Study Note

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Teaching Method in Mathematics Education: Neediness of the Paradigm Shift to Structured Problem-Solving Approach at Junior High School in Burkina Faso

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Abstract

Burkina School system is composed of Basic, Secondary, and Higher Education. Students' academic performance in Mathematics at all levels of this schooling are affected by many factors. One of these factors is the way of teaching used in junior high school. That is why this paper is advocating a shift in the pedagogical teaching in Mathematics. Regarding the weakness of the lecture and other teaching pedagogy in Mathematics, we consider Japanese Structured Problem-Solving (SPS) approach as a better alternative. The SPS approach is based on whole-class discussions with various solutions by students. It is a method that helps students to be more interactive and get intellectually engaged with their pair. The choice of Japanese SPS is based on my experience in Japan and also on several research studies that confirmed its effectiveness. Some theories in this study are constructivism and social constructivism because they viewed learning as discussion with argumentation and Interactions. We suggested the use of SPS in Burkina Faso junior high school to raise students' Mathematics performance.

Keywords: Teaching method, Structured Problem Solving, Whole class discussion, Proactive learning

1. Introduction

Burkina Faso's schooling system is composed of three levels. For general Education, pupils spend six years in primary school and four years in junior high school, which is 10 years of "Basic School", before they move to secondary school where they spend three years, which is usually defined as an upper secondary school in another country. Primary and junior high schools are compulsory in Burkina Faso. The last level of the educational system includes University education and the number of years spent is in function on the type of Course. However, the Government of Burkina Faso has taken like other countries the Education as a priority to obtain Education-for-All and to accelerate economic growth. As quote Joseph Ki Zerbo[1] "Education is the mainframe software that programs the future of societies".

During Burkina Faso Independence, several educational reforms have been made to improve the quality of Education. One of these reforms, Ten-Year Basic Education Development Plan (Plan Décennal de Développement de l'Éducation de Base: PDDEB: 2001-2011), helped to improve the gross enrollment rate of primary school from about 40% in 2001 to about 70% in 2011, but the quality is still low. In 2011, the government developed the Strategic Development Program for Basic Education (Programme de

[1] Joseph Ki-Zerbo (1922-2006) was one of those who worked to raise African consciousness.

Développement Stratégique de l'Éducation de Base: PDSEB) to give global access to primary education and the improvement of the education quality at all levels. The result shows an increasement in the enrollment rate in primary education; 78,85% in 2018. However, some improvement of Education quality is observed in the quality in primary school, but in junior high it always still to be improved. According to Assessment of Educational Achievement (Évaluation des Acquis Scolaires: EAS), 92% of students assessed in junior high school do not reach sufficient competency in Mathematics (MENAPLN, 2017)

In 2007, adopting the education policy letter (the Decree 2001-179/PRES/PM/MBA), the government opted for a revision of curricula according to the Competency-Based Approach, abandoning the pedagogy of Objectives (Pédagogie Par le Objectifs: PPO). Since then, the competency-based approach has been in its initiation phase and in March 2013, the country embarked on a vast curriculum reform project. After several years of attempts to reform curricula according to the Competency-Based Approach (Approach Par les Compétences: APC), a decision was taken to abandon it in favor of an eclectic approach. This new approach is called the Integrative Pedagogical Approach (Approche Pédagogique Integrative: API) and is based on the socio-constructivism that induces the learning paradigm. Socio-constructivism allows learners to confront ideas in the teaching-learning process through socio-cognitive conflict and thus to interact to understand, act and master. The API based on socio-constructivism integrates the APC, PPO (contents, methods, supports), text pedagogy (Pédagogie du Texte: PdT), and the Activity-Student-Experienced-Improvisation/Plan-Do-See-Improve (ASEI/PDSI) approach.

Since the beginning of the 2015/2016 school year, the Minister of Education has started the experimentation of its new API curriculum reform (OPERA, 2015). This is to improve the quality of education by focusing on student activities in the teaching-learning process. It is in this sense that Burkina joined the second phase of the SEMASE project that aims to improve the quality of teaching and learning, especially in mathematics and science. This project using ASEI/PDSI approach had a good impact on student performance and teachers' teaching by changing the practice to learner-centered approach. That is why it is included in the guidelines for Basic Education Curriculum (COC) of March 2015 as one of the approaches that contribute to enriching the API (JICA & MENA, 2015). Nowadays in Burkina Faso, ASEI/PDSI is used in primary schools during mathematics teaching. Unfortunately, this approach is mainly for primary school, is not used in junior high school.

Many teachers in junior high school have difficulties making teaching more student-centered. Pierre & Michel (2009) show in their research that some teachers continued to use ineffective teaching methods during classroom practice. Therefore, these teachers lacked appropriate instructional strategies for teaching and preferred to use lecture methods. According to Douamba (2015), teachers practice transmissive teaching in primary school and junior high school. Indeed, at the time of his intervention, out of 24 secondary school teachers, 14 teachers were simply lecturing instead of active teaching method. This traditional method caused poor academic performance in Mathematics because it is considered a lack of effective interactive approach.

In Burkina Faso, students face many difficulties and do not perform well in this subject (Kone, 2006; Traoré, 2007). However, many factors cause the poor performance of students in Mathematics and some studies accuse teaching methods used by teachers during classroom practice.

One vision of the education orientation law was to have a continuum between primary and junior high school in mathematics teaching. However, in practice, it is not observed. This may be also one of the weaknesses of the effectiveness of student performance. Based on the low performance, the teaching methods, the volunteer of government to have a continuity in the practice in basic education and aspiring the paradigm of the new curriculum in implementation in the country. Therefore, it is important to review some teaching methods in mathematics education and theories that allow a good teaching method based on students centered learning and the need for a shift of paradigm.

2. Teaching methods In Mathematics Education

The teaching methods describe the path taken by the teacher to further his/her teaching and to achieve

a goal. They play a role in students' Achievements in all subjects. Teachers to succeed in their mission must know the teaching/learning methods and techniques related to the discipline. In other words, the method is the way to bring the learner to determining to learn.

Pedagogy of mathematics includes the application of different teaching methods divided into two groups: Modern and Traditional Teaching Methods. The traditional way that education was delivered was through recitation and memorization techniques, whereas the modern way of doing things involves interactive methods. Masanja (2002) highlights that the 20th-century approach to mathematics resulted in more developed mathematics language, new powerful mathematics tools, and inspired new application areas that resulted in tremendous discoveries in other applied sciences.

Modern mathematics teaching influences the pupils' learning achievement. Indeed, a new teaching methodology on mathematics achievement towards mathematics attitude, achievement motivation has a positive effect on pupils' understanding. Damrongpanit (2019), in his paper, shows that Attitude towards mathematics is the most important factor in explaining the academic achievement of individual students.

Different teaching methods are employed in Mathematics Education at Junior high schools in Burkina Faso. Some methods recommended are Discovery, Rediscover, Experimental, Interrogative, Intuitive Observation, which are considered as active methods. Using effectively one of these methods during classroom practice, teachers can stimulate the learner's activity by making a large part of observation and manipulation. However, most of the teachers use the lecture method during Mathematics education.

The lecture method is a process of teaching in which students listen and take notes following a teacher's presentation of facts that he or she has planned. It is the oldest method and is qualified as a traditional method of teaching. According to Marmah (2014), this traditional method is a teaching method where a teacher is the central focus of information transfer. Indeed, during the lesson, teachers will stand before a class and present information for the students to learn. Sometimes, they will write on a board to provide visuals for students. Students are expected to take notes while listening. That is why Brown (1994) supposed that teaching mathematics through lectures may be an easy instructional method for teachers.

However, some researcher asserts that the traditional lecture approach for teaching is ineffective compared to active methods of teaching and learning (Jungst et al., 2003; Marbach-Ad et al., 2001). During the lecture method process teacher shows and tells learners what to do instead of allowing them to discover by themselves. In lectures, students are often passive because there is no mechanism to ensure that they are intellectually engaged with the material. Lectures fail to provide instructors with feedback about the extent of student learning.

3. Theories of Teaching and learning

Several theories are used in teaching and learning and each of them has its vision leading to a pedagogical approach. The choice of constructivism and social constructivism is based on the fact that Burkina Faso with its educational reform prioritizes these theories. Also, this learner-centered theory can promote a more participatory learning process for the student.

Originally developed by Jean Piaget and Jerome Bruner, a Constructivism Approach is a learner-centered approach that emphasizes the importance of individuals actively constructing their knowledge and understanding through guidance from the teacher (Lessani et al, 2016). During the teaching-learning process the student builds up his knowledge by his action.

According to this theory, the learner uses previous knowledge as a means of representation, calculation, and reflection on his action. In other words, what an individual learns depends on what he knows. However, socio-constructivists are critical of certain points such as the child being self-centered and also the fact that the development of the child seems to be much more linked to a biological phenomenon than to a learning phenomenon.

On the other hand, Vygotsky (1985) was the first to lay the foundations of Social Constructivism theory, which opposes an individualistic view of learning. For him, learning is to elaborate one's own knowledge by necessarily passing through the phase of social interaction with others and this at any age. In other words, Socio-constructivism considers the fact that learning is an active process and that the development of the individual can only take place in a network of

exchanges with others. Moreover, knowledge, to be learned, must be put into a situation so that the learner's knowledge can interact with each other.

In many countries, Mathematics is one of the major subjects in the school curriculum. It plays an important several fields of study. Its learning means-built mathematics by himself/herself with their pair. Furthermore, the fact to know mathematics concepts definitions, theorems does not mean learn mathematics. we should construct them through our own intellectual efforts with the peer, according to Sfard (2000) to the basic issue in mathematics teaching and learning is to find ways to organize the classroom so as to motivate the students to participate in the lessons and to make them active learners of mathematics, without losing focus on content. One of the methods that can facilitate this way of teaching can be Japanese Structured Problem-Solving (SPS) approach.

4. Japanese Teaching Method of Mathematics: Use of SPS Approach

4.1. Background of SPS

The Japanese education system is receiving much attention for the performance of its students in mathematics and science. Indeed, the way used by Japanese teachers for teaching is highly effective to students. Since many reforms have been done in the teaching and learning mathematics. However, the major reform occurred during the 1970 and 1980 (Takahashi, 2000, pp.15-21), and transforming teacher-centered instruction to student-centered that focuses on students' active participation during mathematics activities was one of the major aspects.

According to Izumi (2018), SPS goes hand in hand with student-centered teaching and learning. In other words, for a good application of student-centered, Japanese SPS is well come. This method of teaching is the key to Japanese students' results and focuses on Student-centered especially in the teaching of problem-solving. The phrase SPS is used to describe Japanese Mathematics teaching by Stigler & Hiebert (1999) in the book the Teaching Gap.

4.2. Descriptions of Japanese SPS

SPS approach does not show how to solve the problem but the way the teacher uses during classroom activity to facilitate student-centered learning. Usually, problem-solving focuses on the process to solve a problem but in Japan, Problem-solving is used in the lesson to focus on developing problem skills, strategies and also throughout the entire curriculum to develop mathematics concepts, skills and procedures (Ssesanga, 2021).

SPS is the way to learn Mathematical thinking and to become independent thinkers or intellectually independent human beings. Takahashi (2006) declared SPS approach is designed to create interest in mathematics and stimulate creative mathematical activity through students' collaborative work. For Isoda & Katgiri (2012), the basic principle of this approach is to nurture students' learning by or for themselves.

According to Stigler & Hiebert (1997), This approach is an instructional approach for mathematics lessons in Japan. It has been identified as one of the effective instructions of mathematics teaching by the TIMSS videotape study. Stigler & Hiebert in 1990 tried to explain the Japanese teaching approach as follows. Teachers start by presenting students with mathematics problem what has not been learned by students. Then students work individually or in a small group to devise the solution. After students present their solution (more than 1) follow by whole-

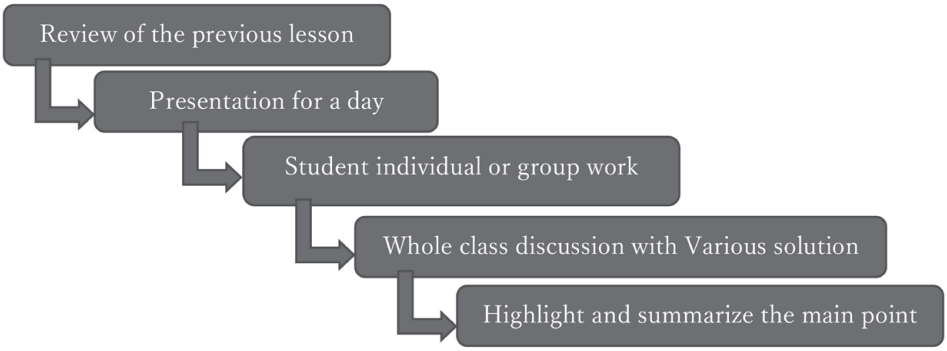

Figure 1. Structure of Japanese mathematics lesson.

class discussion through the problem and different solutions. Students give what they learn during the lesson. According to Stigler & Hiebert (1999, pp.79-80) the Japanese mathematics lesson is structured as in Figure 1.

4.3 Procedure of SPS

This section comprises four steps that are very crucial in the Japanese SPS approach. Before putting the SPS method into practice Teachers must consider this section.

Presentation of the problem (Hatsumon)

This first step is called "Hatsumon" in Japanese. In this step, the teacher organizes previously learned knowledge by making clear what previous knowledge can be used for solving the new problem. Then teacher carefully, introduce today's problem by encouraging the use of previous knowledge. Generally, the problem is a single problem to achieve a single goal in a topic by omitting some conditions to stimulate the students' interest.

Solving the problem (Kikanshido)

"Kikanshido" is actually a word for "instructing while walking around desks of students," but here we use it to represent the section for individual/group work of students. This is the step for students to think about the problem. Teachers give instruction at student work. Base on teachers' Instruction, students work individually or in a group during the problem-solving process. During group discussion, students explain their methods with their pair by using mathematical sentences or diagrams. Students are encouraged to find many ways to solve the problem by thinking about an expression, Understanding the problem, and solving the problem individually or in a group. The teacher encourages and notes the different solutions.

Whole Discussion with Various solutions (Neriage)

Whole-class discussion after individual/group work is called "Neriage" in Japanese. This part can be qualified as the core of SPS. According to Asami-Johnson (2015), an SPS approach aims to have a whole-class discussion with various solutions. In this step, the teacher asks students to present their solutions and explain the method used to solve the problem on the board. More than one solution is presented including an incorrect answer or solution, depending on the importance for the class. This can help students to understand other solutions by identifying similar ideas and talking about what was impressive about those ideas. The basic form of the Neriage process can be categorized as Table 1 (Fernandez & Yoshida, 2004).

Highlight and summary (Matome)

Teachers ask to summarize and reflect on solutions and learning. Teachers put out what students learn during the lesson.

4.4. Effects of SPS on teaching and learning

SPS is an approach that allows students to think and find the solution on their own. According to Fujii (2014), the Math Counts 2017, one teacher who has been using SPS for one year found out that this approach helps to build students' confidence. He found that if once students understand they can solve the problem without the teacher showing them a specific technique. They try to find solutions and are keen to know what other students did. This approach can consider a helpful approach to better have student-centered learning in the sense that students have the most active role when it comes to learning and have the freedom to think by themselves.

Table 1. Basic for of Neriage

1-write the idea on the blackboard	2-Present the ideas (are there students who did it differently)	3-Ask if student has anything to add to the idea on blackboard	4-student can ask question about their friend answer	5-which one of the presented are similar to your
4-What do you think are the good points about your friend answer that you also thought about?	5-Let's compare your own idea with your friend's idea?	6-Why did you think so?	7-Which one of the solutions do you think it is better?	8-Which one of solution is better than others?

Note: Created by the author based on Appendix C (Fernandez & Yoshida, 2004)

4.5. SPS and Lesson study

SPS in japan develops over time. Japanese teachers improve their teaching process by developing a specific plan for a lesson during collaboration work. This practice of collaboration is called lesson study in Japanese Jyugyou Kenkyuu. According to Asami-Johnson (2015), every elementary school and most junior high school in Japan has its lesson study teams within the school. Through this practice, teachers get an idea for different teaching strategies to develop their own one.

SPS is the result of lesson study in the 20s century (Isoda et al., 2007; Isoda & Nakamura, 2010). During lesson study activity in Mathematics, the teaching approach the most used is SPS (Hino, 2007).

4.6. Use of SPS in other countries

Many types of research have been done on the Japanese SPS approach to examine its impacts on teaching and learning like Kenya, South Africa (Kigamba, et al., 2021; Mandina & Ochonogor, 2018). Starting with Japan, some researchers have used this approach as a teaching methodology to strengthen the teaching development in those countries through lesson study. Despite the differences, we can find among these countries and Burkina Faso, we have some similarities in each of the country contexts like the mathematics objectives and knowledge that learners are expected to know and understand. The effects of the use of SPS in their contexts are specific to each country.

Kigamba et al. (2021) investigated the effectiveness of teaching through Problem Solving on student's mathematics attitude and achievement in secondary school in Kenya. Considering the low performance of students in mathematics, this research had for aim to assess student attitudes towards mathematics when taught through a problem-solving approach and those taught using traditional strategies in public school. Using a quasi-experimental of four-group design, Kigamba et al. reports that there is a significant improvement in mathematics achievement and change in student attitudes towards Mathematics. This emphasized the positive effects of problem-solving in mathematics achievement and positive attitude which can be classified as an effective classroom practice (Kigamba et al., 2021).

Before Kigamba's study, another research was conducted by Mandina & Ochonogor (2018) in southern Africa. The study aimed to investigate the effect of the SPS instructional strategies on advanced level chemistry learners' achievement. The study employed a quasi-experimental design with a non-equivalent control group approach consisting of pre- and post-test measures. The results of this study indicated that the participants in experimental schools performed significantly better than participants in control schools on certain aspects of problem-solving performance. However, semi-structured interviews, focus group discussions and classroom observations revealed that participants rated problem-solving instruction highly as an effective teaching strategy to enhance the problem-solving skills of learners in chemistry.

These studies put in exergue the effectiveness of SPS in teaching/learning and student's performance according to its applicability in different contexts. Therefore, if SPS had impacted student's performance in other countries, maybe it possible to have the same results for Burkina Faso junior high school students.

4. Recommendation

The various literature review confirmed, the effectiveness of the SPS approach in improving the interest and understanding of students in learning content. Therefore, it is suggested that research studies using the SPS approach in Burkina Faso's junior high school should be conducted in order to assert the veracity of its effectiveness in mathematics education.

It is also important to carry out studies using SPS approach instruction to teach other subjects at junior high school in Burkina Faso. This is necessary because almost all Studies carried out in other countries on the SPS approach were at a higher level.

5. Conclusion

Based on the above discussion, it is clear that there are some teaching pedagogies in Mathematics that engages student active participation in the class. However, the SPS approach could be a better one based on various reviewed studies that SPS is a teaching pedagogy that engages students in active learning through the use of whole-class discussion with various solutions and group work.

This pedagogical teaching is similar to ASEI/PDSI approach used in many African countries by JICA. It emphasizes student-centered. However, these approaches are still very new to many African schools and teachers in various continents as well as in Burkina Faso.

Furthermore, many studies highlight the effectiveness of SPS approach in the teaching and learning of mathematics. Also, its applicability in different Countries shows that students succeed in better achievements compared to their previous mathematics performances. However, we can think that the Japanese SPS will may have an Impact on students learning of mathematics.

Reference

Asami-Johansson, Y. (2015). Designing Mathematics Lessons Using Japanese Problem-Solving Oriented Lesson Structure. A Swedish Case Study (Dissertation). *Department of Mathematics Linkoping University*. pp.10-25. Retrieved on November 30, 2021 from https://www.researchgate.net/publication/327867203_Designing_Mathematics_Lessons_Using_Japanese_Problem_Solving_Oriented_Lesson_Structure_-_A_Swedish_case_study

Brown, T. (1994). Describing the mathematics, you are part of: A post structuralist account of mathematical learning, London: UK. Falmer Press.

Damrongpanit, S. (2019). From modern teaching to mathematics achievement: The mediating role of mathematics attitude, achievement motivation, and self-efficacy. European Journal of Educational Research, Vol.8(3), pp.713-727. Retrieved on September 25, 2021 from https://doi.org/10.12973/eu-jer.8.3.713.

Douamba, K. (2015). *Formation à l'enseignement des mathématiques au Burkina Faso : étude de pratiques d'enseignement de stagiaires sur la fraction dans les classes de CM2 et de sixième* (Dissertation), Québec, Canada.

Fernandez, C. & Yoshida, M. (2004). *Lesson study: A Japanese Approach to Improving Mathematics Teaching and Learning*, Routledge. 276pp.

Fujii, T. (2014). Implementing Japanese lesson study in foreign countries: Misconceptions revealed. Mathematics Teacher Education and Development, Vol.16(1), pp.65-83. Retrieved on November 30, 2021 from https://mted.merga.net.au/index.php/mted/article/view/206/196

Hino, K. (2007). Toward the problem-centred classroom: trends in mathematical problem solving in Japan. *ZDM–Mathematics Education*, Vol.39, pp.503-514.

Isoda, M., & Katagiri, S. (2012). Mathematical thinking: How to develop it in the classroom. Singapor: World Scientific Retrieved on November 16, 2021 from https://www.criced.tsukuba.ac.jp/math/apec/ICME12/Lesson_Study_set/MATHEMATICAL%20THINKING%20(c)World%20Scientific/MathematicalThinking_preface(c)WorldScientific.pdf

Isoda, M. & Nakamura, T, eds. (2010). Mathematics Education Theories for Lesson Study: Problem Solving Approach and the Curriculum through Extension and Integration, *Journal of Japan Society of Mathematical Education*, Vol.92(11), pp.1-158.

Isoda, M., Stephens, M., Ohara, Y. & Miyakawa, T., (2007). *Japanese Lesson Study in Mathematics: Its Impact, Diversity and Potential for Educational Improvement*. Singapore: World Scientific. 280pp.

Izumi P.H. (2018). The Japanese Teaching Methods of Mathematics. Retrieved on March 21, 2021, from https://izumiph.medium.com/the-japanese-teaching-methods-of-mathematics-dcf13182ddc7

JICA & MENA (2015). *Compte rendu projet d'appui à la formation continue des enseignants en matière de sciences et mathématiques à l'école primaire phase II: rapport conjoint de l'évaluation Finale*.

Jungst, S., Licklider, B. & Wiersema, J. (2003). Providing support for faculty who wish to shift to a learning-centered paradigm in their higher education classrooms. *The Journal of Scholarship of Teaching and Learning*, Vol.3, pp.69-81.

Kone, N. (2006). *Echec en mathématiques dans les classes de 6eme: Approche de quelque causes au CM2 et en 6eme dans la commune de Koudougou* (Mémoire inédit de fin de formation d'inspecteur de l'enseignement primaire) (Dissertation), Université de Koudougou Burkina Faso.

Lessani, A., Yunus, A.S. Md, Bakar, K.A. & Khameneh, A.Z. (2016), Comparison of Learning Theories in Mathematics Teaching Methods, 21st Century Academic Forum, *Fourth 21st CAF Conference in Harvard, Boston, Massachusetts, USA, March 2016*, Vol.9(1), pp.165-174. Retrieved on November 30, 2021 from https://www.21caf.org/uploads/1/3/5/2

/13527682/14hrd-4111_lessani.pdf

Kigamba, J.G., Wanjiru, B.N. and Miheso-O'Connor, M. (2021). Effects of Teaching through Problem-Solving on Students Mathematics Attitude Achievement in Secondary Schools in Murang'a County, Kenya. Journal of Research & Method in Education, Vol.11, pp.50-56. Retrieved on November 23, 2021 from https://www.iosrjournals.org/iosr-jrme/papers/Vol-11%20Issue-1/Ser-2/F1101025056.pdf

Mandina, S. & Ochonogor, C. (2018). Comparative Effect of Two Problem-solving Instructional Strategies on Students' Achievement in Stoichiometry. *EURASIA Journal of Mathematics, Science and Technology Education*, Vol.14(12), pp.1-9. Retrieved on November 13, 2021 from https://www.ejmste.com/download/comparative-effect-of-two-problem-solving-instructional-strategies-on-students-achievement-in-5585.pdf

Marbach-Ad, G., Seal, O. & Sokolove, P. (2001). Student attitudes and recommendations on active learning. Journal of College Science Teaching, Vol.30, pp.434-438.

Masanja, V.G. (2002). Mathematics and Other Disciplines: The Impact of Modern Mathematics in Other Disciplines. University of Dares Salaam Mathematics Department. Retrieved on November 30, 2021 from http://users.math.uoc.gr/~ictm2/Proceedings/invMas.pdf

MENAPLN, (2017). *Rapport sur l'évaluation des acquis des élevés*.

OPERA (2015). Observation des Pratiques Enseignantes dans leur Rapport avec les apprentissages des élèves: Recherche Opera dans 45 écoles du Burkina Faso 2013-2014 Rapport décembre 2015.

Pierre, K. & Michel, N.O. (2009). Exploring Educational Quality through Classroom Practices: A Study in Selected Primary School Classes in Burkina Faso. *CICE Hiroshima University, Journal of International Cooperation in Education*, Vol.12(1), pp.51-69.

Ssesanga, C.N. (2021). *Research Thesis Report of the In-Service Teacher Training Program for Foreign Teachers: The Impact of Structured Problem-Solving Approach on Students Academic Performance and Concept Acquisition in the Teaching and learning of Mathematics in Elementary Schools. A Case of japan*. Naruto University of Education.

Sfard, A. (2000). On Reform Movement and the Limits of Mathematical Discourse. *Mathematical thinking and learning*, Vol.2(3), pp.157-189.

Stigler, J.W. & Hiebert, J. (1997). Understanding and improving mathematics instruction: An overview of the TIMSS video study. Phi Delta Kappan, Vol.79(1), pp.14-21.

Stigler, J.W. & Hiebert, J. (1999). *The teaching Gap. Best Ideas from the world's Teachers for Improving Education in Classroom*. New York: The Free Press. 224pp.

Takahashi, A. (2000). Current Trends and Issues in Lesson Study in Japan and the United States. Journal of Japan Society of Mathematics Education, Vol.82(12), pp.15-21.

Takahashi, A. (2006). Characteristics of Japanese Mathematics Lessons. *Tsukuba Journal of Education Study in mathematics*. Vol.25, pp.34-39.

Traoré, K. (2007). *Des mathématiques chez les paysans*. Montréal: éditions Bandes Dicdactiques-Matheses, (Dissertation), Université du Québec Montréal, Canada.

Marmah, A.A. (2014). STUDENTS' PERCEPTION ABOUT THE LECTURE AS A METHOD OF TEACHING IN TERTIARY INSTITUTIONS. VIEWS OF STUDENTS FROM COLLEGE OF TECHNOLOGY EDUCTION, KUMASI (COLTEK). *International Journal of Education and Research*, Vol.2(6), pp.601-612.

Vygotsky, L.S. (1985). *Pensee et langage (trad.F.seve)*. Paris: Edition Sociales (1ere edition en russe 1934).