

Lesson Study: An Approach to Increase the Competency of Out-of-Field Mathematics Teacher in Building the Students Conceptual Understanding in Learning Mathematics

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Abstract. The study was conducted to observe the effectiveness of Lesson Study as an approach used to increase the skills of an out-of-field Mathematics teacher or ‘non-optional’ teacher, in building the conceptual understanding among students during the teaching and learning process. This qualitative case study was conducted using a Lesson Study approach involving a novice Mathematics teacher who is also a non-optional teacher, in a district of Seremban, Negeri Sembilan, Malaysia. An expert in Mathematics, School Improvement Specialist Coach(SISC+) was involved in the classroom observation. There were three different sessions conducted and the observation was recorded. Transcripts were prepared for the three observations for comparison and analytical review on the learning and teaching process with the Excellent Mathematics Teacher. It was observed that the Mathematics teacher’s competency improved after evaluating the students’ response and achievements after the learning session. Teachers who were involved, developed their skills and expertise through discussions during the Lesson Planning, teaching and review sessions. The teachers are more confident in addressing students issue as well as class control ‘Lesson Study’ approach had contributed to upgrade the skills and efficiency of the non-optional Mathematics teachers as well as enriching the learning strategy, approach and methodology.

Keyword: *Excellent Mathematics Teacher, Lesson Study, Out-of-field teacher*

1. Introduction

The Malaysian education is moving towards the implementation of the 21st-century learning. Based on the statistical data, there was a shortfall of 9900 teachers in 1995 and in the year 2000. This positive development demand for vast number of effective new workforce in the teaching profession. Due to the shortfall of teachers at the school, the State Education Department

(JPN) under the Ministry of Education Malaysia (KPM) had taken steps to employ interim teachers (temporary teachers) to fill the gap. There were cases of non-option teachers or out-of-field teachers were required to teach subjects not according to their options due to the short of teachers under specific areas.

This will put the students at disadvantage position as the quality of teaching is not up to the standard. The Ministry of Education should resolve the problem and take immediate action to rectify the issue on the placement of educational graduates according to their respective option so that that future of future of the students are well taken care of. Lubinski (1990) found that the pedagogical beliefs and knowledge of the content possessed by the teacher influenced the planning and implementation of the teaching and learning process carried out by it. Teachers need to understand the content of the subject in advance.

Methods for teaching Mathematics is differed from teaching history. Mathematics involve numbers and problems while teaching history is based on facts that require field research. Most out-of-field teacher will be given one or two classes. These teachers do not have pedagogical content knowledge(PCK). Even though, they can learn the content knowledge(CK) but the method or the strategy is different. It is not about fulfilling the shortage of teachers but this is a matter of how knowledge can be transferred to the students. W. Hibert (2009) said that a teacher tends to follow the way of teaching as the way their teachers used to teach them way back more than ten years and tend to be outdated. The research is conducted to see the process of Lesson Study that can improve the competency of the out-of-field mathematics teacher. Teachers apply various techniques and methods according to the students learning culture and level. The purpose of the study is to ensure that students will be able to build the conceptual understanding and achieved the learning objectives.

An effective teacher is a teacher who uses various methods according to the learning culture and student level to ensure that students achieve the conceptual understanding and as well as the learning objectives. Abraham Maslow and Carl Rogers, experts in 'Humanistics Theory', emphasized on students morale willingness and potential. The theory focused on matters related directly to the individuals, self-uniqueness and humanity actions towards others. The theory assumes that human requires basic needs and wants and they will motivate themselves strive for further achievements and goals if their basic needs had been fulfilled. Maslow (1984) stated that, if the psychological needs were not fulfilled, people may become miserable. The Humanistic Theory focused on students and these students are regarded as clients. As such, teachers are to take considerations of the students' background as a platform for teachers to choose the correct strategy and teaching method before each learning session. The Humanistic 'theory'

approach emphasized on the thinking process, observation and students interpretation towards any events. Teachers have to look at various angles before delivering the teaching approach.

Gagne (1965) in his book 'The Conditions of Learning' provided these steps so that the teaching process can be carried out effectively and efficiently.. Gagne Teaching Theory lines nine steps to consider before planning the implementation of teaching and learning. This guide can help the non-option teachers in facilitating their teaching.

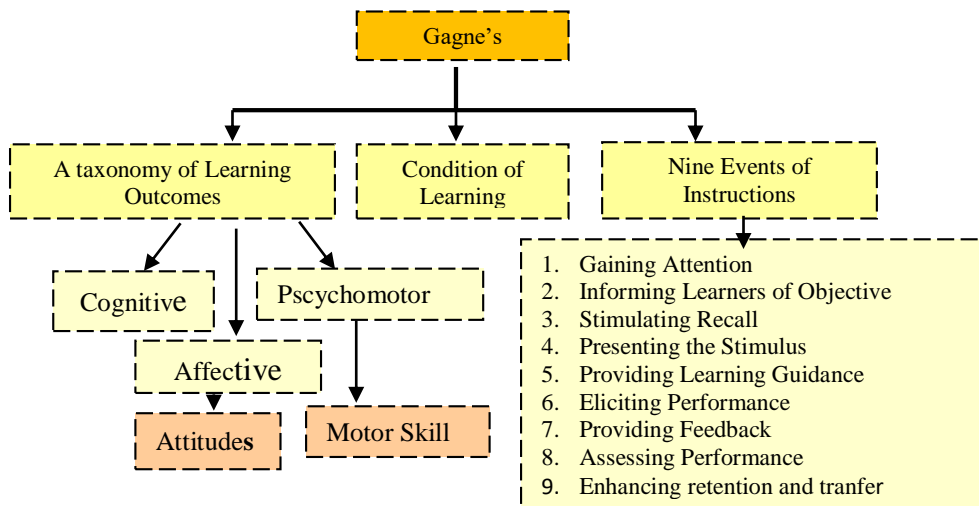


Figure 1. Gagne Teaching Theory

The issues of competency of the out-of-field teachers or non-optional teachers, although considered an isolated case, must be recognized as a real problem as it could give impacts to students education in classroom over the long run. With the current economic condition and education scenario which emphasizes on prudent spending, it is anticipated that more out-of-field or non-optional teachers will be used to teach subjects not in their field of study, in particular to rural areas.

Sharing of expertise and collaboration among teachers in the same committee could in some way resolve issues on competency, suitability, and changes in education system nowadays. It would not be easy for teachers to allow other teachers to be in their class to observe their teaching session. At least, this has not been the culture in Malaysia. However, to implement the Lesson Study in 2011, teachers are demanded to move away from their normal routine for the sake of changes and development.

Table 1 shows the statistics of out-of-field teachers in various fields in the primary and secondary school in Malaysia in the year 2016

Table 1. Number of Out-of-field Teacher

	Primary School	Sekolah Menengah
School	7772	2408
Student	2 685 403	2 188 525
Teacher	239 850	181978
Out-of-field teacher	4 558(1.9%)	3458(1.5%)

The competency of out-of-field teachers had always been an issue. Their capability in teaching subjects not in their field of study is questionable. Furthermore, their problem in mastering pedagogical skills and content knowledge of the subject is the main problems of out-of-field teachers. These teachers have to face the shortfalls and have to prepare and ready to teach the students to face the challenge of educational changes in the 21st century.

Muhammad Faizal A. Ghani and Julie Willian (2014), Wai Ming Cheung and Wing Yee Wong (2013) said about the teachers as the main contributors on the teachers' quality of teaching, methods used, students compatibility, incentives and time management. In fact, that teachers were one of the contributing factors towards students success.

Sven Schueler.et.al(2015) Siti Salwa(2014) Bransford, John(2004) Mohammad Reza Sarkar Arani,(2017) confirmed that it is important for teachers to have subject content and pedagogical knowledge in any discipline of knowledge and found that out-of-field teachers have exceptional capabilities to increase their understandings on the non-optional subject which is the Living Skill subject teacher. It is worth to note that positive attitude and dedication to improving their subject knowledge on teaching is considered as a pro-active action in increasing the competency of these out-of-field teachers.

Joao Pedro da Ponte, (2017), AoibhinnNi Shuilleabhain, (2016) concluded that the Lesson Study format as a suitable programme for new teachers. The new teachers' programme provided theoretical learning and practical training, learning professional research practice

and in addition, to review and expand their understanding of Mathematical concepts and process. Wood, (2000) had identified three learning concepts within the group members which were the conceptual changes towards a strong understanding of teaching approach derived from the concentrated attention given to the two variables on dimensional teachings. There were variations with regard to students' understanding and their approach towards learning and variations teachers teaching and learning experience and their teaching approach.

Rongjin Huang and Xue Han (2015) studied on ‘Parallel Lesson Study’ (PLS) where teachings based on activities or problems were carried out concurrently with teachings by novice teacher and teachers with less than ten years teaching experience. These teachers were teaching the same subject and topic. The PLS study showed that concurrent teaching may increase new teachers competency by observing other teachers teaching technique. Tantang Suratno (2016) stated that Lesson Studies is an approach to systematically change in improving teachers’ competency. Noemi Peña Traperero and Ángel I. Pérez Gómezjain (2016) concluded that learning is understood as a strategy for teacher training and skills, comprising shared relational sharing which focuses on how students learn, with the ultimate aim of improving teaching.

Aoibhinn Ni Shuilleabhain, (2016) said that learning studies have long been identified as effective teacher professional models. This research shows how teacher conversations become more focused on pedagogical elements that cannot be achieved without being sought and demonstrate the teaching experience of teachers during the research period. Kendyll Stansbury, Joy Zimmerman (2000) produces induction programs for beginner teachers who bring the ultimate goal of improving teacher teaching. He also suggested appointing mentors to novice teachers.

2. Methodology

Issues faced by out-of-field teachers is common in rural areas or schools where the number of teachers is not equivalent to the number of options to fulfill the shortfalls of teachers in teaching specified subjects in a particular school. This case was carried out in a qualitative manner to address competency problems faced by out-of-field teachers. It was stated that these cases happen in most schools around Malaysia but in a low percentage. This case study can be used as a review purposes on similar issues faced by the educational institution. The study was conducted at a school in a rural area in Rantau. The school has 60 teachers, 8 mathematics teachers, and 3 non-option mathematics teachers. The respondent is a novice out-of-field teacher and involves 75 students of three different races – Malay, Chinese and Indians from three classes of Form 1 and Form 2. The out-of-field teacher chosen in the case study was assigned in this school in September 2015 with a background in Agriculture Science Study and teaches Mathematics in Form 1.

The implementation of Lesson Study as an approach

Lesson Study is already being exposed in this school since 2015. Lesson Study had proven its success for decades in Japan. Lesson Study as part the Professional Learning Community (PLC) should be the platform to improve

teacher's competency. LS should be accepted and used as a paradigm shift as it provides changes in teachers approach, thinking process and skills to suit the changes and fast thinking process of the students. The lesson was done in three sessions. The first lesson was observed by SISC+ and during coaching session they

had decided to do Lesson Study with the committee of the Mathematics Panel in the school. The Lesson Study cycle had been implemented in the second and third session. Sustainability of Lesson Study with context to culture and lesson planning will improve teaching continuously (Sarkar Arani, 2017).



Figure 2. Lesson Study Cycle

The teacher had to undergo three phases of teaching. The first teaching was conducted in a class on 16/2/2016 by SISC+ followed by classes on 30/6/2016 and 15/8/2017.

Session 1(16/2/2016)

The first criticized lesson video had been done in the panel. The video recording was used during the video critique session in the first lesson. Video critique session was conducted after the first teaching session. All members of the Mathematical committee will provide their comments according to the instrument provided and were required to follow the necessary procedures in completing it.

Session 2(30/6/2016)

In the second session, Lesson Study approach was applied. They need to analyze the result from the first session and discuss a lesson plan collaboratively among the committee of the Mathematics panel. Video and audio recordings for each group activity were recorded throughout the teaching and learning process. A reflective session was done after the second session.

Session 3(15/8/2017)

The teacher was supervised by a coach that came a few times a year and a mentor who is the experienced teacher from the school. Another session of Lesson Study was done the following year. Transcripts for all three lessons were provided. The Transcript-based analysis was carried out to see any improvements in the learning process. The research must be conducted qualitatively to avoid any leakages in the findings and analysis.

3. Results and Discussion

Findings from observations, interviews, teacher teaching transcripts, and instruments such as observation forms used during video critic and class teaching observation. Explanation of the findings will be elaborated according to the instrument applied.

Comparison of reflection for session 2 and 3

Table 2 shows the comparison between session 2 and session 3. It is divided into a few themes.

Table 2: Comparison Reflection

Activity	Session 2	Session 3
Class Control	<ul style="list-style-type: none"> • Students was under control but less active • Well organized group work 	<ul style="list-style-type: none"> • Active pupils are in control • Pupils are actively involved • Fun learning
Strengthening the Concept	<ul style="list-style-type: none"> • Students see more of this topic • The concept is understood clearly • There is a KBAT element in this teaching 	<ul style="list-style-type: none"> • The concept is clearly stated but there are sometimes instances that are not relevant • Many questions that challenge the thinking in this teaching session
Question Technique	<ul style="list-style-type: none"> • Instructions are expressly stated • Questions submitted to conceptualists 	<ul style="list-style-type: none"> • Instructions are expressly stated • Questions submitted to conceptualists • Students are more confident to answer.
Learning aid	<ul style="list-style-type: none"> • Various tools are used either during group activities or during class activities • Students are interested in what they want to convey 	<ul style="list-style-type: none"> • Various auxiliary tools are used primarily on induction sets (Scale Pictures) • ABM is in line with the activity and can reinforce concept understanding

Activity	<ul style="list-style-type: none"> • Organized student activity • Various activities that attract students to engage with the use of ABM that stimulate pupils in activities 	<ul style="list-style-type: none"> • Pupils are active in the group • All members of the group provide cooperation • Attractive and organized activities
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There was a clear difference in the three teaching sessions and the most obvious is the teacher's confidence in conveying the Mathematics concept in her second and third classroom teaching. The main area of interest in this research is to increase the competency of the non-option teachers' especially knowledge based on content and pedagogical. Their knowledge is limited to what they have learned in school. With the increase in questioning technique skills, the students existing knowledge could be uncovered to further improve the concepts that students wish to learn. Somehow, there are always room for improvement, What is interesting here is the active involvement of the pupils in the activities and the teaching have become more meaningful.

Delivery of mathematics concept

Session 1

Teacher	Okay again, okay, this prime number is the number that can be divided by the number only or divided by 1. When divided by its number only or 1, it is not the balance. If it's divided by another number but not the rest, that's not the prime number. So 11 can only be divided by 11 and 1 only. If divided by 2, there is a remainder, right?
Student 1	Exist
Teacher	So this is the prime number. Ok if 13's, 13's can be divided by itself and also 1. Ok 17, is not it?
Student 2	Same
Teacher	Ok 19
Student 3	Same
Teacher	So 11, 13, 17 and 19 is the prime number. Ok number 41 to 50. So this is the prime number. This is the same. 23 and 29. Okay now my teacher wants to ask, everyone understands it's not a prime number.
Student 4	Understand

T1:P1:16.2.2016:231-238

(T-Trascript, P-session, date, number line)

Session 2

U	Okay now, the teachers have changed their textbooks, notebooks, pencil boxes, files, correction tape and pen to the symbols. Okay for textbooks. Teach me to change her to the letter T. Okay for your teacher's notebook to change to b. Okay for pencil box? p. Okay for the file, f. Okay for correction tape? Convert to C. For pen teacher change to letter P. Okay I want to ask you. Okay, the teacher asked Tanya T, b, p, f, C, P to represent what?
Khalil	Variable

T2:P2:30.6.2017:67-73

Session 3

Teacher	There, the back group gathered Rubhen. You can get up, then to know your idea, Rubhen.
Student 1	Different values
teacher	Okay, different values. Okay, almost right. Okay, again? There's no other group who wants to try. Ada? Sharzi Group? Okay, Elarasi?
Student 2	Size
Teacher	The size of what? Value him. Okay, answer given by Rubhen and Elarasi is almost right. Okay, is actually linear inequality, we want to compare two things that do not have the same value, so the meaning of equality. Inequality is comparing two objects that have different values. Okay, do not you understand? Okay, this is his concept, comparing two objects that have different values. Okay, teacher for example, ok in our everyday life, ok usually if we want to buy stuff near the supermarket, what do we usually do?

T2:P2:15.8.2017: 72-84

Building the concepts

Siham El-Kafafi, (2011) says cooperative learning is more encouraged as it requires students to become more active and able to build a strong concept resulting in increased conceptual knowledge and build more relationships. Teachers need to organize and unify their mathematical thinking through communication, communicating and mathematically thinking them simultaneously and clearly to peers, teachers, and others, analyzing and evaluating the mathematical thinking and strategies of others, using Mathematical language to express ideas.

Teachers should stress more on the concept discussed during the proses of teaching and learning. The teacher should relate the activities to the concept of prime number. And give more examples until it come into conclusion.

Teacher	Okay, right now there are 5 people. Near the teacher, there are 5 ping pong balls. The teacher is divided into 5 people. So how many people can you do?
All Students	1
Teacher	So there is no balance
Teacher	Okay, now 4 people can sit somewhere, stay here. Who wants to stay here? Now near here, there are 5 balls, right? The teacher wants to share with each other. So how many people can be
All Students	5
Teacher	Okay, so there's no remainder?
All Students	No
Teacher	No remainder, right?
Teacher	Okay, now teacher will add 2 more balls into this pencil box so how many inside this?

T1:P1:16.4.2016:99-109

Misconcept in mathematics

The out-of-field Mathematics teacher in this study shows that there are several parts in the lesson need guidances from more experienced teachers.

Teacher	Textbook. This textbook is more expensive than the notebook, So the word is more expensive shows the relationship between two things. So the relationship between the two objects is linear inequality. Okay, can you? Okay, another example. What else? Do you want more examples? In our daily lives, we can compare two things. Time, who said the past? What time? Ok besides that, we can also make a weight comparison. Okay, for example, we want to buy, what weight? We want to buy, we can compare between chicken, weight a chicken, a chicken with two fish. Okay, between the weight of a chicken with two fish which is heavier?
Student	Chicken

T3:P3:15.8.2017:93-103

To compare between a chicken and two fishes depends on their weight. The committee suggested to the teacher to use the actual scales in this activity. Students will find out which one is heavier by using the scaling tools. The methods are more student-centered and they can inquire the connection between the weight and the size. Sharing knowledge with more experienced teacher is needed in this case.

Based on the findings, the problem about content knowledge and pedagogical content knowledge can be solved by working collaboratively with more experienced committee members so that the competence of the out-of field Mathematics teacher can be improved drastically.

Effect of learning study approach

Lesson Study is not new in this school. LS was conducted since 2015. The teacher that involve in this case study started her profession in this school in September 2015. She had observed several session of LS among the Mathematical Panel.

The first lesson was done with SISC + on February 16, 2016. The video recording was discussed with the Mathematical committee teacher in a video critic session. Based on that reflection, this teacher has been placed under the supervision of an experienced teacher. After two teaching sessions using the Lesson Study process a comparison was done between the two lesson(refer Table 1). The relection showed the improvement on skills and the level of confident to deliver the knowledge to the students.. Lesson Sytudy had a lot of impact on this teacher, especially in terms of improved classroom control, the technique of questioning has risen slightly even though there is still room for future improvement.

4. Conclusion

What is important is the commitment of all teachers involved in this process. More experienced teachers need to work together with the novice teacher, to ensure the understanding of the concepts of our students. The issue of out-of-field teachers which have been discussed should be resolved appropriately. The Lesson Study approach is the most appropriate approach to address this problem. These teachers can also be given courses continuously (CPD) so that knowledge and pedagogical content knowledge about the subject will increase

The credibility of school managers to ensure that teachers there is enough teacher at the beginning of their schooling. Mathematics Panel should arrange training program for the novice teacher especially out-of-field teacher. At present, teachers need to have two major options. The agreement between the other teachers and the administrators should be built upon as the students do not continue to be victims of this situation.

Actions from the school administrators to ensure that all teachers are adequately qualified by the field. The school administrator should prepare for any possibility. The issue of insufficiency of this teacher has been recognized by the administrator. Careful and systematic planning should be made to ensure that the selected teacher most suitable for the subject.

. The creativity of the administrator is needed to ensure that all students are learning on the first day of schooling. At the school level, administrators can get the cooperation of the subject committee concerned. A collaborative lesson study has proven to improve the competence of these out-of-field teachers

The District Education Office (PPD) and the State Education Department (JPN) should look at the issues at the district and state levels. Continuous courses need to be made to ensure that these teachers are trained in terms of strengthening knowledge of content and knowledge of pedagogical content that can be held at the district and state levels. MOE should also consider the need for teachers to have two or three specializations to meet the shortage that occurs each year. Teachers need to be versatile, not just to one degree. At the same time, the KPM needs to think about reducing the burdens of teachers, especially those involving clerical work. Teachers should focus more on education in schools so students can compete internationally.

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