

# Research-Based Learning (RBL): How to Improve Problem Solving Skills?

Tri Saptuti Susiani  
*Universitas Sebelas Maret*  
 Solo, Indonesia  
 trisaptuti@staff.uns.ac.id.

Suhartono  
*Universitas Sebelas Maret*  
 Solo, Indonesia  
 suhartono@staff.uns.ac.id.

Ratna Hidayah  
*Universitas Sebelas Maret*  
 Solo, Indonesia  
 ratnahidayah@staff.uns.ac.id.

Moh Salimi  
*Universitas Sebelas Maret*  
 Solo, Indonesia  
 salimi@staff.uns.ac.id.

**Abstract**—Problem solving skills are part of the 21<sup>st</sup> century competencies that need to be drilled to prospective teachers. Research-based learning (RBL) is an alternative model of learning that can improve problem solving skill. This research was carried out to describe how the application of the implementation and effects of the RBL to improve problem solving skill Pre-Service Teacher Training and Education students. Qualitative approach was used in this classroom research. The participants in this study consist of 106 students. Data were collected using observation and test. This phase of the RBL that student learning can be applied; formulating a general question; overviewing of research-literature; defining the question; planning activities, clarifying research methods/methodologies; undertaking investigation, analyzing data; interpretation and consideration of results; reporting and presenting the results. The results of the research indicated that the implementation RBL can improve problem solving skills. It is proved by the fact that the students were able to show their ability of problem identification, representation, election strategy, implementation and evaluation. This research were used to make more sure the previous research that implemented the RBL can improve the quality learning process and provides a different learning experience which can improve the problem solving skill.

**Keywords**—*research-based learning (RBL), problem solving skill*

## I. INTRODUCTION

The development of technology and information at the beginning of the 21<sup>st</sup> century this trigger global challenges facing society where rapidly changing life patterns. Technological developments rapidly became the community needs to be able to adapt. The global challenges have entered into various sectors of life, including the education sector. The higher the dynamics of the global economy at the start of this 21st century, it will be the larger Bill on education

sector to prepare the students to be able to enter the global market. Educators must be capable of designing the learning that can prepare learners to become human resources competitive power and savvy, able to adapt to a variety of advancement in the 21<sup>st</sup> century. The quality of human resources in Indonesia strongly depends on the seriousness of the conduct of the Agency, including LPTK as an institution of higher education level.

LPTK must be able to provide quality human resources in accordance with the demands of the 21<sup>st</sup> century. Problem-solving skills are often identified as a key component of 21<sup>st</sup> century education [1]. Individuals need to have competence in 5 major skills, which are: (1) being able to adapt (adaptability); (2) communication skills complex (complex communication skills); (3) problem solving skills (problem-solving skills); (4) the skill set the self (self-management and self-development); and (5) the system of thought (systems thinking) [2]. Skills need to be developed in education to meet the challenges of the 21<sup>st</sup> century: (1) Work ethic is a system of principles in performance in the form of rules of behavior; (2) Collaboration is building a network of collaboration skills with others. (3) Good communication is the competence to communicate effectively and efficiently with others either by individuals or groups. (4) Social responsibility is the prowess to participate had a sense of social responsibility. (5) Critical thinking and problem solving are the skills to solve problems [3]. Creating the HR has the ability of critical thinking, problem solving, communicating, mastering the technology and literacy, certainly requires an adequate education and learning through education of the 21<sup>st</sup> century [4]. Thus, training 21<sup>st</sup> century skills is the most important to note in LPTK.

Problem solving skills is part of the 21<sup>st</sup> century a very necessary skills training for college students. This activity will need to continue to be carried out with reference to the human resources needs of the 21<sup>st</sup> century, where education of the 21<sup>st</sup> century can be a decisive criterion of the golden generation of Indonesia 2045. Ability of problem solving is seen needs to be owned by university students because these skills can help students make the right, careful, systematic, logical decision, and consider the various viewpoints [5]. On the contrary, the lack of this ability resulted in student activities without knowing the purpose and reasons to do it. Someone who has the ability to solve a problem can be identified by looking at how someone is addressing a problem. How to cultivate information, argument, capitalize on its intellectual and knowledge in addressing the issue in order to act at hand.

Development of problem solving skills in a less lecturing became the focus of attention, where problem solving skills only expected as the impact of the companion lecture. Based on observations, there are students when learning to follow and given the problems, they feel hard-pressed to addressing and resolving the problem. Lack of ability in addressing problems in the world of work is due to the quality of college graduates who are considered inadequate in terms of the ability of divergent thinking, which is necessary in solving problems [6]. To train the students to be able to develop problem solving skills then the professors need to do learning that gives students opportunities in addressing a phenomenon. Traditional teaching methods are criticized to vote is not capable to trigger critical thinking, cognitive skills, and holistic learning environment. Given the importance of developing learning can develop problem solving skills then needed alternative learning models. RBL social model interactions are one models that could be applied in an effort to develop problem solving skills of students.

Some well-known colleges already implemented model RBL. Some of the colleges of whom Griffith University Australia, Institut Teknologi Bandung, Gadjah Mada University, and Jakarta Islamic State University. The application of model RBL by some colleges is as a manifestation of the attempt to optimize learning start followed by LPTK in improving the quality of learning. Application model Research Based learning through Lesson Study was able to increase the IPA (Science) learning in primary school [7], the implementation of Research Based learning to increase critical thinking skills [8]. Research Based learning can also be implemented on the lecturing in college courses on thematic curriculum development [9]. Based on the success of the implementation of the RBL by LPTK in developing critical thinking skills, it is not a possibility that the model RBL can be implemented in developing the ability to solve the problem of student

candidates. This research was conducted to review related how much influence the implementation of the steps model RBL in developing problem solving skills in students. In addition, the measures can serve as a model of RBL innovation learning in lecture on LPTK.

## II. LITERATURE REVIEW

RBL is one of the learning models developed streams of constructivism, then responded positively and already applied in several colleges. [10] Griffith University Australia implement RBL to encourage positive change for students with high intellectual power, and be able to connect between the research with learning, as well as generate a lot of opportunity to improve the quality of the learning process, such as learning with field observations (inquiry) and the tests are extremely beneficial in improving learning outcomes students [10]. In addition to Griffith University, colleges in the country that already implement RBL is ITB. ITB implement RBL in the process his education because students demanded not only clever in terms of theory, but also practical in the event that dexterous [11]. Gadjah Mada University also published guidelines of the Research-based learning (PUPBR) in 2010 as a model of learning in lecture. Research-based learning is a learning model that leads to activity analysis, synthesis, and evaluation as well as improving the ability of learners and teachers in terms of assimilation and application knowledge [12]. Research-based learning based on the philosophy of Constructivism which includes four aspects that is learning that build students ' understanding, learning by developing prior knowledge, learning is a process of social interaction and meaningful learning accomplished through real experiences. Research is an important means to improve the quality of learning. The research component consists of the background, procedures, implementation, research and discussion of the results and the publication of research results. RBL is a system of instruction which used an authentic learning, problem solving, cooperative learning, hands on, inquiry and discovery approach, guided by a constructivist philosophy. Its usefulness had been recognized for many decades but "research in classroom" had not been adopted as a teaching method by many [13]. The application of research-based learning is an interdisciplinary and collaborative research on student learning in there, which means that the relationship between students ' experiences during the learning in the classroom with new findings on research [14]. RBL strengthen students became active in learning. In RBL, there is a competence that learners can own: 1) have an understanding of basic concepts and methodology, 2) can solve problems creatively, logical and systematic, 3) have the scientific attitude is always searching for the truth, open, and honest [15]. Learners are

expected to have the communication skills, analytical techniques and competent to adapt, work groups and competitive. Based on the exposure to these experts, it can be inferred that RBL is a learning model that integrates research within the learning process in order to build knowledge by way of formulating hypotheses, collecting data, analyzing, making inferences and drawing up a report. RBL model provides an opportunity for students to learn and build knowledge from the research of such measures should seek information, formulate hypotheses, collect data, analyze, make inferences and draw up a report. Stages of learning according to RBL model include the following: (1) Formulating a general question; (2) Overviewing of research-literature; (3) Defining the question; (4) Planning activities, clarifying research methods/methodologies; (5) Undertaking investigation, analyzing data; (6) the Interpretation and consideration of results; (7) Report and presentation of results [16].

Problem solving skill is the ability to find and solve a problem. "Teaching problem solving skill is to adopt a methodology for approaching open-ended problem" [17]. Thus, the indicator in the method of problem solving can be developed into this aspect of the assessment of problem solving skill. Preparation of problem solving skills is developed through indicators include problem solving; problem identification, problem representation or representations of the problem-solving strategies, selection, implementation and evaluation of problem solving strategies results [18]. "The arrangement to implement Problem Solving Skills to high school students on the material environment" formulate indicator assessment problem solving skills include defining the problem, examining the issues, planning a solution, implementing a plan that has been created and evaluate [19]. As for some related research results application of RBL 6 steps:

1. Research-based learning for undergraduate students in soil and water sciences: a case study of hydrogeology in an arid-zone environment. [18] in this journal describe the successful RBL zone hydrogeology exercises on dry, open and guided on the projects research (OPR) which is done is done by a team of students in Oman. A variety of activities and assessments used to support learning for three months. The assessment includes a monitoring laboratory activities and field trip, attendance recording, supervision by a written and oral report panel open presentation. Feedback students through teaching evaluation compared with other programs in the Department-College, describes the high level of student satisfaction. OPR is matched by using the RBL. Thus RBL can improve learning.
2. Supporting student teachers' reflective attitude and research-oriented stance. [21] a major Shift in teacher education in Switzerland 1990-Ness than before the reform namely teacher education at the University level are now focusing more research-oriented. In addition, the curriculum in teacher education-oriented not only academic, but also concurrently focused into practice. Students and teachers in Switzerland is very involved in practical clinical practice from the beginning. Before the reform, the reflection on the teaching is mainly put into practical training. However, due to the Reformation, the reflection has been embedded in the entire curriculum to support competence. The purpose of this article is to discuss how students can be supported to develop a reflective attitude and attitude-oriented research. Therefore, based on the research concluded that RBL can provide more learning opportunities and help to strengthen the relationship between theory and practice.
3. Research-Based Learning: Teaching Development through Field Schools. [22] the challenge to bring research-based learning for the sake of developing undergraduate study and anthropology students has led to the emergence of the field of education in Indonesia. Education field has become important in introducing a methodology of work in the field and in developing a more in-depth understanding of the relationship of the development of theory research data. In addition, students who participate in the education field to find new aspects to learn where the emotional and intellectual response to the situation the required field and they were challenged to consider the ethical issues raised in their research.
4. the development of model research based learning with scientific approach through lesson study in social science learning in the elementary school of the year 2015. [23] the purpose of this research is to analyze the conditions of (1) early learning takes place when the IPS (Social) in SD (Elementary School) (2) developed a model of learning in the curriculum of learning proper IPS elementary school in Kebumen Regency, (3) identify the model development Research Based Learning (RBL) and scientific approach through lesson study in increased learning IPS elementary school in Kebumen Regency. The research of model Research Based Learning with scientific approach through lesson study in SOCIAL SCIENCE learning in elementary school that is designed to produce a product as problem solving in learning IPS SD show results the increase in cycle 1 of 64%, 75% in cycle 2 and cycle 3% at 82.25.
5. Implementation research-based learning (RBL) can develop critical thinking skills [8]. It is proved by the fact that the students were able to show their interpretation, analysis, evaluation, inference and explanation abilities. Meanwhile, aspect of self-regulation ability has not yet been able to be found.

Based on the success of the implementation of the RBL by some institutions in improving the quality of learning and the students' ability in theory as well as practice and can develop skills of critical thinking, then the model can be considered RBL implemented in a lecture in developing problem solving skills of students of teacher candidates the SD. steps model Research Based Learning (RBL) gives the opportunity to students to teacher candidates learn through scientific measures so as to improve problem solving skills of students.

### III. MATERIAL & METHODOLOGY

This study used a qualitative approach. This research includes Classroom Research because research is the development of quality-oriented educational practice or improve the ability of educators themselves in the classroom by testing the theory of practice in education, evaluating and implement in the institution [24]. This research was carried out in Faculty of Educational Sciences, Sebelas Maret University (UNS) with 106 student participants in the thematic curriculum development courses. As for the cycle of observation in Classroom Research there are 3 phases namely planning meeting (planning meetings), classroom observation (classroom observations), and feedback discussion (discussion feedback). The technique of data collection in this study i.e., observation and tests. Tools used in the observation of which sheets of observations and questions. As for the instrument problem solving skill was compiled based on indicator; problem identification, representation issues, election strategy of problem solving, problem solving strategy implementation and evaluation of results. Data analysis in this research include; data collection, data presentation, data reduction and withdrawal of the conclusion. Data collection is done by observation. Reduction of data namely, analyzing and organizing data so that a conclusion can be drawn.

### IV. RESULTS AND DISCUSSION

#### A. Result

RBL model applied to Thematic curriculum development lecture. Stages of RBL model include: formulating a general question; overviewing of research-literature; defining the question; planning activities, clarifying research methods/methodologies; undertaking investigation, analyzing data; interpreting and considering the results; reporting and presenting the results. Activities at the stage of formulating a general question by giving a formula in the form of a topic or a problem to students which is about what it is learning, integrated learning and how the implementation of integrated learning in elementary school is. In this phase, the student has not yet come to know about the concept of learning and integrated

learning. Overview of research phase activities-literature; student discussion groups examine integrated learning of a variety of references and literature. Discussion group consists of 6 students. After students have had a discussion about the concept and various types of integrated learning, they raise questions related to how students in the implementation of integrated learning in elementary school. Activities at the stage of defining the question; students make hypotheses about the implementation of integrated learning in elementary school at this time. Students need to do research to prove the hypothesis. Therefore, students conduct stage of planning activities, clarify research methods/methodologies. At this stage, the students plan and prepare an investigation that will be undertaken to analyze the application of integrated learning in elementary school. Students plan two investigation which are research on the preparation of the plan of implementation of the integrated learning primary school teachers and the implementation of integrated learning in elementary school. At this stage, the students discuss in groups composing an instrument that will be used to observe the planning and implementation of learning. Instruments drawn up cover sheets of observation and interviews. Students devise instruments based on aspects of integrated learning characteristics. Undertaking activities on the investigation, analyzing data, student investigate by conducting observations in primary school. The first investigation was aimed at analyzing the implementation plans of integrated learning created by primary school teachers. The second Investigation aimed at students to analyze the implementation of integrated learning in elementary school. The activity stage of interpretation and consideration of results; students analyze the results of observation and execution of integrated learning plan. Activity report and presentation of results; students write down the results of research and analysis and presentation.

Phase of RBL model is capable of problem solving skills in students. Aspects of problem solving skill that is used in this research; problem identification, representation issues, election strategy of problem solving, problem solving strategy implementation and evaluation of results. To see the ability of problem solving skills of students, tests and observations were conducted during lectures against 106 students.

Through the techniques to the test, students were given a case study in elementary school and then answer related questions in this case. The case study, a teacher will administer the learning material involving Indonesian Language, IPA and PKN. Teacher trouble determining which learning will be implemented. The characteristic of the class is students active in the move. Based on the results of the tests already carried out, with all aspects of

problem solving skill that looks on students; problem identification, representation issues, election strategy of problem solving, problem solving strategy implementation and evaluation of results. The following table gain test problem solving.

TABLE I. THE RESULTS OF THE TEST PROBLEM SOLVING

No	Aspect Problem Solving	Percentage (%)
1	Identification Problem	97.14
2	Representation	81.43
3	The selection strategy	42.86
4	Implementation	55.71
5	Evaluation	40

Based on observations during lectures, the results showed a similar test results against. Aspects of problem solving skill looks at students' self identification issue, presentation, election strategy, implementation and evaluation.

#### 1) *Problem identification*

To see this aspect of the ability of problem identification through the test, students were asked to answer the question related the case study are given. The question, "what problems are ther in a given learning?" Almost all of the students were able to answer correctly. LN replied, "That the teacher has not specified the model and the themes that will be used. Ability of problem identification appears in the student self in formulating a general question, overview of research-literature, defining the question; planning activities, clarifying research methods/methodology, undertaking investigation, analyzing data, interpretation and consideration of result, and report and presentation of results. Through observation, student identification capability is seen in the phase of formulating a general question, overview of research-literature, and defining the question.

#### 2) *Representation*

To see aspects of student representation, requested the ability compose step or what strategy to solve the problem of learning. AC students answer questions related the case study, "teacher learning integrated learning model. teachers can connect to Indonesian Language learning as well as the PKn (Civic) IPA using environmental themes ". The ability of representation appeared in student self-phase formulating a general question, overviewing of research-literature, defining the question; planning activities, clarifying research methods/methodology, undertaking investigation, analyzing data, and the interpretation and consideration of result.

#### 3) *The Selection Strategy*

To see this aspect of the ability of election strategies, students were asked to answer the question related the case study, "the reason for choosing these strategies/measures?". HR student replied, "Applying

the model of integrated learning model Webbed because associate 3 competency in different subjects with one theme that is circles would be more effective." Based on observations, the ability of the election strategy appears at student self-planning phase activities, clarifying research methods/methodology, undertaking investigation, analyzing data, interpreting and considering the result, and reporting and presenting the results.

#### 4) *Implementation*

To see the aspects of implementation, a student's ability to answer the question, "how these strategies apply?" 55.7% of the students answered correctly. The ability of the student appeared on the implementation phases planning activities, clarifying research methods/methodology, undertaking investigation, analyzing data, interpreting and considering the result, and reporting and presenting the results.

#### 5) *Evaluation*

The ability of the students in evaluating look when asked to evaluate his strategies are effective or not and what being a consideration. Only 40% of students can afford. Based on the observations, the ability of the evaluation appears on the self of college students in analyzing data, interpretation and consideration of result, and report and presentation of results.

### B. *Discussion*

RBL phase already applied to the study: (1) Formulating a general question; (2) Overview of research-literature; (3) Defining the question; (4) Planning activities, clarifying research methods/methodologies; (5) Undertaking investigation, analyzing data; (6) the Interpreting and considering the results; (7) Reporting and presenting the results [16].

Based on the results of observation and tests, the application of the model of RBL may develop problem solving skills in students on problem identification, representation, election strategy, implementation and evaluation. Learning at this time has not been attentive toward the development of problem solving skills. Traditional teaching methods are criticized due to their inability to trigger critical thinking, cognitive skills and a holistic learning environment for children [25]. Problem solving skill is one form of cognitive skills. Problem solving skill is one of the most important cognitive abilities of an individual may be put into use in various lifestyle-related context, especially in terms of fast lifestyle, the technological revolution information and accelerating changes in all aspects of life [26]. Problem solving skills characterize one of the most intelligent human activities.

RBL model gives the opportunity to students to be active in learning. Through the experience of research, students are expected to carry out collaborative learning during research and apply the knowledge gained. Furthermore, the benefits of RBL is skills development inquiry. The process of the invention has a characteristic controlled, systematic, empirical, and basing on theory. Through RBL, students gain the opportunity to learn not only from material from the lecturer but by carrying out the research. The research consists of a systematic scientific step that includes the identification of the problem, devise a hypothesis, study literature, searching for data, analyze data, conclude and report. These aspects are part of the problem solving skill. RBL is the acquisition of knowledge leading to new knowledge of each filed and research process also enables the researcher to plan a take action systematically. RBL can discover the truth and build new, correct and useful knowledge [27]. [22] Advocates for research-based learning have pointed to the need to develop an enthusiasm for critical enquiry, resourcefulness and creative solutions in undergraduate students.

Application of the RBL was able to integrate learning in research. Students locate plan and develop knowledge through practice. Through the experience of research, students are expected to carry out collaborative learning during research and apply the knowledge gained. RBL used for the exercise provides students with an opportunity to practice their metacognitive abilities and foster critical thinking, abilities to make predictions, causative factors, propose and present constructive arguments. This is done/measured via/through oral presentations and final reports which all are the core components of any scientific research "[20]. RBL can develop learning reform in higher education so that the quality of learning is increased. The research of teaching mergers and impart knowledge and develop their abilities, and give freedom to students for self-determination and teachers must guide students to look for problems, carry out surveys, search, and learn in practice. In recent years, China is capable of developing teaching reform of higher education can cultivate students' view of the world, strengthening the students' ability to analyze and solve problems, and foster a spirit of students explore and innovate [28]. Expansion of the participation of the University fosters talent is better for the community, which has expanded the scale of higher education, and improve the overall quality of the national.

Application of RBL can be made one of the efforts in advancing research in Indonesia particularly in the College through student researchers. RBL is a solution to the institutional policy of the integration of research and inquiry that bridges the gap between research and teaching staff and changing attitudes about academic value and implications of

undergraduate research, work with staff research on teaching and learning issues, and made available for staff resources to facilitate the implementation of undergraduate research thus undergraduate research universities in Australia are becoming more meaningful [29].

## V. CONCLUSION

Based on the research results, it can be concluded that the model RBL can be applied to the learning of the students of elementary school teacher candidates by which consist of stage; formulating a general question; Overview of research-literature; defining the question; planning activities, clarifying research methods/methodologies; undertaking investigation, analyzing data; interpreting and considering the result, and reporting and presenting the results. The results showed the implementation of RBL may develop problem solving skills of students. This is proven by the student is able to demonstrate the ability of problem solving skills including problem identification, representation, election strategy, implementation and evaluation.

## REFERENCES

- [1] Kay, K., 21st century skills: Why they matter, what they are, and how we get there. Foreword in: 21st Century Skills: Rethinking how students learn, J. Bellanca & R. Brandt (Eds.) Bloomington, IN: *Learning Tree*.
- [2] National Research Council (NRC). 2Assessing 21st Century Skills: Summary of a Workshop. J.A. Koenig, Rapporteur. Committee on the Assessment of 21st Century Skills. Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. 2012
- [3] Guru Abad 21. [http://www.kompasiana.com/baslah/guru-abad-21\\_550dd0daa33311a42dba7d34](http://www.kompasiana.com/baslah/guru-abad-21_550dd0daa33311a42dba7d34) . Retried 4 Februari, 2016.
- [4] Moh. Salimi. *Guru yang Efektif dan Pengajaran yang Efektif dalam Rangka Menyongsong Generasi Emas 2045: Sebuah Kajian Awal*. Joint International Seminar PGRI Semarang University- IPG Temenggong Ibrahim Malaysia Education in the 21<sup>st</sup> Century: Innovation and Challenges. Universitas PGRI Semarang Press. 168-174 (2016).
- [5] Pendidikan Usia Dini (Mengajar Anak Berpikir Kritis) <https://www.kompas.com/kesehatan/news/0605/05/093521.htm>. Retried 4 Februari, 2016
- [6] Lulusan-lulusan Kita Belum Siap Kerja. <http://edukasi.kompas.com/read/2011/07/13/19561657/Lulusan.lulusan.Kita.Belum.Siap.Kerja>, Retried 4 Februari, 2016.
- [7] Suryandari, K. C., Peningkatan Pembelajaran IPA dengan Aplikasi Model Research Based Learning Melalui Lesson Study di Sekolah Dasar. *Paedagogia* 16 (2) (2013)
- [8] Susiani, T.S., Salimi, M., Hidayah R., Research Based Learning (RBL): How to Improve Critical Thinking Skills? *In the Proceedings of GC- TALE 2017*, SHS Web of Conferences 42, 00042 (2018)
- [9] Susiani, T.S., Salimi, M., Hidayah R., Implementasi RBL dalam Pembelajaran Mata Kuliah Penegmbangan Kurikulum Tematik, In the Proceedings of Seminar Inovasi Pendidikan, fkip UNS, (2017)
- [10] D. Rosyada, *Pembelajaran berbasis penelitian*. [<http://www.uinjkt.ac.id/pembelajaran-berbasis-penelitian/>] (2016)

- [11] *Research based learning, asah kemampuan praktis mahasiswa* ITB. [https://www.itb.ac.id/news/read/3211/home/research-based-learning-asah-kemampuan-praktis-mahasiswa-itb] .(2011).
- [12] Widayati, Tri D. dkk., *CPedoman Umum Pembelajaran Berbasis Riset (PUPBR)*, Yogyakarta: Universitas Gadjah Mada, 2010.
- [13] Poonpan, Suchada & Siriphan, S. *Indicators of Research-Based Learning Instructional Process: A Case Study of Best Practice in a Primary School*\*, dalam Faculty of Education, Chulalongkorn University Phaya Thai. Bangkok.Thailand, (2001).
- [14] Kazura, K. and Tuttle, H., *Research Based Learning Approach: Students Perspective of Skills Obtained*, *Journal of Instructional Psychology*, 37(3): 210-215 (2010)
- [15] P. Arifin, *Makalah seminar nasional research based learning*, ITB, Bandung, 2010.
- [16] Tremp, Peter., (Research-based Teaching and Learning A LERU project, Munich: *University of Zurich*, Center for University Teaching and Learning. 2010.
- [17] Mourtos, N. J., Okamoto, N. D. & Rhee, J.. *Defining, Teaching, and Assessing Problem Solving Skills. 7th UICEE Annual Conference on Engineering Education*, 9-13 February, (2004)
- [18] Eggen, P., & Kauchak, D. (2012). *Strategies and Models for Teachers Teaching Content and Thinking Skills* (6th ed.). Boston Pearson.
- [19] Novitasari et al. *Penyusunan Assessment Problem Solving Skills*. Seminar Nasional XII Pendidikan Biologi FKIP UNS. 2015
- [20] Al-Maktoumi, Ali. et.al. *Research-based learning for undergraduate students in soil and water sciences: a case study of hydrogeology in an arid-zone environment. Journal of Geography in Higher Education* .Volume 40, Issue 3, Hal. 1-19. (2016).
- [21] Buschor1, C.B & Kamm1, e., *Supporting student teachers' reflective attitude and research-oriented stance, Pädagogische Hochschule Zürich*, Zurich University of Teacher Education, Lagerstrasse 2, 8090 Zürich, Switzerland. SpringerScience+Business Media Dordrecht 2015. (2015).
- [22] Guinness, Patrick, *Research-Based Learning: Teaching Development Through Fieldschools*. *Journal of Geography in Higher Education* ,Volume 36. No. 3. Hal. 329- 339. (2012).
- [23] Chamdani, Muhammad. Dkk. *Pengembangan Model Research Based Learning dengan Pendekatan Scientific melalui Lesson Study dalam Pembelajaran IPS di Sekolah Dasar Tahun 2015*. Prosiding Seminar Nasional Pendidikan "Inovasi Pembelajaran untuk Pendidikan Berkemajuan" FKIP Universitas Muhammadiyah Ponorogo, 2015.
- [24] Hopkins, David, *A teacher's guide to classroom research Fourth edition*. New York: Open University Press, 2008.
- [25] Asiye Bahtiyar and Bilge Can, *An investigation of problem-solving skills of pre-service science teachers*, *Pamukkale University, Turkey* 11 (23) (2-16). Pp 20108-211,
- [26] Nahil M. Aljaberi1 & Eman Gheith1, *Pre-Service Class Teacher' Ability in Solving Mathematical Problems and Skills in Solving Daily Problems*. *Higher Education Studies, Canadian Center of Science and Education*, 6 (3), (2016)
- [27] Chaiwat Waree, *A Classroom Research Skills Development Emphasizing Data Analysis and Result of SSRU Students by RBL*, *International Education Studies* 10 (4) (2017)
- [28] Xiaolai Liu & Qinghuai Li, *Combination of the Research-Based Learning Method with the Modern Physics Experiment Course Teaching*, *College of Science* 4 (1) (2011)
- [29] Angela Brew and Evan Jewell, *Enhancing quality learning through experiences of research-based learning: implications for academic development*, *International Journal for Academic Development* 17 (1), 47-58 (2012)