Novice and Experienced Math-ematics Teachers' Decision Mak-ing Process in Designing Math Problem

by Prosiding 3

Submission date: 29-Dec-2022 02:56PM (UTC+0700)
Submission ID: 1987244449
File name: Prosiding_3.pdf (1.43M)
Word count: 4224
Character count: 23821

JOURNAL OF PHYSICS:
CONFERENCE SERIES

IOP Publishing

IOP CONFERENCE SERIES TEAM

Anete Ashton
Publisher, Conference Series

Anete Ashton is the Publisher for the proceedings programme at IOP Publishing. With an MA in linguistics and over ten years' experience in proceedings publication she has developed and grown the IOP Conference Series and has commissioned some of the most prestigious conferences in physics and related subject areas.

E-mail Anete Ashton
Tel +44 (0)117 930 1280

Steph Gill
Conference Publishing Co-ordinator

Steph looks after the day-to-day operations of IOP Conference Series, including commissioning content and liaising with conference organizers/editors. Steph joined the Conference Series team after eight years in the Production department. She has a degree in Media and Film from the University of Winchester.

E-mail Steph Gill
Tel +44 (0)117 930 1252

Kayleigh Parsons
Editorial Assistant, Conference Series

Kayleigh works three days a week with the operations of IOP Conference Series, including system organisation and point of contact for organisers/editors. Kayleigh joined IOP Publishing back in 2008 working in Publishing, she then took 18 months off to travel but re-joined the company in 2015. Kayleigh then joined the Conference Series team in 2018.

E-mail Kayleigh Parsons
Tel +44 (0)117 930 1252 or 1280

Svetlana Kalinina
Technical Production Editor

Svetlana Kalinina is a Production Editor who coordinates the online and print production of proceedings for IOP Conference Series journals. She joined IOP in January 2002. She has a degree in genetics from St.Petersburg State University.

TABLE OF CONTENTS

Journal of Physics: Conference Series
Volume 1464

Digital literacy for children based on steam in family education
I Purnamasari, I Khasanah and S Wahyuni

Statistical reasoning levels and error analysis of prospective mathematics teacher students
A Rozak and Nurwiani

Traffic Light Regulatory System Based on Fuzzy Algorithm Using Microcontroller
Abdul Latif and Prisma Megantoro

The Prototype of Automatic Water Sprinkle with Soil Moisture Sensor Based on ATMega 8535
Abdul Latif and Prisma Megantoro

1
The potential of discovery learning models to empower students' critical thinking skills
Muhammad Minan Chusni, Sulistyo Saputro, Suranto and Sentot Budi Rahardjo

The Use of ICT in Teaching: Lecturers' Perceptions, Obstacles, and Expectations
Y A Bansa and Asrini

Collaborative Learning Group Investigation Type Based on Lesson Study in MI Al-Ikhsan Kota Jambi
M Louisiana, S Nasyariah and P Haerul

6
Developing Electronic Learning Media Using 3d Pageflip On The Material Of Classification Of Living Thingsfor the 7th Grade Students Of Junior High School
Upik Yelianti, E. Anggereini and M. K. Irfan

Primary Valuation of Coastal Flood Impact to Fish Farming in Brebes, Central Java
Anang Widhi Nirwansyah and Suwarsito

6
Blended Learning Strategy on Disaster Mitigation Learning to Improve Character Care of The Environment
Mustolikh, Dasim Budimansyah, Darsiharjo and Encep Syarief Nurdin

Bioprospects From Clamshell Of Geloina Sp As Calcium Substitution Material for Poultry In Indonesia
Tumisem and Satriya Ramadhan

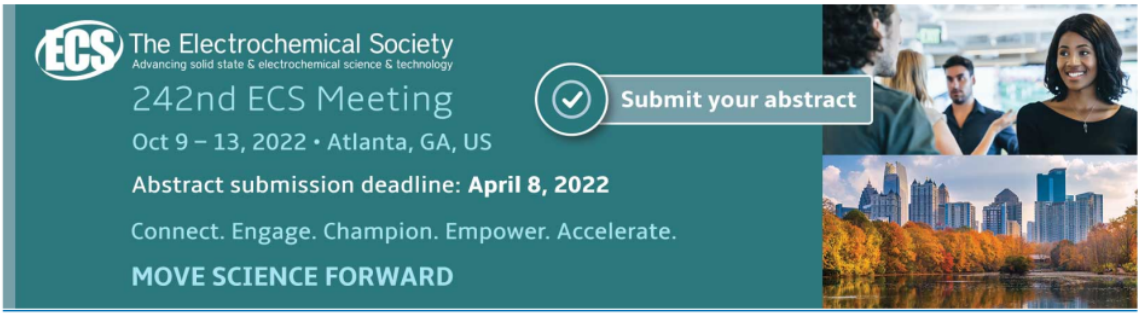
Optimization of Floating Tablet Containing Glibenclamide Using Simplex Lattice Design
Agus Siswanto, Reza Aditya Al Iman, Erza Genatrika, Asmiyenti Djaliasrin Djalil and Iwangga Afif Gawa Panulung

Disaster mitigation tutorial based on android
Hindayati Mustafidah, Erwin Febriyanto, Suwarsito and Sriyanto Sriyanto

Effect of Postharvest Maturation Storage at Different Age Fruit on Chemical Characters Fruit and Seed of Wood-apple (Feronia limonia (L.) Swingle)
Endang Dewi Murrinie, Prapto Yudono, Azis Purwantoro and Endang Sulistyaningsih

Gesture of slow learner student in mathematical Communication
A Sovia and T Herman

Novice and Experienced Mathematics Teachers' Decision Making Process in Designing Math Problem



Novice and Experienced Mathematics Teachers' Decision Making Process in Designing Math Problem

Wasilatul Murtafiah[1], Cholis Sa'dijah[2], Tjang Daniel Chandra[2], Susiswo[2], Moh. Zayyadi[3]

[1]Mathematics Education Study Program, Faculty of Teacher Training and Education Universitas PGRI Madiun, Jalan Setiabudi No. 85 Madiun Indonesia
[2]Mathematics Education Study Program, Faculty of Mathematics and Science Universitas Negeri Malang, Jalan Semarang No. 5, Malang, Indonesia
[3]Mathematics Education Study Program, Faculty of Teacher Training and Education Universitas Madura, Jalan Panglegur KM 3,5, Pamekasan, Indonesia

*Corresponding author: wasila.mathedu@unipma.ac.id

Abstract. This study aims to explore the decision-making process of novice and experienced teachers in designing mathematics problems. Data collection of decision-making process is done by interview based on the results of observations of problems designed by the teacher and the framework that includes the stage of generating ideas, clarifying ideas and assessing the reasonableness of ideas in creating mathematics problems. The findings show that in generating ideas, novice teachers are still less creative than experienced teachers. In clarifying ideas, experienced teachers always associate problem with real contexts close to students, while novice teachers create problems based on contexts that are still less associated to students' real life. When assessing the reasonableness of ideas, novice and experienced teachers alike have the confidence that the problems are designed according to students' abilities in which experienced teachers claimed that the problems also supported by students experiences.

1. Introduction

One of teacher's thinking processes is when making a decision. One of the teacher's thinking skills is used to make decisions in learning [1]. Decision making in learning is the most essential activity in learning process [2]. The quality of learning implemented by teacher is highly depends on teacher's thinking process in making decisions. Decision making in learning is teacher's thinking process in determining activities from a series of alternatives while designing and implementing learning. It is also known as a thinking process that starts from generating, clarifying and assessing the fairness of ideas [3].

One of the decisions made by teacher in designing and implementing mathematics learning is decisions on assignments. Tasks are the most dominant thing in planning and implementing learning [2]. Most teachers focus on planning assignments, while many interactive teachings focus on the smooth execution of tasks as planned. Mathematics assignments influence students' thinking and understanding of mathematics. Tasks designed by teacher are highly depend on teacher's goals to develop students' abilities. Teachers need to consider the form of task to achieve the desired goals in learning where in accordance with the current mathematics curriculum, mathematics teachers are required to present

assignments in the form of problems [4].

Mathematics problems are questions with non-routine solution [5]. They are highly recommended by the 2013 curriculum to be given to students. The design of appropriate mathematics problems can develop students' thinking skills. Mathematics problem given by prospective mathematics teachers is still rarely done during on-field teaching practice [6]. Similarly, mathematics teachers, based on the results of observations, rarely provide questions in the form of mathematics problems to their students consistently. On the other hand, teachers who consistently provide math problems to students, were found to have interesting differences between novice and experience math teachers in designing problem. This is certainly influenced by their decision making process.

Research on decision making in mathematics learning has been conducted. Borko, Roberts, & Shavelson (2008) have reviewed mathematics teacher decisions, reasons, mechanism, influencial factors, and differences between novice and experienced teacher in planning [7]. Stahnke, Schueler, & Roesken-Winter (2016) examined teacher decision making from a cognitive and other perspective [8]. Vanlommel, Van Gasse, Vanhoof, & Van Petegem (2017) explore how teachers use data and intuition in the decision-making process in class retention cases [9]. Schoenfeld (2010) states that decision making can be modeled and explained as a function of intellectual, social and other material knowledge and resources; aim; and its orientation (beliefs, values, and preferences) [9]. Santagata & Yeh, (2016) found that teacher communities also played an important role in the decision making [10].

From the explanation above, it can be sum up that there is no research reveals the cognitive processes of teacher decision making which focus on designing mathematics problems. Thus, this study will provide more information on the thinking process of mathematics teacher in their decision making based on the stages of generating, clarifying, and evaluating ideas on designing mathematics problems by novice and experienced teachers. Lande & Mesa (2016) also stated the need for further research to pay attention to teachers as individuals to better understand teacher decision making [11].

2. Methods

2.1. Research subject

This research uses an explorative qualitative approach. The researcher explores the process of decision making of novice and experienced mathematics teachers. The researcher has observed 9 high school math teachers in Madiun, East Java, Indonesia. The 9 teachers consisted of 4 novice teachers (teaching less than 5 years) and 5 experienced teachers (teaching more than 15 years). Based on the observation which was conducted 6 times in 2 months, the researcher chose 2 research subjects, one novice teacher and one experienced teacher. The two teachers were chosen because of the consistency providing mathematics problems to students in 6 lessons. The selected novice teacher is a 29-year-old female math teacher who has 3 years of teaching experience. While selected experienced teachers is a 45-year-old male mathematics teachers who have 15 years of teaching experience. In addition, this selected novice and experienced teacher teaches at the same school, SMAN 2 Madiun, where the curriculum and the characteristics of students are similar.

2.2. Data Collection and Analysis

The data of this research was collected through observation and interviews. Observation focused on the design of mathematics problems given by novice teachers and experienced teachers. Interviews were conducted to collect data of the decision-making process with a framework that included generating, clarifying and assessing the fairness of ideas as shown in Table 1.

Table 1. Framework for Decision Making Process on Mathematics Problems

Decision Making step	Description
Generating Idea	Gather various ideas about mathematics problems.
Clarifying Idea	Analyze ideas on mathematics problems. Give reasons and

	explain ideas on mathematics problems.
Assesing fairness Idea	Assess existing logical ideas onmathematics problems. Assessment is based on existing facts and rules.

The framework was selected to reveal the teachers' thinking process in making decision. Swartz et al. (1998) are experts who have done a lot of research in one's domain of thinking. Data analysis was conducted through reading interview transcripts and written records based on the framework in Table 1. Data reduction and exposure were then conducted. The validity and reliability of the data is done through time triangulation by conducting interviews several times to optain saturated.

3. Result and Discussion

Based on the results of observations, decision making by novice and experienced teachers is to provide mathematics problems during core activities and learning evaluation. The researcher selects a mathematics problem design for the learning process and learning evaluation which is then analyzed the decision making process comducted by novice and experienced teachers. The selection of one design problem is based on the consistency of the mathematics problems given by novice and experienced teachers to students.

3.1. Decision making process in designing mathematical problems for core learning activities

The following is decision making in designing mathematical problems for the learning process by novice teachers and experienced teachers.

Jarak rumah Dini dan sekolah $\left\|\frac{3-2x}{-5}\right\|$ km. Jika jarak rumah Dini lebih dari 5 km dan kurang dari 7 km, tentukan nilai x yang memenuhi.	Dalam suatu kelas terdapat 22 siswa. Guru mengadakan ulangan matematika seperti terlihat dalam gambar :  Hasil ulangan siswa diperoleh rata-rata 5 dan jangkauan 4. Bila seorang siswa yang paling rendah nilainya dan seorang siswa yang paling tinggi nilainya tidak disertakan, maka nilai rata-ratanya berubah menjadi 4,9. Berapa nilai siswa yang paling rendah dan paling tinggi tersebut?
Translate:	
Distance between Dini's house and school is $\left\|\frac{3-2x}{-5}\right\|$ km. If the distance of Dini's house is more than 5 km and less than 7 km, determine the value of x.	In a class there are 22 students. The teacher holds a math test as shown in the following picture.  Mean value of 5 and range value of 4 were obtained from the result of the test. If a student with the lowest score and a student with the highest score are not included, the mean value changes to 4.9. What is the lowest and highest score?

(a) Novice Teacher (b) Experienced Teacher

Figure 1. Mathematics Problem Task for Learning Process

Generating Idea

The decision making process by the two teachers starts with the idea generating stage, where the idea of a novice teacher on the problem given dependent on the problem in the student book. This is also supported by the novice teacher's statement, "*I chose a mathematical problem by looking at the problem in the student book. I choose questions that are not too procedural in their solutions so that the question becomes a problem for students*". While experienced teachers have various ideas on the problems presented.

Experienced teachers said, "*I have a large selection of mathematical problems, I modified from*

several forms of problems to design new problems. I made some modifications of the information to the problem, what is asked about the problem and adjusted it to the context of the students". Problems designed by experienced teachers differ from those in student books as they were designed by modifying existing problems which contain contexts familiar to students. Thus, experienced teachers are more creative than novice teachers in generating ideas about mathematical problem design for core learning activities.

Clarifying Idea

The process of clarifying ideas suggests that the novice teacher does not compare the chosen question with other questions. She directly chooses the question although there could be many reason to shoose other question which could be consider as problems. She stated that, "*I choose mathematical problems in books based on students previous understanding on the materials (class situation)*".

In contrast to novice teacher, the experience teacher compares question with other problems existed and created previously as well as provided reason for his decision. Experienced teacher stated, "*I choose problems based on my teaching experience and the development of students' thinking skills by presenting problems in the real context.*" The idea of the problem being made.

Assesing fairness of the Idea

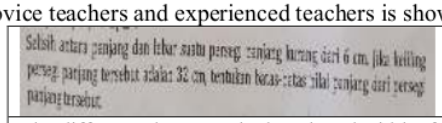
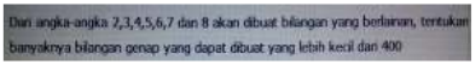
The process of evaluating the fairness of ideas founds that the novice teacher believe that the problem given is suitable for students as it was taken directly from the student book. She stated, "*I am sure about the problem that I have chosen as it was presented in the student's book and the student book was made by competent experts.*"

Whereas experienced teacher believes that problems he had chosen awere made appropriate to given to students based on previous his teaching experience. The designed problems were the best problem when compared to other problems on the same topic and have been made earlier. He said, "*based on my experience, the problem that I gave was in accordance with the learning objectives*."

There are differences between the decision making process of novice and experienced teachers. Novice teacher make her decision based on existing learning resources and the state of the students. This shows that novice teacher are less creative than experienced teacher. Experienced teacher is able to design problems with modifications based on previous knowledge. The modified problem is attracting attention as the context of the problem is familiar to students. This indirectly defines creativity in teaching mathematics [12]. The novice teacher doesn't use her experience to make her decision. On the other hand, experience teacher used his experienced on his decision making process. One of the factors that influence decision making is the experience possessed by the teacher [7].

3.2. Decision making process in designing mathematical problem assignments for learning evaluation

Furthermore, decision making on the design of mathematical problems used for learning evaluation by novice teachers and experienced teachers is shown in Figure 2.

	
The difference between the length and width of a rectangle is less than 6 cm. If the periphery of the rectangle is 32 cm, determine the boundaries of the length value of the rectangle.	From the list of numbers 2,3,4,5,6,7 and 8, different numbers will be made. Determine the sum of even numbers that can be made which are smaller than 400.

(a) Novice Teacher (b) Experienced Teacher

Figure 2. Mathematics Problem Task for Learning Evaluation

Decision making on the design of mathematical problem assignments for learning evaluation differs from that given in the learning process. Novice and experienced teachers choose mathematical problems with modifications from some of the previous mathematical problems.

Generating Idea

The process of generating ideas reveal that novice teacher develop the idea of a problem from previous knowledge about the material of absolute value. The mathematical problem made by novice teacher is a modification that combines the concepts of absolute values and concepts rectangles

periphery (Figure 2a.). Whereas experienced teachers develop the idea for the problem from routine questions about finding the mean value students have learned (Figure 2b.). Experienced teacher develops questions by adding conditions to create problems. Novice and experienced teachers alike build ideas by modifying problems and both look equally creative.

Clarifying Idea

The process of clarifying idea done by novice teacher was conducted by comparing several problems in the form of absolute value and reasons to find out students' learning outcomes. Novice teachers state that "*the main considerations in designing problems for evaluation are the learning indicators or objectives and the level of students' abilities*".

Experienced teachers clarify ideas by comparing other problems that have been made previously (based on their previous experience in teaching). In addition to learning indicators and students' abilities, problem-solving is also adjusted to the real context that is familiar to students. Novice and experienced teachers have reasons to choose problems suitable to the standard competencies and indicators that must be achieved by students.

Assesing The Fairness of Idea

Furthermore, in assessing the fairness of ideas, the novice teacher believes that the problem the problem he made was the best and appropriate to measure student's learning outcomes. While experienced teachers assess the fairness of ideas by having confidence that the problems are made appropriate to students based on previous teaching experience and the problems made are the best problems compared to other problems on the same topic and have been previously made.

The description above shows that in generating ideas on mathematical problems for core activities and learning evaluation, novice teachers are still less creative compared to experienced teachers. In clarifying ideas, experienced teachers always associate with real contexts familiar to students, while novice teachers make problems with contexts less familiar to students. When assessing the reasonableness of ideas, novice and experienced teachers alike have the confidence that the problem given is in accordance with students' abilities which is supported by experience for experienced teachers.Teachers' schemes for designing and implementing learning are influenced by their beliefs and experience [7][13].

4. Conclusion

The findings of this study have implications for increasing the competence of other mathematics teachers in order to meet the demands of the current curriculum. For teachers who are not accustomed to presenting mathematics questions as a mathematics problem for students, the results of this study can provide information in the novice and experienced teacher's decision making process. However, there are still some deficiencies in novice teachers in generating ideas, analyzing questions and evaluating problem as a result of the limited knowledge. In developing ideas about mathematics problems, creativity is needed to create real problems familiar to students. Clarification idea in assigning important mathematics problems is important to ensure that the problem given are in accordance with the basic competencies, indicators and abilities of students. The fairness of idea on mathematics problems is also important to to create problems which can measure students 'abilities and develop students' thinking skills. The researchers suggest to improve the competency of novice teachers through training to develop creativity and competency in analyzing mathematics problems suitable to students' abilities. In addition, knowledge of experienced teachers must be constantly updated, especially on pedagogical content and knowledge on designing mathematics problems in accordance with current curriculum requirements. Due to the fact that decision making is the teacher's thinking process, further research must be done to explore how the decision-making process works based on the influential factors.

References

[1] Huang J L, 2015 Cultivating teacher thinking: ideas and practice *Educ. Res. Policy Pract.* **14**, 3 p. 247–257.

[2] Bishop A J, 2008, Decision-Making, the Intervening Variable, in *Critical Issues in*

Mathematics Education, p. 29–35.
[3] Swartz R J Fischer S D and Parks S, 1998 *Infusing the Teaching of Critical and Creative Thinking into Secondary Science: A Lesson Design Handbook* New Jersey: Critical Thinking Books & Software.
[4] Cai J and Lester F, 2010, Why is Teaching with Problem Solving Important to Student Learning?
[5] Siswono T Y E, 2008 Promoting Creativity In Learning Mathematics Using Open-Ended Problems in *The 3rd International Conference on Mathematics and Statistics (ICoMS-3)* August 2008.
[6] Murtafiah W Sa'dijah C Candra T D Susiswo S and As'ari A R, 2018 Exploring the Explanation of Pre-Service Teacher in Mathematics Teaching Practice *J. Math. Educ.* **9**, 2 p. 259–270.
[7] Borko H Roberts S A and Shavelson R, 2008, Teachers' Decision Making: from Alan J. Bishop to Today, in *Critical Issues in Mathematics Education Major Contribution of Alan Bishop*, (New York: Springer), p. 37–70.
[8] Stahnke R Schueler S and Roesken-Winter B, 2016 Teachers' perception, interpretation, and decision-making: a systematic review of empirical mathematics education research *ZDM - Math. Educ.* **48**, 1–2.
[9] Schoenfeld A H, 2010 *How We Think: A Theory of Goal-Oriented Decision Making and its Educational Applications* New York: Routledge.
[10] Santagata R and Yeh C, 2016 The role of perception , interpretation , and decision making in the development of beginning teachers ' competence *ZDM Math. Educ.* **48**, 1 p. 153–165.
[11] Lande E and Mesa V, 2016 Instructional decision making and agency of community college mathematics faculty *ZDM - Math. Educ.* **48**, 1–2 p. 199–212.
[12] Mastuti A G *et al.*, 2016 Interpretation Awareness of Creativity Mathematics Teacher High School *Int. Educ. Stud.* **9**, 9 p. 32.
[13] Belo N A H Van Driel J H Van Veen K and Verloop N, 2014 Beyond the dichotomy of teacher- versus student-focused education: A survey study on physics teachers' beliefs about the goals and pedagogy of physics education *Teach. Teach. Educ.* **39**, 2014 p. 89–101.

Novice and Experienced Math-ematics Teachers' Decision Mak-ing Process in Designing Math Problem

ORIGINALITY REPORT

13%	12%	7%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Bristol Student Paper	2%
2	www.scilit.net Internet Source	1%
3	backend.orbit.dtu.dk Internet Source	1%
4	nlist.inflibnet.ac.in Internet Source	1%
5	files.eric.ed.gov Internet Source	1%
6	eppi.ioe.ac.uk Internet Source	1%
7	N Ban, M Boyd, R Coates, D A Cool, J-F Lecomte, T Schneider. "Perspectives on tolerability and reasonableness", Journal of Radiological Protection, 2022 Publication	1%
8	sinta3.ristekdikti.go.id Internet Source	

		1 %
9	ijnaa.semnan.ac.ir Internet Source	1 %
10	libeldoc.bsuir.by Internet Source	1 %
11	ojs.fkip.ummetro.ac.id Internet Source	1 %
12	researchid.co Internet Source	1 %
13	www.atlantis-press.com Internet Source	1 %
14	Tommaso Menara, Giuseppe Lisi, Fabio Pasqualetti, Aurelio Cortese. "Brain network dynamics fingerprints are resilient to data heterogeneity", Journal of Neural Engineering, 2021 Publication	1 %
15	repository.maranatha.edu Internet Source	1 %

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		