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The Quantitative and Qualitative Study of the Effectiveness of the Problem-based Learning Approach in Teaching Research Methods

Azam Kaeedi
University of Isfahan, Iran, a.kaedi@gmail.com

Ahmad Reza Nasr Esfahani
University of Isfahan, Iran, arnasr@edu.ui.ac.ir

Fereydoon Sharifian
University of Isfahan, Iran, f.sharifian@edu.ui.ac.ir

Saeed Moosavipour
University of Arak, Iran, moosavipour@araku.ac.ir

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Abstract

Research methods is an essential ingredient of postgraduate programs across a wide range of social science disciplines. The purpose of this study was to compare the effectiveness of problem-based learning (PBL) and lecture-based learning (LBL) approaches to teaching research methods through a mixed-methods approach in an explanatory sequential design. The quantitative data were collected following a quasi-experimental design whereby two classes of research methods in a postgraduate program randomly received either an LBL or a PBL treatment. To assess students' academic achievement, a final exam on the course was used. The results indicated a higher academic achievement of students in the PBL class compared to LBL class. The qualitative data were gathered through a semi-structured interview to gain deeper insight into the quantitative results. The thematic analysis of the interviews showed that PBL led to deeper and more meaningful learning, increased students' knowledge in their field of specialty, provided more enjoyable and active learning, increased the students' skills in doing their thesis projects, enhanced their autonomy and independence, and also promoted their dignity and status.

Practitioner Notes

1. PBL is more effective in teaching research methods than LBL.
2. PBL improves students' knowledge acquisition in both their field of expertise and research methods.
3. PBL enhances student's research skills and motivation.
4. PBL leads to a deeper, enjoyable and meaningful learning.
5. PBL promotes students autonomy and status.

Keywords

Research methods teaching, problem-based learning, lecture-based learning

Introduction

Research methods is an essential ingredient of postgraduate programs across a wide range of social science disciplines (Kilburn et al., 2014; Daniel, 2018). It is often taught to help students do research projects and complete their theses and dissertations (Carty, 2007). Providing a quality, relevant research methods course for higher education students is a concern to education professionals all around the world (Daniel et al., 2018).

There is a consensus in the literature that the ability to conduct research is obtained only through experiencing the research process. In a research methodology course, it is necessary to provide students with learning activities that are practical and as realistic as possible to help them learn and use research methods (Burgess, 1990; Burgess & Bulmer, 1981; Rose, 1981; Winn, 1995). The conventional approach to teaching research methods is lecturing. Perhaps lecture-based teaching is the most prevalent, yet questioned, pedagogical approach (Macaranas, 2022). It has retained its popularity as an easy-to-implement, economical method, especially for sharing information with many students (Alaagib et al., 2019). Students and teachers (Macaranas, 2022) favour it possibly because it is less cognitively demanding (Solomon, 2020). Nevertheless, lecture-based learning (LBL) has been principally criticised for failing to provide students with active learning experiences (Benson & Blackman, 2003; Ekmekci et al., 2012), resulting in the reduction of students' interest and participation (Ball & Pelco, 2006). Kay et al. (2018), among many others, add that lecture-based pedagogy may not be effective at improving higher-order thinking, nor in developing hands-on ability of applying the gained knowledge to real world problems. There are a number of studies which support the contention that incorporating active learning elements into research methods courses can positively affect student performance and satisfaction (Alaagib et al., 2019; Currin-Percival & Gulahmad, 2021; Monson, 2017; Ruggieri, 2016; Wilson, 2013).

Several initiatives have been undertaken to overcome the disadvantages of lecture-based approach. For instance, interactive lecture allows students to participate and process knowledge throughout the lecture (Alaagib et al., 2019). Other examples are Harvard researchers' Peer Instruction (Zhang et al., 2017), Massachusetts researchers' class-wide discussions (Nicol, & Boyle, 2003), Angelo and Cross's minute papers, and Johnson and Johnson's think-pair-share, (Butler et al., 2001) along with using data-driven teaching methods and technology gadgets like classroom communication systems (Boyle & Nicol, 2003) and interactive simulations (Farashahi & Tajeddin, 2018).

Despite these initiatives, LBL is deemed 'not suited for teaching higher levels of thinking like analysis, synthesis, or evaluation' (Bonwell, 1996, p. 32), nor to develop practical skills and knowledge (Kay et al., 2018). Some scholars contend that students learn best when they apply theory to real life problems (Wijnia et al., 2019). This is particularly the case for subjects that are

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practical rather than theoretical. Research is an instance of subject matters that may be best learnt by doing. The relevant literature supports this idea that the ability to conduct research is obtained only through actively experiencing the research process (Burgess, 1990; Burgess & Bulmer, 1981; Rose, 1981; Winn, 1995).

During recent decades, problem-based learning (PBL) has surged through academic education to alleviate the deficiencies of the traditional didactic lecture approach. In a typical PBL pedagogy, students are encouraged to work collaboratively in small groups to identify authentic, real-life problems. Students actively seek for relevant facts and apply their current knowledge and experiences to provide possible solutions to the problems (Palupi & Subiyantoro, 2020; Seibert, 2021). This problem-solving process requires, and is thus supposed to foster, students' capability of, investigating, thinking, planning, analysing, evaluating, generating ideas, and communicating ideas and results (Lee & Blanchard, 2019; Sari et al., 2021). As compared to traditional teaching methods, PBL has been repeatedly praised for cultivating students' professional and generic skills (Carrió et al., 2011; Li et al., 2022), improving higher-order thinking skills (Dabbagh, 2019), providing autonomy (Lee & Blanchard, 2019), elevating interest and motivation (Carrió et al., 2011), long-term information retention (Almulla, 2019), and application of knowledge in real world (Lee & Blanchard, 2019). Given its contextual-learning approach, PBL may serve as more effective method for research methods teaching as compared to conventional LBL. Although literature is replete with research on the effectiveness of the two teaching methods in many higher education programs (e.g. Almulia, 2019; Carrió et al., 2011; Khatiban et al., 2019; Palupi & Subiyantoro, 2020; Sari et al., 2021; Solomon, 2020), it has paid scant attention to this issue in the field of research methods pedagogy. To address this gap, we compared the effectiveness of the two approaches in teaching research methods.

Unlike many established research fields, teachers of research methods are rarely taught how to teach research methods even though research methods courses are included in almost every undergraduate and graduate programs (Earley, 2014). Scholars warn that research on research methods teaching remains limited to inform teaching practice (Daniel et al., 2018; Kilburn et al., 2014). They call for more scientific efforts intended to improve research methods teaching (Kilburn et al., 2014). Therefore, this study aimed to compare the effectiveness of the two pedagogical approaches, namely PBL and LBL, to teaching research methods to postgraduate students of education using a quasi-experimental design. To enrich the study with students' insights, the results explained through qualitative interviews with our participants in an explanatory sequential design.

Theoretical Background

Research activities are adopted by higher education bodies in search of an empowered human resource and enhanced intellectual capital (Al-Hashimi et al., 2019; Wishkoski et al., 2022). A research methodology course prepares students for making research-informed decisions (Wishkoski et al., 2022) in their academic and professional career while potentially bolstering real life thinking and analytical and communication skills (Motjolopane, 2019). Despite the frequent inclusion of research methods components in university degree programs across countries and disciplines, the literature is narrow with respect to the research methods pedagogy (Al-Hashimi et al., 2019; Nind & Lewthwaite, 2018). Consequently, teachers of research methods lack a

pedagogical support (Nind & Lewthwaite, 2020) from a 'pedagogic culture' (Nind & Lewthwaite, 2020). Moreover, a number of studies report students' negative attitudes towards research methods (August-Brady, 2005; Halcomb & Peters, 2009; Wishkoski et al., 2022) in addition to anxiety (Earley, 2014; Tremblay et al., 2000; Wishkoski et al., 2022) and low engagement (Rajecki et al., 2005; Vittengl et al., 2004) in the research methods classrooms. This unfavourable milieu exacerbates the trouble of teaching research methods which is already a taxing, sometimes unwelcome task (Nind & Lewthwaite, 2020). Marek et al. (2004) ascribe these perceptions to the course teacher and the teaching method. They argue that passive lecture-based approach which dominates the research methods pedagogy hampers the students' interest, motivations and hence participation.

The lecture is a teaching strategy where the teacher directly communicates content knowledge to students. It is one of the oldest and most common methods of teaching. Lecturing is an effective approach to present relatively large amounts of information to numerous audients (Kay et al., 2018). It is often considered as a time-saving, cost-effective method which, compared to active learning modes, imposes less cognitive load on both instructors and learners (Alaagib et al., 2019; Solomon, 2020) However, academicians and practitioners have criticised against this traditional teaching approach for several disadvantages including reinforcing passive roles of learners (Butler et al., 2001), ignoring students' individual differences (Baeten et al., 2012), waning students attention (Rao & DiCarlo, 2000), poor effectiveness in promoting higher order thinking (Hainey et al., 2011) and encouraging superficial learning (Alaagib et al., 2019).

Attempts have been made to instil active learning into traditional lecturing to heighten the effectiveness of the lecture-based approach. For example, Mazur (1997) developed peer instruction pedagogy where students began with answering a question individually, and then engaged in an active peer-led discussions (Zhang et al., 2017) before being retested on the same question (Dancy et al., 2016). At the end of session, the teacher explained the correct and incorrect answers (Vickrey et al., 2015). In parallel with Mazur, Dufresne et al. (1996) devised 'class-wide discussion' approach which started with small group discussion on a question and continue by an individual or group response. Students then participated in a class-wide discussion moderated by the instructor (Nicol & Boyle, 2003). Both strategies seek to increase students' engagement in class (Bian et al., 2018). Multiple studies have reported the positive impact of both amendments to the traditional lecture approach on learning (e.g. Dufresne et al., 1996; Porter 2011; Porter et al., 2013; Versteeg et al., 2019). Butler et al. (2001) mixed minute papers and think-pair-share exercises to develop short, in-class writing exercises for psychology students. They found that this modification to the lecture class facilitated students' learning and motivated attendance. In a more recent endeavour, Alaagib et al. (2019) introduced the problem-based lecture method to teach physiology to medical students. They showed that the interactive lecturing approach was more successful than traditional lecture in triggering students' attention and active participation in addition to enhancing satisfaction and comprehension.

Despite that these developments have enhanced the performance of conventional LBL in terms of deepening students' conceptual understanding, recapturing their lost attention, and improving their attendance motivation, lecturing is regarded as 'not suited for teaching higher orders of thinking such as application, analysis, synthesis, or evaluation' (Bligh, 2000; Bonwell, 1996, p. 32; Charlton, 2006). Moreover, many students learn a skill only 'by doing'; i.e. they should undergo

the actual process. Some scholars believe that students learn best when applying theory to real world problems (Wijnia et al., 2019) which is of paramount importance in learning research methods. To address these and other concerns regarding limitations of LBL approach, more active, experiential learning methods such as PBL are developed and have spread to many disciplines worldwide (Mann et al., 2020).

PBL is an active student-centred approach to teaching, as opposed to teacher centred LBL. Considering learning as a self-directed, constructive, contextual and collaborative activity, PBL tries to offer learners the opportunity to combine theory and practice and apply knowledge to solve real-world problems (Assen et al., 2016; Carriger, 2016; Hmelo-Silver & Barrows, 2006; Savery, 2006; Yew et al., 2011; Yew & Goh, 2016). This approach emphasises the importance of students' roles in the process of learning and building knowledge by themselves, rather than being merely receivers of information (Barrows, 1996; Hmelo-Silver, 2004). Having shown remarkable results in medical sciences where it was first used, PBL has spilt over into other fields of study such as economics, commerce, psychology, biology, law, architecture, engineering, nursing and teacher training (e.g. Assen et al, 2016; Barrows, 2000; Dochy et al., 2003; Gallagher et al., 1992; Hmelo-Silver, 2004; Hung et al., 2008; Yew & Goh, 2016; Palupi & Subiyantoro, 2020; Sari et al., 2021).

PBL pedagogy is founded on the constructivism premise (Hung et al., 2008). The constructivism tradition holds the view that students as seekers and knowledge builders organise the related new experiences in their mental schemas with the help of prior knowledge (Derry, 1996; Mayer, 1996; Yew & Goh, 2016). PBL is also grounded on the theories assuming that learning is more effective when occurred in authentic tasks of everyday life as learners learn from a real-life problem (Carriger, 2016; Hung et al., 2008).

A plethora of studies attests to the favourable outcomes of PBL in higher education. For example, the results of a meta-synthesis by Strobel and Van Barneveld (2009) in medical science indicated that PBL increased students and teachers' satisfaction. In a meta-analysis, Leary (2012) found that PBL improved self-directed learning. Stanton et al. (2017) observed an enhanced communication practices with patients and colleagues among graduate students who had participated in a medical PBL curriculum. The findings by Kumar and Refaei (2017) revealed that PBL improved the student's critical thinking in an English composition course. Almulla (2019) reported a significant positive effect of PBL on students' learning motivation and thinking skills. Sari et al. (2021) found the same positive effect on the problem-solving and scientific writing skill among geography education students.

Lecture-based strategy may be beneficial in research methods teaching. Research methods is a complicated domain where students face difficulty with the integration of methods and principle-specific knowledge (Howard & Brady, 2015; Reddy, 2018). To help students with this task, LBL approach might avoid perception of 'unorganised knowledge' (Cónsul-Giribet & Medina-Moya, 2014) and lack of basic knowledge (Hemker, 1998) by imparting a considerable amount of clearly defined blocks of information through delivering well-structured lectures. It is also a more relaxing and time-saving method to both students and instructors because the content is systematically presented (Kay et al., 2018). Besides, regarding the scalability, LBL is a practical choice (Alaagib et al., 2019).

However, given the importance of the skills-based aspect of research methods, Reddy (2018)

acknowledges that PBL is a successful strategy for skills development in research methods. Further, Howard and Brady (2015) argue that constructivist pedagogical strategies in social research methods improve students' critical engagement with course material while tapping into diverse student knowledge, opinions, and needs. This can also reduce students' anxiety about the relevance of research methods to their future career needs. In the same vein, Persell et al. (2008) highlights that the distinctive feature of sociological leaders in their teaching practices is that they actively engage students in empirical research in classroom. PBL as a critical pedagogical approach is potentially able to involve students as active learners, other than passive information receivers (Pferee & Rogalin, 2012) in learning research methods. This can mitigate students' disinterest in research methods by presenting opportunity of gaining confidence in research process through applying knowledge to practice (Wishkoski et al., 2022).

Despite that PBL is considered a fruitful alternative mode of teaching research methods, most studies that compare PBL with LBL is conducted outside of the social sciences (Linneman, 2019). A long line of work from biochemistry (Dods, 1997) to engineering (Polanco et al., 2004) and from economics (Mergendoller et al., 2000) to medical sciences (Davis et al., 2006; He et al, 2017; Li et al., 2022; Sangestani & Khatiban, 2013; Solomon, 2020) has documented that PBL pedagogy outperforms LBL approach in various learning outcomes, despite some inconclusive results. For example, Carriger (2016) showed that PBL had a positive effect on problem-solving skills, but negatively affected the acquisition of knowledge or had no effect on it. Carrió et al. (2011) failed to show significant differences in factual knowledge acquisition between hybrid PBL group and traditional LBL group. Li et al. (2022) analysed the studies that compared the effectiveness of PBL and LBL in standardised residency training in China. They found that PBL outperformed LBL in the mastery of theoretical knowledge, clinical diagnostic thinking, teamwork ability, ability to analyse and solve problems, ability to consult documents, learning interest and learning efficiency. Surprisingly there were no advantages in improving self-directed learning, communication skills and hands-on skills. Linneman (2019) examined the impact of introducing active learning elements into an LBL course across nine research methods courses taught by one instructor. The findings exhibited few performance differences between lecture-only and alternative groups.

The international literature on the research methods pedagogy is underdeveloped. The situation is worse regarding implementing PBL in research methods. In a geography curriculum, Spronken-Smith (2005) solicited research methods students' perspectives after being taught under PBL approach. Students expressed significant improvement in overall quality, organisation, and stimulation of interest. They reported development in teamwork skills, but not all expected skills. In addition, teachers found the teaching more pleasant and relaxing, but also more stressful because of the unpredictable nature of the course and frustration of acting as a learning facilitator. Taken together, the author advocated the use of PBL to teach research methods. Barraket (2005) reflected on a case study where a range of learner-centred teaching methods including PBL were introduced to a graduate social research methods course. She concluded that this intervention had a positive effect on student performance, learning experience and subject evaluation. However, the students' opinions about traditional teaching methods were equally positive. Based on these results, the author recommended integration of student-centred and formal didactic teaching approaches to achieve the most desired outcomes. Reddy (2018) reported on a cross

sectional descriptive case study where PBL was used to teach research methods in an undergraduate environmental health program. Participants provided positive feedback on the use of self-directed learning. They felt that they would be able to apply their improved skills in their future career.

The research conducted on research methods pedagogy in Iran is sparse. There are a few scholars who have criticised the existing research methods curricula for reducing a practical activity of doing research to a theoretical argument on doing research in research methods courses (Naji, 2006) and educationalists' ignorance of the epistemological and methodological foundations of research methods which has resulted in mere reliance on positivist approach to research methods (Lotfabadi et al., 2007). To the best of the authors' knowledge, no study in Iran has addressed the effectiveness of a specific research methods teaching strategy. The literature of 'PBL versus LBL' is dominated by studies in medical and nursing science. In a systematic review and meta-analysis, Sayyah et al. (2017) concluded that academic achievement of undergraduate students in medical courses was higher in PBL method relative to traditional methods such as LBL. A study by Salari et al. (2018) demonstrated that PBL was more effective than traditional lectures at developing higher order cognition in a paediatric nursing course. Khatiban et al. (2019) compared the two approaches to ethics education to nursing students. They found that the PBL group score higher in moral development compared to the LBL group. However, the two groups were similar in moral decision-making, practical considerations, and familiarity with dilemmas.

To sum up, literature leans towards PBL regarding positive learning outcomes compared to traditional LBL approach, despite mixed results. It also implies a paucity of research on the effectiveness of implementing PBL compared to LBL in social sciences pedagogy in general and research methods in particular.

Method

Participants and research design

To fully understand the difference between the two approaches of PBL and LBL in teaching the research methods, a mixed-method approach was used. The data were collected in two phases in an explanatory sequential design. An explanatory sequential design is a two-step mixed method which is intended to explain or extend the initial quantitative results with the help of qualitative data (Creswell et al., 2003). To garner quantitative data, we first used a quasi-experimental non-equivalent comparison groups research design. To extend our understanding of quantitative results, we then conducted semi-structured interviews.

A convenience sample of forty postgraduate students (31 females and 9 males) of education at (name removed for blind reviewing purposes) who enrolled in research methods course in the second semester of 2018, participated in the research. Participants received either an LBL (control group) or a PBL (experiment group) treatment during the course class.

Ethical approval for this study was granted by Arak University's institutional review board (Number 97/24266). All the students in the study gave their verbal informed consent before participating.

Instruments

To assess and compare the effectiveness of LBL and PBL approaches to teaching research methods, students of both groups took an exam at the beginning of the semester and a final exam at the end of the semester. The exams were similar in terms of structure, the number, type and content of questions and scoring. Both exams were 20-point score consisted of multiple-choice questions, short answer questions, and essay answer questions totalling 22 questions per exam. Both exams were designed based on different levels of Bloom's cognitive domain taxonomy (Krathwohl, 2002) to particularly assess higher order thinking skills especially analysis and evaluation, in addition to understanding the concepts of research methods. The beginning exam and the final exam served as the pre-test and post-test, respectively.

To further extend our understanding of the students' experience with learning through PBL, a semi- structured interview was conducted at the end of the semester with ten students in the PBL class. To ensure the reliability of the interview results, after the initial coding, the codes were reviewed after a short period of time. Also, a research assistant (who had no other role in the study) encoded 20% of each text of the interview independently. The results showed a high level of agreement among coders ($k = 0.93$, $p<0.001$). To ensure the accuracy of the qualitative findings, member checking was also used (Creswell, 2009, p. 191). For this purpose, the interviewees were asked to review the final report of the research along with the extracted themes and express their views on the correctness of results.

Procedure

In the winter semester, 2018 (February- June), two postgraduate research methods classes were held at the department of education at (name removed for blind reviewing purposes). We randomly assigned the two classes to either a PBL or an LBL teaching approach. Students in the LBL class was taught the research methods using LBL approach during the 16-week semester, while students in the PBL class received the intended treatment through the PBL approach. Students in both classes were briefed and aware of the research objective and gave their consent to participate in the study. Both groups were trained by two same professors of research methods who shared a similar course plan and taught the course jointly. Both classes took a pre-test at the beginning of the semester.

In the LBL class, the instructor taught research methods using lecturing method for 2 hours and a half a week. The procedure was as follows: At the beginning of the semester, students took an exam which was similar to the final exam. In the opening session, the instructor provided students with the course syllabus including course objectives, topics to be covered in each session, recommended readings and resources, assignments for each session, and assessment method. In the same class, students were taught how to work with Google scholar and a number of popular online scholar databases. Students were required to study reading materials before each class to get prepared for the class. The instructor began each class with a summary of the last class to correct students' misunderstanding and misconceptions. The instructor then started the new topic and continued the lecture with several pseudo and real-world examples of academic publications. Students participated in class-wide discussions and answered the instructor's questions. Almost all assignments were designed based on the real research objectives and titles. Students were required to turn in the assignments on the due date. The instructor examined the assignments

and handed the corrected assignments back to the students to provide them with feedback. For example, students had to compare and contrast an article with a quantitative research design to an article with a qualitative methodology in terms of sampling method. Another example was identifying different types of research variables in ten articles published in well esteemed academic journals. At the end of the semester, students took the final exam.

The PBL class included a two-hour and a half session every week. In this class, students were divided into six groups at the beginning of the semester, as each group selected a problem from their work environment or their field of study. The study was designed in such a way that students, through working on the selected problem and putting forward a proposal for solving the problem at hand, gradually mastered the concepts and skills needed to conduct the research. The first 30 minutes of each session were devoted to a brief description of the session's topic and to answering possible questions of the students with respect to the same and the last class's topics. It should be noted that pre-class preparation was mandatory. Students were required to search for and study scholar resources about the class topic to get ready for applying their gained knowledge to the problem they had selected at the beginning of the semester. Thus, in the opening minutes of each session, the tutors tried to prevent or correct any misconceptions of students in order that students were able to apply the right knowledge to their problems during the rest of the class time. Within the next two hours, the students worked on the problem with the help of the facilitators. Each group had to present some part of the proposal they had worked on; other students could critically comment on the proposal. For instance, each group had to raise a problem concerning their work environment or their field of study. They then prepared and presented a problem statement to the other students. They, also, had to choose an appropriate research method and justify the adopted method to their classmates. In turn, students from other groups discussed the selected method. Students had to submit their proposal until the end of the semester. At the end of the semester, students took the final exam.

Analysis of the scores of the final exams showed the superior academic performance of students in PBL class as compared to the students of LBL class. To shed more light on this finding, we continued our study to the second phase in which ten participants from the PBL group took part in a semi-structured interview where we recorded their experience towards taking part in the PBL class. Finally, the interview results were compared with the findings from the quantitative analyses.

Data Analysis

To analyse our quantitative data gathered from the non-equivalent comparison groups design in the first phase of the study, we used ANCOVA since covariance analysis is the most frequently used approach in non-equivalent comparison groups design (Johnson & Christensen, 2014, p. 358). We also used independent samples t-test to compare pre-test scores of the two groups and paired samples t-test to compare pre-test scores with post-test scores of each group of treatment. We ran the analysis using SPSS 24.

For the qualitative analysis, all interviews were audio recorded and carefully transcribed. The data were then analysed through thematic analysis based on the six steps suggested by Braun and Clarke (2006), namely familiarizing with data, generating initial codes, searching for themes, reviewing themes, defining, and naming themes, and producing the report. Finally, the findings

from qualitative data were connected to the results of quantitative analysis in an explanatory sequential research design.

Results

The findings of the research are presented in two parts as follows:

Results of the quasi-experimental study

We analysed academic achievement of PBL and LBL students. Descriptive characteristics of the pre-test and post-test of each class are illustrated in Table 1.

Table 1

Mean and Standard Deviation of PBL and LBL Groups for Pre- and Post-Test

Group	N	Pre-test		Post-test	
		M	*SD*	*M*	*SD*
PBL	22	3.49	1.77	14.00	3.62
LBL	18	4.14	1.60	11.10	4.49

An independent t-test was done to examine whether there was a significant difference between pre-test scores of two groups. The results did not show a significant difference (t (38) = -1.289, p= 0.205) indicating that two groups were equivalent before the manipulation. We found no significant difference in pre-test scores between the two groups, and we ran an ANCOVA to remove the difference between averages. Here, pre-test was used as the covariate variable.

To examine the effect of treatment (teaching mode) on students' academic achievement, we compared the pre-test and post-test scores of each class using paired-samples t-tests. There was a significant difference in the grade performance of both groups ($t_{PBL}(21)= -18.137$, $p<0.001$; $t_{LBL}(17)= -8.667$, $p<0.001$).

To conduct ANCOVA, we first checked the assumptions. Shapiro-Wilk test ensured the normality of data distribution (W= 0.954, p=0.105). The assumption of equality of variances was also met (Leven's F (1, 38) = 0.583, p= 0.450). Furthermore, the slopes of regression were shown to be homogenous (F= 0.784, p= 0.382).

Arithmetic means of post-test scores were corrected with pre-test average mean scores and standard deviations which are illustrated in Table 2.

Table 2

Descriptive Statistics of Experiment and Control Groups

Group	N	Mean	SD	Corrected mean
PBL	22	14	3.62	14.555
LBL	18	11.10	4.49	10.430

According to results of ANCOVA, the difference between PBL and LBL groups in students' academic achievement was statistically significant ($F(1,37)=10.853$, $p=0.002$, $\eta 2=0.227$) while controlling for pre-test scores. The mean score of PBL class ($M=14$, $SD=3.63$) was higher than that of LBL class ($M=11.10$, $SD=4.49$). The result of ANCOVA is presented in Table 3.

Table 3

One-Way ANCOVA Test Result

Source	Sum of squares	Df	Mean square	F	P
Pre-test	338.515	1	338.515	44.855	0.000
Group	161.394	1	161.394	21.385	0.000
Error	279.235	37	7.547		
Total	7151.219	40			

Results of explanatory interviews

The demographic characteristics of the interviewees are shown in Table 4. We analysed the interviews using the thematic analysis suggested by Braun and Clarke (2006). Five main themes were extracted from students' experiences with the PBL approach: 1) deep and meaningful learning; 2) increasing students' knowledge in the field of specialty; 3) enjoyable and active learning; 4) acquisition of skills for conducting a thesis and raising students' motivation to do research, and 5) increasing students' autonomy and independence and promoting their status. (Table 5).

Table 4

Demographics of the Students Participated in the Interviews

Name	Gender	Age	Job
Student 1	Male	23	Teacher
Student 2	Female	24	Teacher
Student 3	Female	23	Teacher
Student 4	Female	23	-
Student 5	Female	34	-
Student 6	Male	25	Teacher
Student 7	Male	24	Civil servant
Student 8	Female	23	-
Student 9	Male	26	Teacher
Student 10	Female	24	-

Table 4

The Main and Secondary Research Themes

Main themes	Sub themes
Deep and meaningful learning	Increasing students' analytical power
	Using previous knowledge to learn the new content
	Durability of more concepts in mind
	Transferability of learning to other situations
	Helping in learning other courses in the field
Increasing students' knowledge in the field of specialty	Familiarity with various issues and topics in the field of specialty
	Learning new content in the field of specialty
	Finding field of interest in the field of specialty
	Familiarity with scholars who work in different fields of study
Enjoyable and active learning	More involvement with the content
	Increasing the accuracy and attention of learners
	Creating a vibrant and vigilant class
	Increasing students' interest and motivation
	Encouraging collaborative learning and helping each other in the learning process
	Increasing self-confidence
	Creating a sense of positive and constructive competition
Acquisition of skills for conducting a thesis and raising students' motivation to do research	Familiarity with the search strategies in reputable scientific databases
	Practical familiarity with different stages of conducting research
	Familiarity with various research methods
	Familiarity with various research instruments
	Reducing anxiety for doing thesis
Increasing students' autonomy and independence and promoting their status	Using extensive learning resources
	Developing an independent personality in learning
	Highlighting the role of students in building knowledge
	Preserving respect and promoting students' status

The following is a description of each of the five themes extracted from the interviews.

Theme 1: Deep and meaningful learning

Students said that the PBL approach involved them more with the content, provided them with more time to think and increased their analytical power.

Student 2, who was a discerning student, said:

> The conventional approach to teaching is teacher-centred and does not provide the opportunity for learner to think critically. Accordingly, the learner must learn the content materials by heart which are forgotten after some time. Conversely, one of the great benefits of the PBL approach is that it is learner-centred and allows learners to think and explore the content.

Similarly, other students reported that the PBL approach would help them use their previous knowledge to learn new content and transfer what they learn to other situations. Student 9, who was a very interested student, stated:

> Working on the problem can be very useful as it empowers learners to make meaningful relationships between their previous knowledge and what they are learning. We had learnt some content materials in some prior LBL classes, but we forgot them quickly.

Some students believed that learning from the PBL approach was more durable. They maintained that learning the research methods through the PBL approach would also help them learn other courses better. As for the durability of learning in the PBL approach, Student 10 said that:

> PBL approach to learning is an interesting method leading to better learning. When a student has a problem and is working on it, learning is better and more durable. For example, when a chemistry student at the laboratory combines two matters together and makes a new material as a result of the reaction, he certainly learns better compared to the times he only reads the contents theoretically. Similarly, in the university settings, when the student himself engages in learning and works closely with the subject, his learning is better and more lasting.

Theme 2: Increasing knowledge in the field of specialty

The experience of many students in the PBL group suggested that the teaching of research methods using PBL method increased their knowledge in their field of specialty, because they had to search and explore databases to solve the problem. In effect, they had to study different sources in terms of the problems related to their field of study or their work environment, which made them familiar with a variety of topics and issues. This, in turn, increased their knowledge and interest in their field of study. As for increasing knowledge in the field of specialty, Student 2 argued that:

> When the teacher raises a problem and does not provide students with necessary information from the beginning, they have to search several resources to find the answer to the problem. This way, they learn many things and their knowledge is increased.

Student 5 also mentioned the search of various sources and databases as one of the merits of the PBL approach and maintained that:

> Searching for various sources and databases is one of the advantages of PBL approach.

> On the contrary, in the traditional approaches to teaching students do not study other sources except class resources. PBL approach, however, makes the learner build their knowledge and, during the search for the answer to the problem, they also learn new things and add them to the extent of their knowledge. This, in turn, increases their learning and knowledge.

Student 6 described increasing knowledge in the field of specialty as a result of taking PBL approach enjoyable and stated that:

> The study we carried out to solve the problem was satisfying and increased our knowledge in our field of study. Moreover, we got new insights into our field of study and became interested in some of the topics.

Theme 3: Enjoyable and active learning

As for the learning occurred under the PBL approach, some students believed that in the PBL approach the learners' attention and involvement are increased as they are actively engaged in the learning process. Accordingly, they feel less tired, and learning is more enjoyable for them, and the class is, thus, a happier place for them. Besides, a feeling of positive competition is created between students as they are taking part in the problem-solving activities. Student 6 described the attempt to solve the problem as a pleasing activity and said:

> We were enjoying what we needed to do to solve the problem. The study on the problem at hand was enjoying and increased our knowledge.

Student 1 described the role of learners in learning through PBL as follows:

> Surely, the way that students learn the concepts on the basis of PBL is efficient and useful, because each student participates in the activities and takes up responsibility for their learning. This active role and involvement in learning process, in addition to affecting the individual student, affects other peer students. For example, based on the experience I gained in the PBL class, when each group learnt some information about the problem and presented it to the class, students in other groups were also interested to know about the solution. This way, they recognised their strong and weak points and tried to correct their mistakes.

Student 9 commented on the PBL's impact on learning enjoyment:

> I can safely say that one of the best and most useful classes I had was the one under PBL. This approach opened us the door to the other world in which we were the doer in our own world and we decided on what to read. Besides, we could apply what we learnt in practice. In this class, since we played a key role in the learning process, learning was more enjoyable.

Students also believed that learning through PBL was collaborative and helped learners learn from each other. Student 7 acknowledged that:

> 'The positive thing about this approach was the team-working happened; we learnt some parts that we had not understood earlier as we helped each other in learning.'

Students also reported that PBL provided them with an opportunity to show their abilities. This, in turn, raised their motivation and creativity. Student 1 said:

> In the traditional mode of teaching, due attention is not given to the learner; the learning environment is not enjoyable; the learner is dull and does not pay full attention to the teacher, and, thus, does not enjoy learning. In fact, the methods in which students are passive reduce learners' creativity. On the contrary, PBL approach can increase learners' motivation, encourage their creativity and make learning more enjoyable for them.

Some students said they felt empowered when the problem was solved, and their self-confidence was raised. Student 3 argued that:

> 'When someone investigates a problem, a new world opens up to them and their knowledge increases, and they feel empowered.'

Theme 4: Acquisition of skills for conducting a thesis and raising students' motivation to do research

Students reported that studying the research methods using PBL approach was merited as it prepared them to do their theses and learn the necessary skills for conducting research, including searching in reputable scientific databases, choosing a good topic for their research project, reviewing the research background, finding the research gap, and stating the research problem properly. Besides, the acquisition of such skills reduced students' anxiety for doing their theses. Students also said that, in addition to familiarising them with various issues in their field of study, using PBL acquainted them with different research methods and instruments, and, due to the increased knowledge and skills, they were more motivated to do research.

Student 9 commented about the skills he acquired under PBL:

> I can liken the PBL class to mountain-climbing activities in which the instructor teaches the students how to climb rather than show others' climbing. Under PBL, we learnt how to write academically. We also hope we can write an article and do a thesis later.

Student 8 pointed to the practical aspect of learning the content through PBL approach, and said:

> During the semester, doing homework and working on the problem, we were able to learn the research methods for conducting the thesis. What we learnt in the PBL class is applicable to doing the thesis and research projects.

Student 4 said she feels less worried about doing her thesis as a result of taking PBL approach for learning the research methods:

> Before this class, I did not know what steps to take for writing the thesis and I had a feeling of confusion, but in the PBL class I learnt how to read articles, and do a thesis. Besides, I became familiar with various methods and tools of research.

Theme 5: Increasing students' autonomy and independence and promoting their status.

Students believed that PBL fostered their autonomy and independence in learning. They also held that with PBL approach the tutor showed higher respect for students.

Student 8 described the autonomy and independence of the students under PBL as an important factor in increasing their motivation and creativity, and maintained that:

> Using PBL approach, students have autonomy and independence in the learning process, and contribute to the knowledge-building process. In effect, this independence increases their motivation and creativity. Besides, the students are not bound to limited resources and can be acquainted with various research tools and methods used in other studies.

Likewise, Student 1 considered the students' autonomy as an opportunity to show his capabilities in the PBL class, and stated that:

> In the PBL approach, all students were involved in the learning process, and they had to work to solve the problem. In turn, the teacher evaluated our answers and provided us with feedback. In effect, all students had the opportunity to show their talents and skills. Besides, students' status and dignity were appreciated. For this reason, PBL approach is much better than the traditional one.

In this respect, Student 5 said:

> Through PBL approach, each student develops an independent personality in learning and is respected because they have something to say about the topic they have learnt.

In the same vein, Student 4 considered independence and self-directedness of learners as outputs of PBL approach and argued that:

> Through PBL approach, students are more focused, which makes them more independent and more self-directed in learning than other methods. In effect, when each student is involved in the knowledge-building process, they feel happier as their individual differences are appreciated and respected.

Discussion

The present study intended to compare the effectiveness of two pedagogical approaches, namely PBL and LBL in teaching research methods to postgraduate students of education. The results are discussed here in relation to the existing literature.

Based on the findings of the quantitative part of the research, students who were trained in the PBL approach performed better than the other group in the final test. These findings can reduce the concerns that constructivist approaches such as PBL do not have any effect on acquiring knowledge, or even negatively impact the acquisition of knowledge. Our results are consistent with those of Gallagher and Stepien (1996), showing that learners are not likely to acquire less knowledge using PBL approach relative to traditional methods. Similarly, our findings conform to

those of Schwartz et al. (1997), which illustrated the equal and even better performance of PBL students in the factual knowledge test, and their better performance in the application of knowledge. The results of this study are also in line with the results of Polanco et al. (2004) which showed a better performance of the PBL group in the Mechanics Baseline Test (Hestenes & Wells, 1992).

However, our findings contrast with the results of Dods (1997) who showed that in PBL approach less content was covered than LBL approach. Mergendoller et al. (2000) also reported a lower grade for the students in PBL class regarding their economic knowledge compared to LBL classes. Also, Carriger (2016) reported that PBL approach had no effect on the acquisition of knowledge. Besides, the results of meta-analyses in the field of medicine by Albanese and Mitchell (1993), Vernon and Blake (1993) and Duchy et al. (2003) suggested that PBL improved the problem-solving skills of students but did not have any effect on their knowledge acquisition.

The discrepancies in the findings may be justified due to the nature of the field of study and the materials used in the previous studies. For example, in Polanco et al. (2004) research, engineering students were taught subjects like physics, mathematics and computing in a single course through solving engineering problems in real life. This, in turn, led to their better performance in the Mechanics Baseline Test (Hestenes & Wells, 1992). The reason is probably the fact that in disciplines like engineering, learning from a real-life problem is likely to lead to better performance. This also applies for courses like research methods as the nature of such a course may be such that its concepts and skills are learnt better through practice and accomplishment of assignments rather than direct presentation of concepts in lectures. Teaching different courses across different programs through PBL approach may also lead to different findings. For example, during a master's degree, students are expected to have mastered basic subjects in undergraduate programs and enhance their research skills and knowledge during the master's through doing research in their field of study. Therefore, PBL approach might be more effective for higher education programs.

One of the main extracted themes from the semi-structured interviews was deep and meaningful learning that contained the sub-themes of increasing students' analytical power, using previous knowledge to learn the new content, the durability of more concepts in mind, transferability of learning to other situations and helping in learning other courses in the field. These findings are consistent with the constructivist viewpoints, according to which learners' previous knowledge and experiences play a key role in learning. It is believed that learning is a dynamic and inward process in which learners are actively involved in linking new information to what they have already learnt to build knowledge (Boethel & Dimock 2000; Hmelo-Silver, 2004; Yilmaz, 2008).

A further main theme was increasing students' knowledge in the field of specialty which included sub-themes of familiarity with various issues and topics in the field of study, learning new material in the field of specialty, finding the field of interest in the field of specialty and familiarity with scholars who work in different fields of study. In effect, the PBL approach was designed with several goals, one of which was the establishment of a flexible and extensive database for students (Barrows & Kelson, 1995) which covers information from different domains (Hmelo-Silver, 2004).

Another key theme extracted was providing an enjoyable and active learning, with the sub-themes

of more involvement with the content, increasing the accuracy and attention of learners, creating a vibrant and vigilant class, increasing students' interest and motivation, encouraging collaborative learning, and helping each other in the learning process, increasing self-confidence, and creating a sense of positive and constructive competition. According to the constructivism, learning is not an inactive stimulus-response phenomenon, but it is an active process of knowledge building which is influenced by how one interprets and interacts with new ideas and events (Yilmaz, 2008). In line with the constructivism underling principles, PBL approach helps learners to become active learners as it incorporates learning into real-world issues and makes learners responsible for their learning (Hmelo-Silver, 2004). In turn, following the constructivism tenets, when students believe that learning outcomes are under their control, their motivation increases (Dweck, 1991).

One more theme pertaining to the students' experience with the PBL approach is the acquisition of skills for conducting a thesis and raising students' motivation to do research. This included sub-themes of familiarity with search strategies in reputable scientific databases, practical familiarity with different stages of conducting research, familiarity with various research methods, familiarity with various research instruments, and reducing anxiety for doing the thesis. Accordingly, the findings obtained were consistent with the findings of Davis et al. (2006) who showed that a short-term educational intervention was successful in increasing the research activities of physicians.

Many undergraduate and postgraduate curricula contain research methods modules with the intention of preparing students for undertaking dissertations or research projects. An effective research methods teaching method is the one that improves students’ research skills such as finding an appropriate topic, doing a literature review, and defining the research problem by supporting students to experience real research before starting off their dissertations. This preparation may also drastically allay the students’ anxiety.

The last theme extracted from students' interviews was increasing students' autonomy and independence and promoting their status, which included the sub-themes of using extensive learning resources, developing an independent personality in learning, highlighting the role of students in building knowledge, preserving respect, and promoting students' status. The findings in this respect are consistent with the results of Norman and Schmidt (1992), Woods (1996) and Ryan (1993); All of which indicate the positive impact of PBL on the students' self- directing abilities. In effect, the ultimate goal of PBL is to train students to become self-directed, independent, and life-long learners (Hung et al., 2008). This way, in a PBL class students feel empowered after solving a problem, their self-confidence is enhanced, and they are more motivated to conduct further research. This is an invaluable outcome of PBL for postgraduate students who may be expected to embark on research projects to fulfil their master's and PhD degree.

Conclusion

Based on the findings of this research, it is concluded that PBL approach may work superior to LBL approach for teaching the research methods to postgraduate students. Reviewing the experiences of students taking PBL approach suggests their positive attitudes towards this approach in teaching the research methods. Accordingly, it seems that a PBL approach is more effective and useful in teaching research methods as a postgraduate course.

The findings of this study help teachers of research methods in choosing appropriate methods for effective teaching. It also helps curriculum developers to optimise curriculum design process. More specifically, according to our experience with PBL in research methods class, we offer multiple recommendations for research methods teachers:

1. Research methods teachers should provide students with the learning experiences that engage students in real research and problem-solving process, instead of swamping students with a series of unconnected concepts and facts. Empowering students to solve a real problem stimulates students' internal learning motivation and makes the research methods learning a pleasing experience.
2. Research methods teachers are recommended to ensure that students understand the importance of research methods course and the implications and applications of research methods in their education, career, and even daily lives.
3. Building a friendly and cooperative class climate is highly recommended. Teachers are recommended to make students feel what that they are doing is important. It is essential that teacher shows their gratitude and pleasure when students find and share with them a new piece of knowledge, they find during problem solving process, which is valuable for both teacher and students.
4. When presenting their solutions, findings, and choices with respect to solving their problems, students should be asked for reasoning and justifying their choices to their classmates.
5. Teachers are recommended to involve all group members in class discussions, particularly those students who normally do not incline to participate.
6. Tutors are recommended to bring in every group to evaluate and criticise other groups' choices in problem solving process, hence developing the critical thinking skills in students.
7. Teachers are recommended to ensure that students understand, and make, connection between what they learn in research methods course and the content of other courses in their program.

Considering that the results of some studies evaluate a hybrid mode of PBL and LBL more effective, it is suggested that other researchers compare the efficacy of the three approaches (PBL/LBL/Hybrid PBL-LBL) for undergraduate and postgraduate programs. Moreover, it was not possible for the authors to compare the effectiveness of teaching research methods through PBL and LBL approaches in undergraduate and postgraduate courses at the same time. This comparison can be the subject of further research.

Conflict of Interests

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