

Student teachers' perceptions of project-based learning at the University of Namibia

Eveline O. Anyolo¹ & Suama P. Nantanga²

University of Namibia, Faculty of Education, Hifikepunye Pohamba Campus
Emails: eanyolo@unam.na¹; snantanga@unam.na²

ABSTRACT

This study explored the Project-Based Learning (PBL) perceptions of student teachers at the University of Namibia, Hifikepunye Pohamba Campus. PBL is a dynamic approach to learning that teaches a set of skills needed for the twenty-first century. At the University of Namibia (UNAM), all third-year students are expected to do a PBL module which is a pre-requisite for the completion of the honors degree program. In this module, students take responsibility for their learning through inquiry, as well as work collaboratively in solving problems. This study adopted a qualitative approach using case study design to explore student teachers' perceptions of PBL. Sixteen student teachers participated in this study. Focused group discussions were used to collect data. The findings revealed that student teachers describe PBL as collaborative learning in which they are engaged in identifying problems experienced in schools and suggest solutions. The findings further revealed that most of the students were well informed about PBL although there were a few that were not well prepared. Challenges such as time, lack of collaboration, and doing reflections were experienced by student teachers. The study suggests that PBL should be taught in the classroom just like any other module.

Keywords: Collaborative learning, Educational Research, Perceptions, Project-Based Learning, Reflections

INTRODUCTION AND BACKGROUND

PBL method is generally defined as focused, experiential learning organized around the investigation of and resolution of messy, complex, and authentic problems (Torp & Sage, 2002). It is one of the methods to support students' engagement in problem-solving situations (Doppelt, 2003). The nature of PBL is developing skills and content by engaging student teachers in logical tasks that involve the skills and content to be learned, have personal relevance for students, and provide real-world context for learning (Warlick,

1999). Students in a PBL learning environment deal with real-life problems/situations which may result in students developing enduring knowledge and skills. It prepares student teachers for real-world problem-solving context (Hung, 2013). Students typically have more autonomy over what they learn, maintaining interest and motivating them to take more responsibility for their learning (Worthy, 2000). With more autonomy, students “shape their projects to fit their interests and abilities” (Moursund, 1998:4). Moreno (2017) concurs that PBL is a source of identity, self-worth, and pride. It provides a sense of accomplishment in students because the project is built around their interests and experiences. So, project-based learning enables the expression of diversity in students, such as interests, abilities, and learning styles.

Five major criteria for a method of learning to be called PBL:

- PBL projects are focused on questions or problems that drive students to encounter the central concepts and principles of a discipline.
- Projects involve students in a constructive investigation.
- Projects are student driven to some significant degree.
- Projects are realistic, not school-like.
- PBL projects are central, not peripheral to the curriculum. (Thomas, 2000:4)

As indicated above, PBL is an inquiry-driven learning process that engages students to ask meaningful questions to investigate compelling real-world problems. Through this process, student teachers build crucial problem-solving skills and learn how to generate creative solutions to complex problems. According to McKay (2007), PBL connects students with the real world around challenging questions. Students can make real-world connections by investigating a local or global issue, connecting to students’ interests and concerns, simulating a professional product, or simulating a professional process to solve real-world problems. PBL helps students bring the disciplines to their work, to understand the usefulness of discipline-based knowledge, skills, and mindset in addressing real-world challenges (Moreno, 2017).

At UNAM, all third-year student teachers are expected to do a PBL module which is a pre-requisite for the completion of a degree program in the Faculty of Education. The module was introduced as a practical module in 2013. The main aim of PBL is to engage students in a practice-based inquiry into an aspect related to their major subjects. The project also aims at developing students' 21st-century skills such as collaboration, problem-solving, critical thinking, and ICT integration. This is done through an extended student-directed inquiry process structured around authentic driving questions that result in carefully designed products and reports. Students identify a meaningful question to explore in their major subject areas (specializations). They then try to engage real-world problems or challenges through designing a meaningful product by using an interdisciplinary approach. During the PBL process, students take ownership of their

learning through collaboration and teamwork. The rewarding aspect of PBL is seeing students as independent and be able to create solutions to real-world complex problems (McKay, 2017). The module is offered in the second semester and has only one contact hour per week through group consultations with mentors.

Statement of the problem

PBL at UNAM is a module that is carried out through group consultations between students and mentors. It is offered in the second semester of year three during which the workload for both students and mentors is very high. The duration of the PBL is eight weeks. During these eight weeks, students are expected to meet with their mentors to discuss issues about their projects and write weekly reflections thereafter. Because of time constraints, these meetings do not always take place as expected. Such duration is also not sufficient enough for students to effectively work on the project to meet the required standard. This compromises the quality of the whole project. Mentors, on the other hand, find it difficult to give students proper guidance and detailed directions on how to develop the project to answer their driving questions effectively. This is because PBL takes place at the time when mentors are occupied with the finalization of the students' end-of-the-year assessment marks. Such inadequate supervision results in poor quality PBL presentations, products, and reports. As PBL mentors, we find this gap sobering, to say the least. Thus, we were motivated to explore the student teachers' perceptions of PBL and the challenges that they experience in carrying out PBL in order to design effective educational interventions in ensuring the smooth running of PBL in the future.

Research questions

1. What are the student-teachers' perceptions of PBL?
2. How does PBL benefit student-teachers?
3. What challenges do student teachers experience in carrying out PBL?
4. How can the PBL process be improved?

LITERATURE REVIEW

PBL is an approach for a classroom activity that is different from the usual teacher-centered classroom practices (Rubrica, 2018). The approach has its origin in inquiry where children pursue knowledge by asking questions that triggered their natural curiosity (Bell, 2010). The core idea of PBL is that real-world problems capture students' interest and provoke serious thinking as the students acquire and apply new knowledge in a problem-solving context (David, 2008). The teacher acts as a facilitator in working with students to develop worthwhile questions, structuring meaningful tasks, coaching both knowledge development and social skills, and carefully assessing what students have learned from the experience. This resonates with Harmer and Strokes, (2014) who found

that PBL has key features which give its distinction; learning by doing, the role of the facilitator, interdisciplinary, collaboration on the group work, and an end product.

PBL approach supports learning through active participation in the learning process rather than passively receiving information from lecturers, books, videos, and other learning resources (Haiping, 2020). Through active participation, students can share their background experiences with others. PBL also creates opportunities for groups of students to investigate meaningful questions that require them to gather information and think critically (David, 2008). The approach also requires students to actively engage with the learning content by inquiring, investigating, concluding, creating, and sharing their products of learning. In this way, they relate to real-world issues and find amicable solutions to the problems.

Students are integrated with real-world issues and problem-solving (Wrigley, 1998). This means that in PBL, students explore, make judgments, interpret, and synthesize information in meaningful and creative ways, to improve their 21st-century skills. According to Ravitz, Hixson, English, and Mergendoller (2012) 21st Century skills are productivity and accountability, social and cross-cultural skills, creativity and innovation, critical thinking and problem solving, communication and collaboration, information, communication, and technology literacy, flexibility, and adaptability, initiative and self-direction, and leadership and responsibility.

It is believed that many young people are full of explorative ideas. They have lots of interest, many of which they never had an opportunity to fully explore. PBL can help them narrow in on their interests, one of which they want to dig deeper. Only then can they take that interest out in the real world. Thus, PBL has been found to increase content knowledge retention and improve student ability to transfer problem-solving processes into new and more complex circumstances (Blumberg, 2000; Strobel & Bareveld, 2009). With PBL, students gain higher-order thinking skills, self-direction, and the ability to reflect on their learning (Hmelo-Silver, 2004). PBL can also be transformative. This means that through participating in PBL activities, students develop an understanding and advanced thinking system which will facilitate their use of PBL in future teaching contexts.

The literature review, however, indicated that PBL leaves students on their own to explore and figure out problems with minimal supervision from their mentors (Ge, Planas & Er, 2010). Students may be confronted with difficulties in generating meaningful driving questions, managing complexity and time as well as developing a logical argument to support claims (Krajcik, Blumenfeld, Marx, Bass, Fredricks, & Soloway, 1998). This comes as a result of a lack of familiarity and understanding of PBL by both students and facilitators. When driving questions are identified, students struggle to employ the skills needed to answer these questions to solve problems (Barron et al., 1998). PBL also generates a heavy load on students working memory due to the lack of a proper scheme

to integrate new information with their previous knowledge (Ge et al. 2010). With heavy loads, Aslanides, Kalfa, Athanasiadou, Gianelo, and Karapatsias (2016) believe that students tend to focus mainly on their projects, neglecting, therefore, the rest of the courses in the semester. The authors further indicated that the allocation of different project topics by professors is also students' concern. However, this is done to secure the transparency of the process (Aslanides, Kalfa, Athanasiadou, Gianelo, and Karapatsias, 2016). Saye et al. (2009); Wynn, Mosholder and Larsen (2006) also attributed teacher resistance to using PBL practices to teacher dispositions; beliefs about knowledge, teaching and learning, and pragmatic concerns such as class size, time, energy, and cognitive demands required by such practice.

METHODOLOGY

Research approach and design

A qualitative approach utilizing a case study design was employed to explore the student-teachers' perceptions of PBL. A qualitative approach is best used to explore people's experiences. A qualitative approach used in this study followed a case study design. A case study facilitates exploration of a phenomenon within its context and ensures that the topic of interest is well explored and that the essence of the phenomenon is revealed (Baxter & Jack, 2014). A case study was used to generating deeper and detailed knowledge of a well-defined context (Bell, 2010).

Sampling procedure and sample

To ensure that rich data were obtained, purposeful sampling was used. In purposeful sampling, the researchers decide what needs to be known and set out to find people who can and are willing to provide information of knowledge and experience (Bernard, 2002). The aim is to generate a sample that allows an understanding of the social process of interest (Nigatu, 2009). A total of 16 student teachers were chosen to participate in this study. These participants were chosen because of their experiences in doing PBL, thus they are the most productive sample to answer the research questions.

Data collection method

Focus group interviews

The researchers conducted two focus group sessions consisting of sixteen student teachers. The use of this method is based on the assumption that "knowledge is socially constructed" (Kleiber cited in DeMarrais & Lapan, 2004:89) and has the potential to reveal personal experiences, meanings, and attitudes. Focus groups are suitable for this study which is explorative by nature and since the interaction and group dynamism will allow in-depth exploration of the topic. The discussion was audio taped, and field notes were taken

to capture the observed activities and behaviors. The recording was thereafter transcribed verbatim.

Data analysis

Data analysis in qualitative research takes place simultaneously with data collection (Macmillan & Schumacher, 2006). In doing this, the researcher gained a better understanding of the phenomenon, as new interpretations emerged. For this study, the content analysis method was used. According to Zhang and Wildemuth (2009), content analysis condenses data into categories or themes based on valid inference and interpretation. Thus, in analyzing data for this study the researchers identified segments that were assigned codes as reading proceeded. Related codes were combined into different categories which were then developed into themes. Themes were then discussed concerning the literature reviewed. The explanations made in the discussion of themes were used to provide answers to the research questions.

FINDINGS

The findings of this study are presented in four themes, which attempted to answer the research questions of this study.

Student-teachers' perceptions of PBL

Student-teachers perceive PBL as collaborative learning that engages them in identifying problems experienced in schools and suggest solutions to the problems. They reported that in PBL students have to work together and motivate each other to reach common goals. They also see PBL as a gateway to research as they believe that it prepares them for the research project that they are expected to conduct in their fourth year. One student teacher said: *I see PBL as just a study that students need to engage and identify the problems they experienced at schools, either like in teaching or behaviors, and then now they come up with solutions as to how to tackle the problems. It is more on collaboration as students work in groups to see if they have that ability to motivate one another to reach a common goal.* Another student teacher puts it: *"It is a getaway to research that we going to do after this. It is going to give us a clue as to how things will be done. Getting us ready as to what we are expected to do a year after"*.

Another student reported that PBL is just research indirectly. She believes that PBL is a formal way of preparing, organizing, and presenting data found during the data collection. The student also felt that PBL is quite important since it assists students to learn about their careers through practice.

Student teachers were asked to indicate whether they were well informed about PBL or not. Most of the students indicated that they were well informed about PBL. They reported that PBL was clear to them as they were provided with toolkits that contain what was

expected of them. Students further indicated that the fact that their supervisors provided them with PBL deadlines, as well as rubric that was going to be used to assess all components of PBL, made it easy for them to follow and do what was expected of them.

Few students however thought that they were not well prepared for PBL especially at the beginning of the course. They reported that things were confusing and they did not understand what was expected from them. For one student, PBL was too brought for her. However, student teachers further indicated that they managed to gain an in-depth understanding throughout the process. They believe that their tutors, their group mates, and the reading of different sources contributed a lot to their understanding. Students also came to realize that PBL is not difficult; it just needs time to understand the process. Below are some of the student-teachers' quotes: *"I was pretty much confused". "When we started, I didn't like really understand what we were supposed to do. "With me, at the beginning, the PBL module was very complicated to me. I couldn't understand how to come up with the problem of formulating the guiding question.*

Student teachers also found the time allocated for PBL sufficient enough for them to complete the project. One student teacher felt that if more time is allocated to the project, one is likely to be reluctant to do the work, thinking that there is much pretty of time to do what is expected of her/him. They believe that it works better when they work under pressure because you have to make sure that the work is done. Students also indicated that they worked very hard and are proud of the effort that they put in completing their PBL. They believe that they learn a lot in carrying out projects rather than learning the module theoretically. One student teacher stated: *"I put all my effort on it"*.

However, some student teachers observed that other student teachers do not put much effort into doing PBL. This is mainly because the project is done in groups and some students are always free riders. In some cases, students try to duplicate what was already done by previous student teachers. This is also the experience of some of the student teachers who participated in this study. As one student puts it: *"There is an issue of copying! I've observed some of the year 3 students who are doing PBL but yet you find that somebody is doing something just try to change here because he's got something from somebody who did it last year. That means that person is not doing it to learn, he is doing it to get away with PBL"*. Another student said: *"I once copied"*.

Benefits of PBL

All student teachers acknowledged that the PBL module is very educative and that they have learned a lot from it. They believed that the module prepared them to be innovative, the skill that they can use in their future when they actually get into the classroom. This may include coming up with teaching materials that they can use during their teaching for their learners' better understanding. Student teachers also pointed out that, in doing PBL, they developed the 21-century skill (collaboration, ICT, problem-solving, and critical

thinking skills). They emphasized that this is because PBL aims to develop 21st-century skills. One student said: *“Another benefit that we get from PBL, it seems PBL aims to develop the 21-century skills”*. There was also a feeling from some students that PBL allows them to think outside the box to solve problems as well as boost their confidence by allowing them to do presentations among groups of other students and lecturers.

Students also reported that they learn more about how to research information and design different materials. They believe that this gives them that opportunity to be creative and innovative, something they can use to develop teaching materials from the environment that they can use to teach their learners. They further reported that they learned how to accept others' suggestions and criticisms as well as taking responsibility of their learning.

Challenges faced by student teachers in doing PBL

Challenges such as time, lack of collaboration, finance, negative perceptions from the community, and doing reflections were experienced by student teachers. They reported that it was very challenging to find a suitable time to meet and have group discussions. This forced them to meet late after lessons (which compromises the safety of students who are not boarders) or during weekends.

For the teachers who are already in the teaching profession, time was a very big challenge for them as they are not working at the same time. Some of these teachers reported that they teach at rural schools and they find it hard to meet up with other colleagues who are teaching at schools in urban areas as their schools are very deep in the remote areas. As these students are from different schools, the only time that they can meet is on weekend days only.

Similarly, working collaboratively was also challenging as some group members might not cooperate with others. Most student teachers felt that it is not easy to work with people you never worked with as it is always a challenge to come to the same consensus. In some instances, students have to redirect others from their focus, which in many cases led to us (students) fail the module or have to redo the project. Some students' quotes: *“We didn't usually meet on the days we were supposed to meet”*. *“Sometimes we have to meet like during weekends and even like sometimes we met after our lessons, like when we have all knocked off. And we have different schedules”*. *“Being in a group of people you never worked with before is quite a challenge. Coming up with a solution is a challenge. You have to go and pull people from their focus; let's do this and this...this cause a lot of distractions and confusion”*.

Student teachers also indicated that they did not have enough money for buying items needed to construct their final PBL products. However, some went the extra mile to put together the little money they have. At times, student teachers had to go through dustbins to find materials for their final products and this embarrasses them. As one student-

teacher puts it: *“We have to put money together to come up with our products. So, the challenge is sometimes if you are not financially fit, and then you come up with something that will ask you money to come up with that thing. You also sometimes walk around in the environment there, in the dustbins there. Like these people that see you will ask questions like “Are these people fine, searching through dustbins?”*

For other students, it was very costly to travel from one place to another, especially from villages to towns where they have to meet with others for their PBL projects. They sometimes have to pay extra money to be taken to town and brought back. This situation limited their movements and affected the way they carry out their PBL projects. Students in towns also have to wait for hours for others to arrive.

Writing reflections was another challenge faced by student teachers in doing a research project. Students felt that the reflection question that was prepared is the same and it was difficult for them to write reflections on the same question every day when they meet for discussions with their peers. So, they felt that the reflection should be open and not given as a specific question. One student said: *“For every week that we have to meet with my group when we are writing the reflections the questions are the same. It should be given as PBL reflection, not to be given questions that are already there”.*

Student-teachers’ suggestions for improving PBL

Students teachers were asked to give suggestions as to how PBL can be improved. Most students suggested that there is a need for PBL to be taught in the classroom just like any other module. Some thought that PBL should be incorporated within the educational research module as an ELO. One student said: *“I suggest that PBL should theoretically be taught. It should be incorporated within the research module itself, just an ELO on its own, having the steps and at least a few examples of topics”.*

A few student teachers felt that the module can still be taught the same way as now, however, PBL supervisors should keep on meeting students on time before the project resume and introduce them to the module. They also believe that the same supervisors need to provide students with the expectations in carrying out PBL. One student felt that PBL should be done on an individual basis and not in groups.

Regarding the PBL presentation, students further suggested that the PBL presentation should be done in the hall where all third-year students and lecturers are present. According to the students, they currently present their PBL to a minimum of 2 to 3 people which is not beneficial to many. They felt that it is more beneficial if the presentation can be done to many students and lecturers. This is what one of the students said: *“What if the presentation is now done in the main hall whereby all the third-year students and lecturers are also there, and then the groups are being called one by one to present their products. It will be more beneficial. Because now you can come up with the model or*

leaflet and then you just present it to a minimum people of 2 or 3, but all the people need to be aware of these”.

DISCUSSIONS

Data analysis indicated that students perceive PBL as collaborative learning that engages them in identifying problems experienced in schools and suggest solutions, thus prepares them for the research project. This supports the view that PBL is one of the methods to support students' engagement in problem-solving situations (Doppelt, 2003). Similarly, David (2008) agreed that the core idea of PBL is that real-world problems capture students' interest and provoke serious thinking as the students acquire and apply new knowledge in a problem-solving context.

Most students acknowledge that they were well informed about PBL. They based their reasons on the fact that they were provided with PBL toolkits that contain what was expected of them. Although there were a few students who felt that they were not well prepared for PBL especially at the beginning of the course, this did not remain a challenge to them. They managed to gain an understanding throughout the PBL process, and this pleased the students. Moreno (2017) concurs that PBL is a source of identity, self-worth, and pride. It provides a sense of accomplishment in students because the project is built around their interests and experiences.

All student teachers acknowledged the importance of PBL in their learning process. They indicated that PBL is very educative in that it prepares them to be innovative, collaborative, problem solvers, and critical thinkers. These results are similar to those found in Warlick (1999) that the nature of PBL is developing skills and content by engaging student teachers in logical tasks that involve the skills and content to be learned, have personal relevance for students, and provide real-world context for learning. Also, with PBL, students gain higher-order thinking skills, self-direction, and the ability to reflect on their learning (Hmelo-Silver, 2004). The same idea can also be linked to Harmer and Strokes (2014) who found that PBL has key features which give its distinction; learning by doing, the role of the facilitator, interdisciplinary nature, collaboration through group work, and an end product.

It is a fact that students do PBL during their third year of study at the University of Namibia. However, they do not do it effectively as they encounter several challenges. Lack of time and collaboration among them are some of the challenges identified by student teachers. They alluded that they always find it difficult to find a time where they are all free as they have a lot of work to do. In cases where they find such time, they do not work collaboratively with one another. This finding concurs with those of Krajcik et al., (1998) who report that students may be confronted with difficulties in generating meaningful driving questions, managing complexity and time as well as developing a logical argument

to support claims. The findings are also in agreement with Achilles and Hoover (1996) who find that students fail to work together well.

Student teachers hold the general feeling that there is a need for PBL to be taught in the classrooms just like other subjects or rather integrated into the Educational Research module. They assume that in this way, they will better understand the content of PBL before they embark upon the project itself. Conversely, students may be confronted with difficulties in managing the PBL process as a result of a lack of familiarity and understanding of PBL content.

CONCLUSION AND RECOMMENDATIONS

The present study has attempted to explore the student-teachers' perceptions of PBL. The study utilized group interviews to collect the data. The findings of the study might be of interest to the University and other student teachers and should be considered when developing the PBL module further. The findings showed that student teachers see PBL as collaborative learning that engages them in problem-solving. They all acknowledged that PBL is an important module that is worth doing as it prepares them to acquire the 21stcenturies skills. However, there are many challenges that students face in doing PBL. Among these challenges is a lack of time to carry out PBL activities as well as a lack of collaboration among group members. Although the results of the study, like any other qualitative studies cannot be generalized beyond its context, it seems that the findings are socially important for other institutions of higher learning in managing their PBL.

It can be concluded that since it is important for student teachers to develop 21st-century skills (collaboration, ICT, problem-solving, and critical thinking skills), PBL should play a major role in achieving such development. It is quite significant that student teachers are critical thinkers, self-directive, and be able to reflect on their learning. This will assuredly show that students are prepared for real-world problem solving now and in the future.

Based on the findings of the study, the following were recommended:

- The PBL module should be theoretically taught to enable students to have the basics of what is expected of them when carrying out the project.
- PBL presentations should be done to all third-year students and their supervisors so that they all benefit from one another.

REFERENCES

Achilles, C. M., Hoover, S. P. (1996). *Exploring problem-based learning (PBL) in grades 6-12*. Paper presented at the Annual Meeting of the Mid-South Educational Research Association, Tuscaloosa, AL. (ED 406 406).

- Aslanides, C. D., Kalfa, V., Athanasiadou, S., Ganelos¹, Z. & Karapatsias, V. (2016). *Advantages, Disadvantages and the Viability of Project-Based Learning Integration in Engineering Studies Curriculum: The Greek Case*. Proceedings of the 44th SEFI Conference, Tampere: Finland.
- Barron, B. J. S., Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., Bransford, J. D., & The Cognition and Technology Group at Vanderbilt. (2010). Doing with understanding: Lessons from research on problem- and project-based learning. *The Journal of the Learning Sciences*, 7, 271-311.
- Bell, J. (2010). *Doing your research project*. Berkshire: Open University Press.
- Bell, S., (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*, 83: 39-43.
- Bernard, R. H. (2002). *Research Methods in Anthropology: Qualitative and Quantitative*, Walnut, CA: AltaMira.
- Blumberg, P. (2000). *Evaluate the evidence that problem-based learners are self-directed learners: A review of literature*. In Evensen, D. H., & Hmelo, C. E. (Eds.). (2000). *Problem-based learning: A research perspective on learning interactive*. Mahwah, NJ: Lawrence Erlbaum.
- David, J. L. (2008). What research says about Project Based Learning. *EL Educational Leadership*. 65(5), 80-82.
- DeMarrais, K. B., & Lapan, S. D. (2004). *Foundations for research: Methods of inquiry in education and the social sciences*. Mahwah, N.J: L. Erlbaum Associates.
- Doppelt, Y. (2003). Implementation and Assessment of Project-Based Learning in a Flexible Environment. *International Journal of Technology and Design Education*, 13(3), 255–272.
- Edelson, D. C., Goldin, D. N., & Pea, R. D. (1999). Addressing the challenges of inquiry-based learning through technology and curriculum design. *Journal of the Learning Sciences*, 8(3-4), 391-450.
- Ge, X., Planas, L. G., & Er. N. (2010). A Cognitive Support System to Scaffold Students' Problem-based Learning in a Web-based Learning Environment. *The Interdisciplinary Journal of Problem-based Learning*, 4(1), 30-56.
- Haiping, E. (2020). *Introduction to Project Based Learning: DJPE INSET*. Namibia: University of Namibia.
- Harmer, N. & Strokes, A. (2014), The benefits and challenges of project-based

- learning: A review of the literature, Pedagogical Research Institute and Observatory (PedRIO), Plymouth University.
- Hmelo-Silver, C.E. (2004) Problem-Based Learning: What and how students learn. *Educational Psychology Review*, 16(3), 235-266.
- Hung, W. (2013). Problem-based learning: A learning environment for enhancing learning transfer. *New Directions for Adult and Continuing Education*, 137, 27-38.
- Krajcik, J. S., Blumenfeld, P. C., Marx, R. W., Bass, K. M., Fredricks, J., & Soloway, E. (1998). Inquiry in project-based science classrooms: Initial attempts by middle school students. *The Journal of the Learning Sciences*, 7, 313-350.
- McKay, F. (2007). How Does Project-Based Learning Work? Tools for understanding the process of planning and building projects. Available online at <https://www.edutopia.org/project-based-learning-guide-implementation>.
- McMillan, J. H., & Schumacher, S. (2006). *Research in education: Evidence-based inquiry*. New York. Pearson Education, Inc.
- Moreno, C. (2017). *Project – and Problem –Based Learning: Whose Problem Is It?* Available online at <https://www.pblworks.org/blog/project-and-problem-based-learning-whose-problem-it?>
- Moursund, D. (1998). Project-based learning in an information technology environment. *Learning and Leading with Technology*. 25(8), 4.
- Nigatu, T. (2009). *Qualitative data analysis*. [Online]. Available at <http://www.slideshare.net/tilahunigatu/qualitative-data-analysis-11895136>. (Retrieved on 10 October 2019).
- Ravitz, J., Hixson, N., English, M., & Mergendoller, J. (2012). Using project based learning to teach 21st century skills: Findings from a state wide initiative, 1-9.
- Rubrica, R. D. B. (2018). *An action research on Project Based learning and understanding design and their effects on the science achievement and attitude of science students*. Philippines: Caloocan City.
- Saye, J. W., Kohlmeier, J., Brush, T., Mitchel, L. & Farmer, C. (2009). Using mentoring to develop professional teaching knowledge for problem-based historical inquiry. *Theory and Research in Social Education*, 37(1), 6-41.

Strobel, J., & van Bareveld, A. (2009). When is PBL more effective? A metasynthesis of meta-analyses comparing PBL to conventional classrooms. *Interdisciplinary Journal of Problem-Based Learning*. 3(1), 44-58.

Thomas, J. W. (2000). *A review of research on Project-based learning*. Available online at http://www.bie.org/research/study/review_of_project_based_learning_2000.

Torp, L., & Sage, S. (2002). *Problems and possibilities: Problem-based learning for K16 education*. 2nd edition. Alexandria, VA: ASCD.

Warlick, D. (1999). *Raw materials for the mind*. Raleigh, NC: The Landmark Project.

Worthy, J. (2000). Conducting research on topics of student interest. *Reading Teacher*., 54(3), 298-299.

Wrigley, H. S. (1998). *Knowledge in action: The promise of Project based learning*. 2(D), 13-18.

Wynn, C. T., Mosholder, R. S., & Larsen, C. A. (2006). Promoting post formal thinking in a U.S. history survey course: A problem-based approach. *Journal of College Teaching and learning*, 13(1), 1-20.