felt PBL encouraged students to use a wider range of resources. The way teaching is conducted was also believed to be instrumental in these differences and was described as one of the major influences on students' information seeking behavior in the literature. The veterinary course is heavily dependent on didactic teaching, relying on standard texts and lecture notes. PBL requires students to retrieve information, encouraging them to use a wider range of resources. In addition, students spent longer in the library for PBL because they needed to use a larger range of resources.

While in other classes students are required to find and learn about information relating to a general topic, students engaged in PBL said that they are dealing with a particular problem and are required to "learn more about [a] specific area". Each student is assigned a learning issue relating to a specific part of the problem. This is a very different type of information need and students who experienced difficulties in PBL said that having to find specific information was one of the problems they encountered, "it's either too detailed or not detailed enough..."

The ability to integrate information is a skill commonly associated with information literacy and was one of the differences between PBL students and other students observed by academic staff. "The other classes would be giving you the backbone to your knowledge but not necessarily showing you how to integrate all that information... whereas PBL, I would expect, would give you more direction." PBL requires students to apply what they have learnt and then integrate it into the problem. Consequently, as discussed in the literature, the information seeking behavior and information literacy of those engaged in PBL separate them from those who are not.

Time in PBL

It was discovered that time restrictions in PBL influenced students' information seeking behavior. These are caused by the structure of PBL. Students had limited time to locate and retrieve information for the next session. Students said that it was therefore necessary to be equipped with the information literacy skills needed to "find... information reasonably quickly for the next session". One interviewee felt that "critical to successful PBL is downtime between the actual sessions". Interviewees also discussed how important it was for students to spend time in the library for PBL as it was critical to its success, "you can't expect them [students] to perform without allowance for independent study" and half of those surveyed did spend more time in the library for PBL.

The Facilitator

It was discovered that the role each facilitator plays can influence the information seeking behavior of students. Significantly, facilitators tended to play a varying role and problems regarding the facilitator were evident throughout the literature. In terms of recommending sources, while there are no official recommended reading lists for PBL, some chose to recommend sources to students, "if the PBL group comes back to me and has had problems then I would recommend certain places they can go." Consequently, these students did not self-select material. This goes some way in explaining why some students used recommended material for PBL work. In addition, it was found that students who were more likely to display some level of information literacy skills by checking another source to verify information were less likely to only use recommended material for both PBL and non-PBL work.

The level of facilitators' skills was seen by some as a hindrance. Facilitators appeared to provide varying degrees of guidance, "there has been a little tendency for some facilitators to teach them [students] through it a little bit too much." Consequently, groups had different experiences in PBL and some staff felt this was a fault in the current programme, "each facilitator should facilitate the same and the problem is that isn't happening because there probably isn't as many firm ground rules". Meanwhile others considered the diverse approaches a benefit of PBL. "I think some of the facilitators have quite different styles but I'm reticent to get too heavy handed. As soon as you try and make things too prescriptive then you really restrain the beauty of it which is letting it go with the flow." These varying roles and expectations had different influences on students' information seeking behavior and highlight the instrumental role the facilitator plays in PBL.

Success of PBL in Final Years

The affect of PBL on students' information seeking behavior was seen through the success of the graduating year. At the time of this research, the current final year was the first to undergo PBL. Staff believed the success of PBL was illustrated in the way these students were "good at working on their own and good at going looking up information", were "better than other years at integrating material" and were more discerning in comparison to other years. . "I think the most radical difference is that they're questioning."

Discussion

When reviewing the literature, the importance of information literacy in PBL was apparent and other studies have shown that in order for students to effectively participate in a PBL curriculum, they need to acquire information skills that will enable them to become life-long learners.³⁴ The majority of students at the Veterinary School that participated in PBL recognized the importance of information seeking skills. They also acknowledged that they help to develop life long-learning skills that will be used as practicing professionals. Within PBL, the role of academic staff is no longer to deliver information but to support students in independent information gathering and staff at the Veterinary School consider these skills to be crucial in the success of the program.

Margetson³⁵ and Engle³⁶ determined that one of the main features of PBL is that, rather than separating theoretical knowledge and clinical practice, students learn how to integrate information effectively. The use of clinical material helps students understand the relevance of scientific knowledge in practice.³⁷ Academic staff at the Veterinary School discussed how one of the major benefits of PBL was that students learnt how to integrate information. While all the required curriculum material was delivered to students during other classes, the introduction of PBL enabled them to apply that material to a problem and learn how to effectively integrate information into their knowledge.

One of the most significant findings of this research was how PBL influenced the way in which students chose information resources. Rankin found that PBL students self-select resources much more than their traditional curriculum counterparts.³⁸ In

addition, other studies have shown that PBL students have information seeking behaviors that separate them from other students, such as becoming more discerning regarding information sources.³⁹ Moreover, this study found that students were much more likely to use a wide variety of resources for PBL. In addition, those who self-selected information tended to display higher levels of information literacy, like verifying information from another source. This demonstrated, that the skills required to participate in PBL resulted in students displaying higher levels of information literacy. Internet use in PBL was a recurring theme throughout this study and staff felt that students engaged in PBL were more likely to use the Internet than those in other classes. In addition, students who considered the library and information seeking skills more important in PBL were less likely to rely on the Internet. These students were also more discerning regarding the Internet, which was encouraged by staff and follows the pattern of a higher level of information literacy among PBL students.

Reference is made throughout the literature to the confusion caused by the changing role of the academic in PBL and this confusion was evident in the Veterinary School.^{40 41 42} However, Schmidt et al⁴³ found that, in contrast to the assumption that if academics are skilled at facilitation they don't necessarily need content knowledge, students who were guided by content experts achieved somewhat better and spent more time on self-directed learning. In the Veterinary School, the role of academic staff has had an influential impact in PBL. It was discovered that staff who were content experts often deviated from the process and recommended reading material. As a result of this confusion, students were not only less likely to self-select information and use a wide range of resources but were also less likely to display a higher level of information literacy.

Another feature of PBL students is the differences that separate them from their traditional counterparts. Studies have shown that PBL students have better knowledge retention.⁴⁴ In addition, PBL students also use the library for longer periods of time, use a wider variety of resources and require additional instruction in information seeking.⁴⁵ Much of this was evident in the Veterinary School, with half of students spending longer in the library for PBL and a higher level of information literacy displayed as a direct result of PBL.

Conclusions

Results from this research support the body of literature relating to PBL and information literacy. Although the Veterinary School curriculum is not a PBL curriculum, the ‘Applications & Integration (PBL)’ program has impacted students’ information seeking behavior in a similar way described in other studies. Its inclusion into a traditional curriculum has reaped similar benefits as those in entirely PBL based curricula. Moreover, the assumed higher level of information literacy in students in the Veterinary School has not impacted any findings in this study. The introduction of PBL has increased the need for information skills and resulted in students visiting the library earlier, better understanding how to use resources, becoming more discerning regarding information and learning how to integrate information effectively.

Although there are other institutions in Ireland that have PBL programs, currently no other research relating to PBL and information literacy has been conducted. However, PBL is growing throughout the country and a PBL network of academics and librarians who are interested and involved in PBL was established in late 2005. This

network published a handbook, documenting Irish experiences of PBL in an international context.⁴⁶ Problem-based learning is fast becoming a ‘hot topic’ in the academic forum, but has yet to move into the library and information studies field in Ireland. Since this research was conducted, in Ireland only one piece of descriptive literature has been written on information literacy and PBL⁴⁷. However, with the continual growth of PBL, it is hoped that librarians and libraries will become more involved in PBL, reporting and researching the field, using this study as a point of reference.

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² Jonathon Elredge, “The librarian as tutor/facilitator in a problem-based learning (PBL) curriculum”, *Reference Services Review* 32 (March 2004): 54-59

³ Eva-Liisa Eskola, “Information literacy of medical students studying in the problem-based and traditional curriculum”, *Information Research* 10 no. 2 (January 2005) <http://InformationR.net/ir/10-2/paper221.html>

⁴ Valerie Ferguson, “Planning and providing a course of problem-based library skills for medical and dental undergraduates; the first year”, *Health Libraries Review* 13 (March 1996): 43-47

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TABLE 1		
Do students spend longer in the library for PBL?		
	No. Students	Percentage
Yes	54	50%
No	54	50%

Table 1: Spending longer in the library for PBL

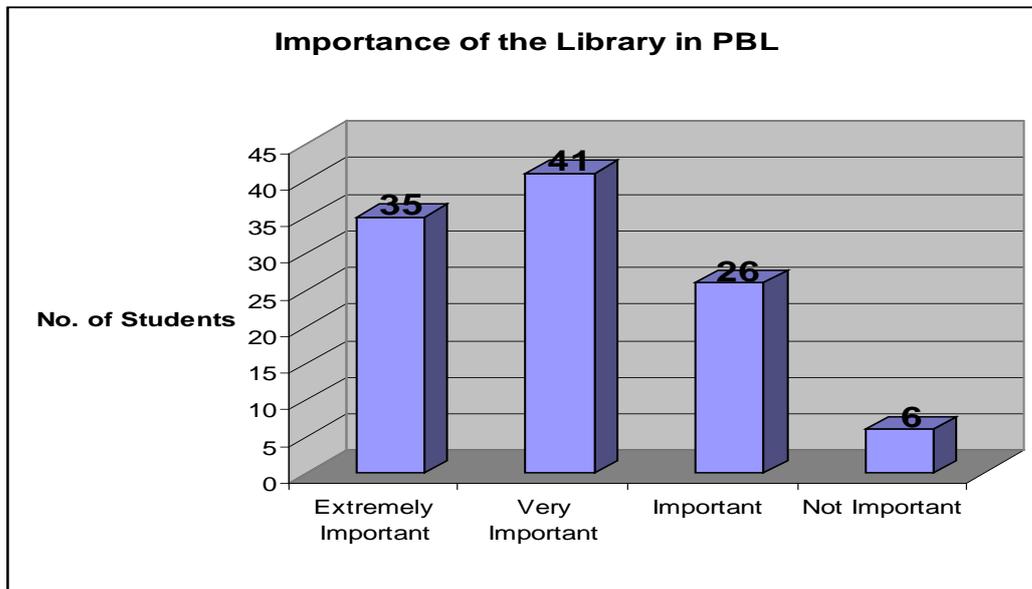


Figure 1: The Importance of the Library in PBL

TABLE 2		
Do students experience problems finding information for PBL?		
	No. Students	Percentage
Yes	43	40%
No	64	59%
Did not Say	1	1%

Table 2: Information seeking in PB

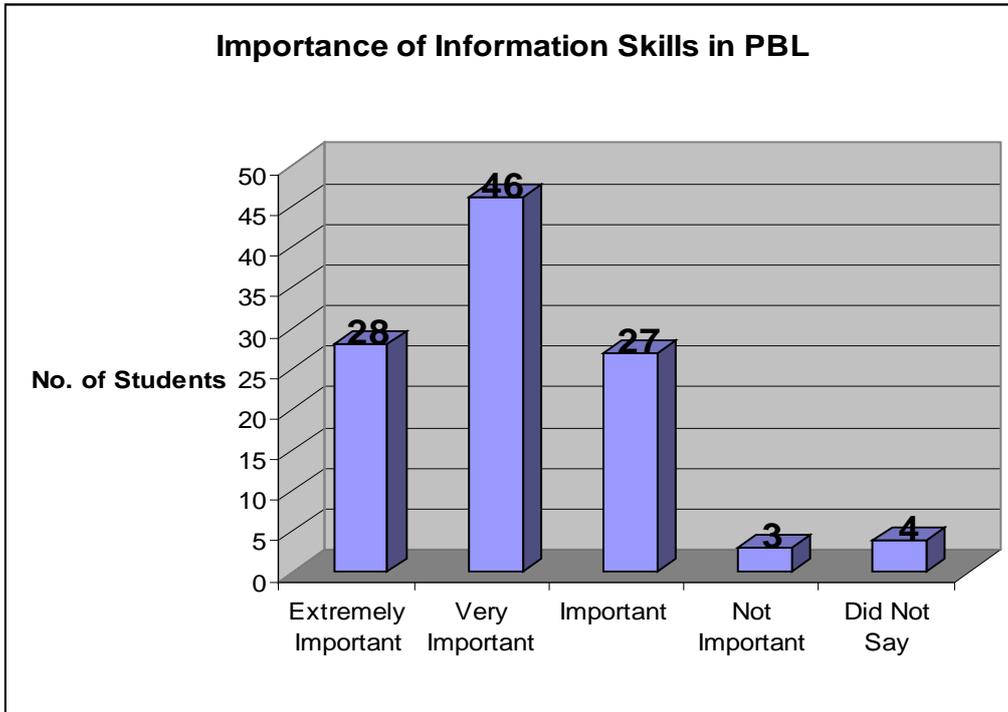


Figure 2: The Importance of Information Skills in PBL

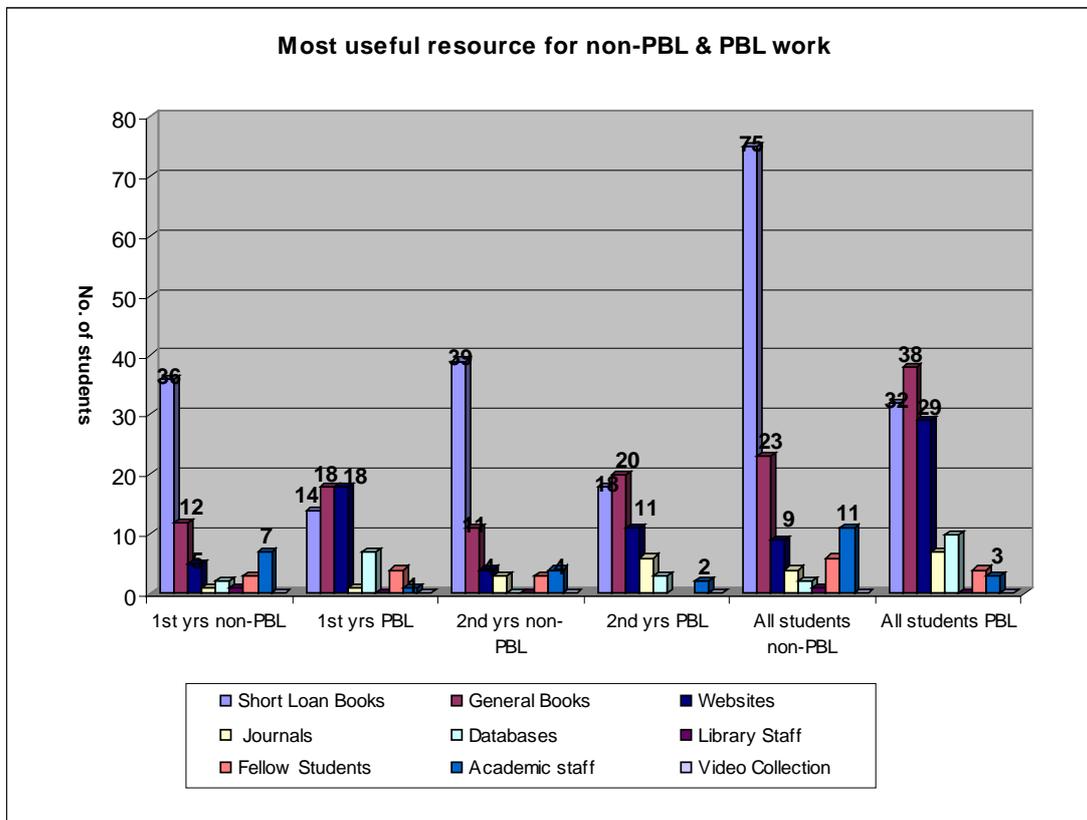


Figure 3: Most useful resources for non-PBL & PBL Work

TABLE 3a		
Of the 54 students who spend more time in the library for PBL		
	No. Students	Percentage
Consider the library extremely important, very important or important in PBL.	52	96%
Do not consider the library important in PBL	2	4%
Consider information seeking skills extremely important, very important or important in PBL.	54	100%
Do not consider information skills important in PBL	0	0

Table 3a: Those who spend more time in the Library

TABLE 3b		
Of the 54 students who DO NOT spend more time in the library for PBL		
	No. Students	Percentage
Consider the library extremely important, very important or important in PBL.	50	95%
Do not consider the library important in PBL	24	8%
Consider information seeking skills extremely important, very important or important in PBL.	49	94.5%
Do not consider information skills important in PBL	3	5.5%

Table 3b: Those who do not spend more time in the library

TABLE 4		
Choosing Resources		
	Non-PBL Work	PBL Work
Self-select	8	79
Use Recommended	28	6
Both	71	19
Didn't Say	1	4

Table 4: Resources

TABLE 5a		
Of the 101 students who consider information seeking skills extremely important, very important or important in PBL		
	Non-PBL Work	PBL Work
Self Select Material	7	77
Use Recommended Material	16	15
Use Both	67	18

Table 5a: Those who consider information skills extremely, very and important

TABLE 5b		
Of the 3 students who consider information seeking skills NOT important in PBL		
	Non-PBL Work	PBL Work
Self-Select Material	0	0
Use Recommended Material	0	2
Use Both	2	0

Table 5b: Those who do not consider information skills important

TABLE 6a		
Of the 27 students who verify information by checking another source:		
	Non-PBL Work	PBL Work
Self-Select Material	1	21
Use Recommended Material	5	1
Use Both	21	5

Table 6a: Those who verify

TABLE 6b		
Of the 42 students who DO NOT verify information by checking another source:		
	Non-PBL Work	PBL Work
Self-Select Material	5	30
Use Recommended Material	15	5
Use Both	22	7

Table 6b: Those who do not verify

TABLE 6c		
Of the 34 students who verify information by checking another source SOMETIMES:		
	Non-PBL Work	PBL Work
Self-Select Material	2	27
Use Recommended Material	5	0
Use Both	27	7
Didn't Say		5

Table 6c: Those who sometimes verify