Application of Problem-based Learning Approach in Senior High School on Community-based Hazard Identification and Assessment

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Abstract This study assessed the effectiveness of using problem-based learning (PBL) approach in senior high school on hazard identification and assessment in the community. This action research applied PBL approach to a Grade 11 class taking up Earth and Life Science Subject at a Senior High School in Las Piñas City. Fifty-six (56) grade 11 students served as the participants. The teacher-researcher applied the PBL approach procedure in teaching selected DRR learning competencies, and required the students to submit group narrative and documentation reports containing their identified and assessed hazards, including their proposed feasible solutions. The teacher-researcher applied document analysis or systematic evaluation to these outputs to understand and gain insights on the learning of the students. Findings show that students were able to explain the concepts and principles of hazards, and they were able to identify and assess community hazards, specifically geological, water and climatic, environmental and biological, and accident-related hazards. Through PBL approach, the students were also able to propose feasible solutions that can be implemented in the community. Thus, PBL approach is relevant for the students to understand the basic concepts of hazards, and is proven effective to learn hazard identification and solving problems. This study proposes the quantitative assessment of learning outcomes in DRR competencies of students using

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PBL, and the teacher's standpoint and evaluation on using this pedagogical approach.

Keywords: disaster risk reduction; hazard; pedagogical approach; problem-based learning; senior high school

Introduction

Disasters are the major concerns and problems worldwide (Cadiz et al., 2018). Many countries have experienced and witnessed natural disasters in recent years that caused damage to man-made structures and losses of human and animal life (Menon et al., 2016). It is for this reason that the concerned countries united in the Second World Conference on Disaster Reduction held in January 2005 at Kobe (Hyogo), Japan (Tuladhar et al., 2015). In this conference, the state signatories decided to adopt the Hyogo Framework for Action (HFA) a 10-year plan from 2005 to 2015 that aimed to strengthen and improve disaster resiliency of nations and communities.

To comply with HFA, the 14th Philippine Congress enacted and passed Republic Act No. 10121 or the Philippine Disaster Risk Reduction and Management (DRRM) Act of 2010 that aims to strengthen the Philippine disaster risk reduction and management system by providing standardized national and local policies (Ballesteros & Domingo, 2015). The DRRM Act stipulates the importance of reinforcing local capacity in disaster resiliency. It emphasizes the significance of all sectors and stakeholders to participate and adopt disaster risk reduction and management approaches (Llanto, 2011). One of which is integrating DRR education in the curricula of basic and tertiary education.

At present, DRR education is incorporated in the curriculum of the new Philippine basic education system, the K-12 Basic Education Curriculum of Republic Act no. 10533 or the Enhanced Basic Education Act of 2013 (Sarmiento & Orale, 2016). This new curriculum added the two-year Senior High School (SHS)

education to the Kindergarten, Elementary and Junior High School levels. The senior high school curriculum is evidently integrated with DRR in the core subjects' Earth and Life Science, and Disaster Readiness and Risk Reduction (DRRR).

The competencies on these subjects ensure the holistic understanding of DRRM in SHS education. These competencies improve the decision-making and application skills of the students in saving their own lives during the occurrence of disasters (Gomez & Valencia, 2015). However, intensive DRRM education does not only rely on the curriculum. The third pillar of the Comprehensive DRRM in Basic Education Framework, which is about Disaster Risk Reduction in education, also relies on appropriate and effective pedagogical approach in facilitating the learning of the students.

In the 1960s, Howard Barrows and other educators at McMaster University in Hamilton, Ontario, Canada developed one of the pedagogical approaches or instructional methods used in the school of medicine program education, the problem-based learning (PBL) (Huang and Wang, 2012). Unlike the traditional teaching methods, PBL is a pedagogical approach that is student-centered, involves self-directed, experiential, and collaborative group-based learning, which promotes problem solving, critical thinking and higher-order thinking skills (De Graaff & Kolmos, 2003; Hung, 2009; Huang & Wang, 2012; & Silver, 2004).

In PBL, the teacher serves as a facilitator all throughout the learning process. The students are driven to learn by focusing on the principles and concepts of a problem (Masek, 2015). The students form small collaborative groups with a task to identify, analyze and solve problems (Silver, 2004). The identified problems will then serve as the starting point and foundation of the process of learning (De Graaff & Kolmos, 2003; Phungsuk et al., 2017). Because students have no prior experience or involvement in dealing and addressing the problem (Bilgin et al., 2009), students are challenged and are engaged in critical and creative thinking and problem-solving skills (Hung, 2009; Hung, 2016).

This study focused on assessing problem-based learning (PBL) as an effective pedagogical approach in DRR education. Because the senior high school (SHS) curriculum was recently implemented in the Philippines, it is crucial to take a deeper look at the teaching methods and approaches suitable or appropriate for various core and specialized subjects offered to both the Grade 11 and 12 levels. Specifically, it is important to assess if PBL approach is an innovative method that can effectively and successfully support the learning process of students taking up subjects with competencies about DRR education. The curriculum of DRRM is too broad and extensive, so this study will only concentrate on one of the objectives prioritized by the third pillar of the Comprehensive DRRM in Basic Education Framework, which is to engage students in hazard identification and assessment.

Apparently, this will be the first report on the application of PBL approach in Philippine DRR education, specifically in senior high school. The findings of this study are the outcomes of using PBL approach in understanding and implementing disaster risk reduction and management among students. This qualitative study clarifies if PBL approach can develop the skills and abilities of students in identifying hazards in their community. Furthermore, this action research supports the objective of the study of El-Adaway (2012), which is to determine the role of PBL in the improvement critical thinking and problem solving skills of students in hazard risk management.

Purposes of the Research Study

The goal of this action research is to assess the effectiveness of using problem-based learning (PBL) approach in senior high school on hazard identification and assessment in the community. Specifically, this study sought answers to the following questions:

1. How relevant is problem-based learning (PBL) in understanding the basic concept of hazards?

2. How effective is PBL approach in engaging the students to identify and assess community hazards?

3. How effective is PBL approach in engaging the learners to propose and suggest feasible solutions to the identified hazards?

Methodology

Research Design

This qualitative descriptive research study used action research design which employs the following stages based on the study of Mondal (2014): identify the problem, create a plan, act to execute the plan, collect and analyze data, and reflect.

Participants

The participants of the study included Grade 11 students who were taking Earth and Life Science subject at a Senior High School in Las Piñas City (23 males and 33 females within 16-18 years old). The teacher-researcher randomly grouped the students into six with eight to ten members each.

Research Instrument

The teacher-researcher prepared daily lesson logs (DLL)/lesson plans that indicate the utilization of PBL approach in specific learning competencies for Earth and Life Science. The DLL specified the flow of tasks that must be performed by the students, and each group received a PBL plan that served as their guide in carrying out the performance task.

The students presented the results of their investigation about the problem and their proposed solutions by submitting a group narrative and documentation report at the end of the PBL approach. The teacher-researcher applied systematic

evaluation of these submitted written/printed outputs. According to Bowen (2009), these documents can help researcher discover the meaning, understanding, and insights significant to the research problem. Hence, the document analysis conducted by the researcher to these outputs helped this study to find out the effectiveness and relevance of PBL on the understanding and engaging of learners in community-based hazard identification and assessment.

Data Collection

Plan

This study applied the problem-based learning (PBL) approach as the intervention or strategy in the teaching-learning process of senior high school students. This action research adopted the PBL model created by the Academy of Sciences and Mathematics from Illinois mentioned in the study of Draghicescu and colleagues (2014). This study also adopted some PBL procedures from the study of Masek (2015), which included mini lectures, group formation, problem delivery, group brainstorming with facilitator, outside class activities, and documentation report.

Further, this research study applied PBL approach in the learning competencies in Earth Science, which are all about natural hazards, mitigation, and adaptation. In the curriculum, the performance standard indicates that the learners shall be able to conduct a survey to assess possible hazards that their community may experience. Based on the competencies, the learners must be able to identify areas prone to hazards.

Act

A facilitator (teacher-researcher) started the PBL approach by conducting a short lecture on the concepts and principles of hazard identification and assessment. The teacher-researcher divided the class into six groups, and each group assigned a leader or a chairperson.

With the help of the facilitator, members of each group work collaboratively to identify the problem. Each group identified and discussed various hazards that can endanger or harm their community. The group selected one barangay (per group) where they investigated these identified hazards. The participants chose five barangays in Las Piñas City. Each group performed hazard identification and assessment by investigating the place or by asking questions to the community and public officials. Furthermore, the group leader and the members, with the help of the facilitator, exchanged ideas and information in generating and suggesting possible solutions to these identified hazards.

Post-activities and Reflection

The students presented the result of their hazard identification and assessment in the community by writing and submitting group reports or outputs which served as basis to determine the relevance and effectiveness of the PBL approach. The written outputs showed the student's learning and performance underlining the chosen DRR topics or competencies which include defining, identifying, and analyzing problem-situation, and in generating feasible and relevant solutions to community problems as the outcome of using the PBL approach.

Data Analysis

There are three types of data in this study: understanding of the students on the basic concept of hazard, hazard identification and assessment in the community, and generating solutions based on the hazards identified. The researcher summarized and tabulated the data, and applied data analysis scheme, because the research was purely descriptive.

Results

Relevance of PBL in Understanding the Basic Concepts of Hazards

Through the problem-based learning (PBL) approach used in the teaching and learning process in this study, students were able to discuss and explain the basic concepts about hazards. Table 1 presents the ideas and basic concepts of hazards per group. The students defined the term "hazard", enumerated the types of hazards, and their possible impacts. PBL approach allowed the students to learn through group discussions. This approach enabled the learners to identify (on their own) the basic concepts of hazard. Students depend on their critical and creative thinking, as well as their skills and abilities to search for the answer. Aside from this learning, students managed to organize and synthesize general concepts about hazards from individually-explored concept. Hence, PBL approach highlights collaborative work and understanding.

Table 1. Basic ideas and concept of hazard generated by group under PBL approach

Group	Basic Concept of Hazard
Group 1	- A hazard is an agent that can cause damages to life, health, property or environment - Hazards can be classified as natural and anthropogenic - Anthropogenic hazards can be classified as technological, sociological, health, safety, and economic
Group 2	- A hazard is any agent that can cause harm to life, health, property, or to the environment - Earthquakes, floods, volcanic eruption and tsunami are natural hazards that threaten people - Accident is any event that is caused by the interaction with hazard
Group 3	- Philippines is a hazard-prone country - Philippines is located in the Pacific ring or realm of fire, where active volcanic eruptions and earthquakes occur - Philippines is prone to tropical cyclones
Group 4	- A hazard can cause harm and damage to man and nature - Hazards can range from environmental deterioration to involuntary social hazards - It resulted to thousands of death and billions of dollars of infrastructure, property and habitat losses

Group 5	- Hazards talk about the danger and risk that people encounter - Hazards can cause great damage or loss of life
Group 6	- Examples of hazards are earthquakes, landslides, volcanic eruptions, floods, typhoons, tsunamis, and tropical cyclones - Hazards can pose theoretical possibilities of harm - There are number of people killed and number of establishments destroyed because of hazard

Note: Based on the written output of the group

Effectiveness of PBL in Engaging Students in Assessing Community Hazards

Table 2 presents the identified and assessed hazards in every barangay based on PBL approach. Common geologic hazards identified in the five chosen barangays include possible collapse of buildings, and other infrastructures during an earthquake. Old structures were also identified for a possible collapse during an earthquake. Common water and climatic hazards include floods which are mainly caused by blocked drainage by garbage, and other waterways. Low-lying areas and those that are near waterways are also prone to floods. Students were able to assess common environmental and biological hazards in the five barangays, which include the following: widespread diseases caused by improper waste disposal; air and water pollution; and unhygienic food preparations and handling of street vendors that often leads to food poisoning. Students also identified accident-related hazards through PBL approach which include electrical and fire hazards, vehicular accidents caused by road potholes and absence of road and street signs, damaged drainage, electrical posts, and electrical wires that can harm people.

Table 2. Hazards identified and assessed by the students in the community using PBL approach

Types of Hazards	Identified Hazards
Geological	- Strong earthquakes can easily damage or destroy old and substandard buildings and structures - Buildings or structures with cracks and fissures can collapse during a strong earthquake - An earthquake can topple down lamp posts in the street - Buildings that are already damaged can be totally destroyed - Infrastructures under construction can be damaged by earthquakes
Water and Climatic	- Clogged drainage systems and waterways can result to flood - Low-lying areas are prone to flood - Roofs made up of light materials can be destroyed and damaged by strong wind - Houses made of light materials can certainly be destroyed by storms and typhoons - Flashfloods can occur in areas located nearby waterways
Environmental & Biological	- Improper waste disposal could lead to widespread diseases - Smoke belching is evident among many jeepneys - Improper handling and preparation of food by street vendors can cause food contamination and poisoning - Open drainages or canals make residents vulnerable to diseases - Air pollution is evident in the area - Stray dogs in the street can bite and attack people - Waterways are heavily polluted - Unhygienic practices can result to diseases - Garbage that pile up in creeks can cause diseases
Accident-related	- Houses made of light materials are prone to fire hazards - Houses with illegal electrical connections can cause electrical and fire accidents - Houses in close proximity can promote the spread of fire - Tangled electrical wires and power cables can cause fire and its weight can cause electrical post to fall down - Sidewalks are blocked by vendors, which force the people to walk in the street making them prone to vehicular accident - Intersections without stoplights and traffic enforcer can cause vehicular accidents - Sharp, curved roads are prone to vehicular accidents - Road potholes can cause motorcycle and other vehicular accidents - Roads without signs and pedestrian lanes are prone to accidents - Damaged electrical posts can break and collapse - Lack of streetlights endanger motorists - Open drainages are accident-prone - Fire accidents are common in old buildings - Damaged electrical posts can break and collapse - Vendors occupying the sidewalk force people to walk in the street making them vulnerable to vehicular accidents - Double parking blocks roads or streets - Tilted electrical posts with dangling wires pose danger

Note: Based on the written reports or outputs

Effectiveness of PBL in Engaging Students to Suggest Feasible Solutions to the Identified Hazards

Possible solutions proposed by the students are listed in Table 3. PBL approach requires the student not only to identify problems, but they are also tasked to propose feasible solutions. Based on the written reports, most of the proposed solutions must be coordinated to the Barangay officials. Students identified the actions that must be implemented by local authorities such as implementation of the law, monitoring, and improvement of the physical aspects of the barangay. These improvements in terms of physical aspects include infrastructure repairs and rehabilitation, declogging of canals and waterways, and putting up road and street signages. Each group also recognizes the importance of cleanliness in a community. The learners also understood that most of the hazards are human factors influenced, therefore the proposed solutions are mostly imposing accountabilities and responsibilities to the community as well as the individual persons, such as proper waste disposal and waste segregation. The community-based projects are possible to conduct and can be implemented with proper coordination to government officials.

Table 3. Outcome of PBL approach on generating possible solutions to the identified and assessed hazards

Types of Hazards	Proposed possible solutions to the identified hazards
Geological	- Immediate repair of buildings such as houses, roads, and overpass with minor damages to avoid major disaster during an earthquake - Old buildings must be renovated to prevent collapse during earthquakes - Implement standard guidelines in constructing houses and other infrastructures to withstand earthquakes - Conduct earthquake drills in the community
Water and Climatic	- Conduct clean-up drive in canals, rivers, and other waterways to prevent flooding - Reinforce the structure of the roof and ceiling of houses to withstand the strong winds of typhoons

Environmental & Biological	- conduct a clean-up drive project for every barangay - Ordinances that maintain cleanliness must be implemented - Strict monitoring of food handling among street vendors - Conduct fumigation to control mosquitoes - Proper segregation of garbage
Accident-related	- Putting up a pedestrian lane in every street or major roads to avoid accidents - Place traffic enforcers that will monitor road activity - Contact the electric company to repair and organize tangled wires - Place road signage - Remove cars illegally parked on roads and other obstacles - Repair of damaged roads - Put street lights to avoid vehicular accidents at night - Remove all illegal electrical connections - monitor and catch of stray dogs in the streets

Note: Based on the written reports or outputs

Discussion

Apparently, this is the first report about the application of PBL as a teaching approach in developing the skills and abilities of senior high school students on hazard identification and assessment in the community. Specifically, this study determined the relevance of PBL in understanding the basic concepts of hazards, the effectiveness of PBL approach in engaging the students to identify and assess community hazards, and the effectiveness of PBL approach in engaging the learners to suggest feasible solutions to the identified hazards.

The disaster preparedness component of disaster risk reduction (DRR) was the focus of risk education in this study. According to Schleyer and colleagues (2007), the learning outcomes in risk education must include the basic concepts and principles of hazards and safety, hazard identification and risk assessment, and techniques or strategies for the reduction and control of risks. Following these target learning outcomes, disaster preparedness can strengthen the capacity of the community to conduct protocols and measures that will prevent, limit, and lessen imminent disaster risks (Kihila, 2017). In this action research, PBL approach provided the students with experiences

through real-world problems to achieve the learning outcomes. PBL provided students with authentic task which makes learning about risk education more effective. This is in far contrast to the traditional approaches, wherein the teacher controls the learning process and just feeds information to the students (Tularam & Machisella, 2018). In this study, the PBL approach's features and characteristics proved to be effective and relevant in providing students a more improved learning process, especially when it comes to understanding community-based hazard identification and assessment.

According to the International Federation of Red Cross and Red Crescent (IFRC) Societies (2011), participatory learning is the appropriate approach to motivate and engage the people in understanding DRR education, specifically, disaster preparedness. The PBL approach used in this study further supports and strengthens participatory learning as mentioned by the IFRC reflected by the following indicators: empowering the students to assess the vulnerability and capacity of their own community, conducting community-based risk and hazard identification, and forming a focus-group discussion to exchange ideas about hazards and their possible solutions. Thus, it can be said that PBL approach may have promoted and developed a very strong disaster risk awareness, because the approach provided the students with opportunities to participate and to have an involvement to these issues and problems on disaster risks.

Problem-based learning approach has also been recognized for positive learning outcomes. Collaborative learning and interactions of students are highly evident in PBL approach (Yew & Goh, 2016). Throughout the PBL process, students work as one within a group, analyze the problem, and finish the tasks at hand. The learners become effective collaborators, wherein they develop the abilities and potentials to create common ground, to resolve conflicting ideas and principles, to discuss the actions that should be done by the group, and to create an agreement among the group members (Silver, 2004). In this study, each group

collaboratively conducted community-based hazard identification and assessment.

Student-based method of learning is also evident in PBL approach (Etherington, 2011). This approach develops the student's abilities and skills for analysis and reflection on the identified hazards. Students are challenged by real-life problems in their community that necessitates possible and effective solutions. Based on this outcome, disaster preparedness is understood by the students through active learning.

PBL is a pedagogical method that also facilitates higher order thinking skills (Hung et al., 2008), which makes it an applicable approach to senior high school education. Problem-solving skill is evident as a learning outcome of PBL approach (Kadir et al., 2016). Initially, students were able to develop fact-finding and problem-finding skills. Learning is instigated when students are confronted with real-life problems. This characteristic of PBL makes it a problem-centered content structure. The students do not receive the learning content from the teacher, but instead, a problem or various problems start the learning process (Hung, 2009). The students in this study identified the basic concepts and principles of hazards, which in turn resulted in finding, investigating, and locating hazards in their own community. Identification of hazards, which is the problem, becomes the core of the lesson that drives the motivation of the students to learn.

Furthermore, this initial step of learning will then be used to develop critical and in-depth problem-solving skills. The learners are transformed into effective problem solvers equipped with their enhanced critical, analytical, and metacognitive thinking skills. As observed in this conducted research, senior high school students critically analyzed the natural or anthropogenic hazards they have identified in the community in order to generate immediate or long-term solutions. High level of reasoning is developed among the learners (Silver, 2004), as well as the skill of investigating the problem (Etherington, 2011). Thus, the PBL approach could be proven to improve problem-solving skills

more efficiently compared to the conventional and traditional method of teaching (Argaw et al., 2017).

This action research shows that PBL approach may have effectively delivered and fulfilled the learning competencies or objectives of DRR in the Earth and Life Science subject of senior high school students. This pedagogical approach is applicable and effectual in aiming for the content standard indicated in the Natural Hazards, Mitigation, and Adaptation component of the curriculum, which has the goal to enable learners demonstrate understanding of different hazards. Moreover, the learning outcomes achieved in this PBL approach are lifelong learning abilities and skills that can empower a person to become a good decision-maker and goal-oriented person who possesses ability to accomplish problem-solving tasks (Silver, 2004).

Because this study only involved one component of DRR, it is strongly recommended to further apply and utilize PBL approach in other components of DRR education. Other learning competencies include interpreting hazard maps, applying precautionary measures and strategies, developing family or community preparedness emergency plans, and preparing survival kits and materials.

This study was only a qualitative description on the relevance and effectiveness of PBL approach based on students' group reports. Future replication of such study may conduct quantitative assessment on the learning outcomes in DRR competencies among students using this approach. Pre-test and post-test can be implemented to determine student's understanding of DRR competencies with the application of PBL approach. Content mastery and conceptual understanding can be assessed before and after the application of the approach, or a comparison between control (conventional or traditional method of teaching) and experimental group (PBL approach).

It is also recommended to determine the pros and cons, or the advantage and disadvantage of utilizing and implementing

PBL approach in DRR based from the teacher's standpoint or evaluation. The teacher will be able to discern if PBL approach can fulfill the content and performance standards in the various learning competencies of DRR as stated in the curriculum. Further studies that will investigate appropriate pedagogical approach in teaching and addressing disaster resiliency, readiness and risk reduction in schools are very timely and beneficial to educators.

Reflection

This study found out that PBL approach is an appropriate strategy in educating the students on the learning competencies or objectives of DRR in the Earth and Life Science subject, specifically on the area of hazard identification and risk assessment. PBL is an effective pedagogical approach for the learning process of students in understanding the basic concept and principles of hazards, in identifying and assessing natural and anthropogenic hazards in the community, and in generating effective solutions and ways of coping to these identified hazards.

PBL approach is relevant and effective in targeting DRR competencies, because this approach supports participatory learning wherein there is an active involvement of students in learning disaster preparedness. This pedagogical approach also promotes collaborative and student-based method of learning, because students work cooperatively as a group to analyze and address the problems using their skills and abilities. With the tasks given, PBL enables the learners to develop critical, higher-order thinking and problem-solving skills. Students are faced with real-life problems, which inevitably transform them to become effective problem solvers. Learning DRR is extended outside the classroom using PBL, because students are immersed into the community to address and solve problems they themselves encountered.

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References

Argaw, A.S., Haile, B.B., Ayalew, B.T., & Kuma, S.G. (2017). The effect of problem-based learning (PBL) instruction on students' motivation and problem solving skills of Physics. *Eurasia Journal of Mathematics, Science and Technology Education*. *13*(3), 857-871.

Ballesteros, M.M., & Domingo, S.N. (2015). Building Philippine SMEs resilience to natural disasters. *Philippine Institute for Development Studies. Discussion Paper Series No. 2015-20* (Revised). Retrieved from https://dirp3.pids.gov.ph/webportal/CDN/PUBLICATIONS/pidsdps1520_rev.pdf.

Bilgin, I., Senocak, E., & Sozbilir, M. (2009). The effects of problem-based learning instruction on university students' performance of conceptual and quantitative problems in gas concepts. *Eurasia Journal of Mathematics, Science and Technology Education*. *5*(2), 153-164.

Bowen, G.A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*. *9*(2), 27 – 40.

Cadiz, A.P., Pascual, C.B., & Evangelista, E.V. (2018). Disaster resilience level of selected barangays in Quezon City, Philippines. *Asia Pacific Higher Education Research Journal*. *5*(2), 1 – 14.

De Graaff, E., & Kolmos, A. (2003). Characteristics of problem-based learning. *International Journal of Engineering Education*. *19*(5), 657-662.

Draghicescu, L.M., Petrescu, A.M., Cristea, G.C., Gorghiu, L.M., & Gorghiu, G. (2014). Application of problem-based learning strategy in science lessons –examples of good practice. *Procedia –Social and Behavioral Sciences*. *149*(2014), 297-301.

El-Adaway, I.H. (2012). Can an integrated problem-based learning framework improve natural hazard management? *Journal of Professional Issues in Engineering Education and Practice*. *138*(1), 10-13.

Etherington, M. (2011). Investigative primary science: A problem-based learning approach. *Australian Journal of Teacher Education*. *36*(9), 36-57.

Gomez, M.A.C., & Valencia, M.C. (2015). Competencies to contend with hazards and disasters. *The Normal Lights*. 9(2), 90-114.

Huang, K.S., & Wang, T.P. (2012). Utilizing problem-based learning (PBL) in a university english interpretation class. *The Journal of Human Resource and Adult learning*. *8*(1), 7-15.

Hung, W., Jonassen, D.H., & Liu, R. (2008). *Problem based learning. Problem based learning approach–AECT*. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.469.4785&rep=rep1&type=pdf

Hung, W. (2009). The 9-step problem design process for problem-based learning: Application of the 3C3R model. *Educational Research Review*. *4*(2), 118-141.

Hung, W. (2016). All PBL starts here: The problem. *Interdisciplinary Journal of problem-based learning*. 10(2). Retrieved from http://dx.doi.org/10.7771/1541-5015.1604.

International Federation of Red Cross and Red Crescent Societies. (2011). *Public awareness and public education for disaster risk reduction: a guide*. Retrieved from http://www.ifrc.org/Global/Publications/disasters/reducing_risks/302200-Public-awareness-DDR-guide-EN.pdf.

Kadir, Z.A., Abdullah, N.H., Anthony, E., Salleh, B.M., & Kamarulzaman, R. (2016). Does problem-based learning improve problem solving skills?-A study among business undergraduates at Malaysian Premier Technical University. *International Education Studies. 9*(5), 166-172.

Kihila, J.M. (2017). Fire disaster preparedness and situational analysis in higher learning institutions of Tanzania. *Jamba – Journal of Disaster Risk Studies.* 9(1), 1 – 9. Retrieved from https://jamba.org.za/index.php/jamba/article/view/311/600.

Llanto, G.M. (2011). Mainstreaming disaster risk management in local governments. *Philippine Institute for Developmental Studies. Policy Notes No. 2011 – 05.*

Masek, A. (2015). Problem based learning instruction approaches for students' intrinsic motivation stimulus. *International Journal of Vocational Education and Training Research*. *1*(3), 42-48.

Menon, V.G., Pathrose, J.P., & Priya, J. (2016). Ensuring reliable communication in disaster recovery operations with reliable routing technique. *Mobile Information Systems*. 2016, 1 – 10.

Mondal, P. (2014). Application of action research in geography in school. *Asian Journal of Multidisciplinary Studies*. *2*(8), 102 – 105.

Phungsuk, R., Viriyavejakul, C., & Ratanaolarn, T. (2017). Development of a problem-based learning model via a virtual learning environment. *Kasetsart Journal of Social Sciences*. *38*(3), 297 – 306

Sarmiento, D.H., & Orale, R.L. (2016). Senior high school curriculum in the Philippines, USA, and Japan. *Journal of Academic Research*. *01*(3), 12 – 23.

Schleyer, G., Duan, R.F., Williamson, J., & Stacey, N. (2007). Assessing the awareness of risk concepts by new engineering students. *International Journal of Mechanical Engineering Education*. *35*(3), 184 – 197.

Silver, C.E.H. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*. *16*(3), 235-266.

Tuladhar, G., Yatabe, R., Dahal, R.K., & Bhandary, N.P. (2015). Disaster risk reduction knowledge of local people in Nepal. *Geoenvironmental Disasters*. *2*(5), 1 – 12.

Tularam, G.A., & Machisella, P. (2018). Traditional vs. non-traditional teaching and learning strategies – The case of E-learning! *International Journal for Mathematics Teaching and Learning*. *19*(1), 129 – 158.

Yew, E.H.J., & Goh, K. (2016). Problem-based learning: An overview of its process and impact on learning. *Health Professions Education*. *2*(2), 75-79.