Preliminary Learning Design Based Realistic Mathematics Education on Entrepreneurship Arithmetic Content in Junior High School

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ABSTRACT

One thing that the causes boring mathematics learning is teachers often do not relate the concepts to students' experiences in their life. This research aims to develop learning designs based on realistic mathematics education on entrepreneurship arithmetic content in junior high school. In this paper, a preliminary learning design is described comprehensively to be used to produce a Hypothetical Learning Trajectory (HLT). The method is qualitative by reviewing several references, conducting observations, and group discussion forums. The results of this study are five stages to increase students' interest in learning, conceptual understanding, and problem-solving, including engagement with content and context, story of entrepreneurship on video, concept deepening, collaboration to solve problems, and making conclusions. The context of this research is the life surrounding the students combined with the 4.0 era development, namely Badung traditional markets, offline malls and online malls, and 3D printing. Instruments designed supporting these five stages are learning implementation plans, student worksheets, video presentations, and PowerPoint slides.

Keywords: Design research, Realistic mathematics education, Entrepreneurship arithmetic content.

1. INTRODUCTION

Mathematics is a scourge and a boring subject for students. One of the reasons is that teachers do not associate mathematics with everyday life. So that the student's perspective on mathematics is a subject that is not important and not beneficial to his life. On the other hand, the development of technology is increasingly sophisticated, where the world is now entering the era of the industrial revolution 4.0, which emphasizes the pattern of the digital economy, artificial intelligence, big data, robotics, and so on or so on or known as the phenomenon of disruptive innovation [1]. This condition becomes a challenge for educators in the teaching and learning process to prepare students for this. According to Beers [2], revealed that the skills that every student needs to have to live well in this era are (1) creativity and innovation skills, (2) critical thinking and problem-solving skills, (3) communication skills, (4) collaboration skills, (5) information management skills, (6) effective use of technology skills, (7) career and life skills, and (8)

cultural awareness skills. Mathematics teaches about critical thinking, creative thinking, sharpening problem-solving skills, practicing communication and collaboration, practicing the proper utilization of appropriate technology, collecting and processing information to make the right decisions, and raising awareness of the cultural wealth associated with the use of mathematics. However, not many teachers can design learning that can hone and improve these skills.

Currently, the government is massively socializing and encouraging people to entrepreneurship. From an early age, students have been introduced to the economic terms contained in mathematics lessons. Many places around students' lives can be used as materials for learning mathematics, such as traditional markets. But not many teachers can take advantage of this. The teacher teaches oriented with the book, what is in the book is taught to students. In this case, the student's impression of mathematics is boring, rigid, and insurable. Therefore, a learning design is needed that can facilitate students to

easily and enjoy learning mathematics and can hone and improve critical and creative thinking skills. Realistic Mathematics Education (RME) is learning based on the real world that is used as a starting point for the development of mathematical ideas and concepts [3]. Realistic mathematics education is formulated based on Freudenthal's theory that focuses on mathematics that must relate to the real world and human activities [4]. This means that mathematics should be close to real life, familiar, and relevant to the daily lives of students who are studying mathematics. Realistic Mathematics Education (RME) refers to the fundamental opinion that mathematics should be linked to real-life human activity. According to [5], the concept of RME learning is very similar to contextual learning and learning which is a learning concept that seeks to help students associate the material learned with students' real-world situations and encourage students to make connections between the knowledge they have and their application with their daily lives. Learning realistic mathematics education involves seven main components of effective learning, namely: constructivism, questioning, finding (inquiry), learning community (learning community), modeling (modeling), reflection (reflections), and actual assessment (authentic assessment).

Entrepreneurial arithmetic material is one of the extensions of social arithmetic that focuses on mathematical calculations that occur in the business world or creative economy. Mathematical calculations such as buying and selling, profit and loss, discounts (discounts), total expenditures and income, and the right price estimate to get maximum profit is a concept that is often used in the business world. Some research on social arithmetic has been done a lot ([6 - 9]). Research [8] discusses the creative thinking skills of students in solving social arithmetic problems. The social arithmetic studied is about discounts, tara, gross, selling price, purchase price, and profit. [6] studied the social arithmetic associated with realistic mathematics education. The context used is the sale and purchase of fruits in a market. The results of his research showed that the learning trajectory compiled can foster understanding of concepts and confidence of students in solving mathematical problems. [9] studied the learning trajectory of social arithmetic using traditional games in Indonesia. The context used is the traditional game "Kubuk Manuk". Through the game, students can stimulate the understanding of student concepts and learning trajectory which is designed to foster understanding of concepts on the topic of expenditure, income, profits, and loss through buying and selling activities. Based on the above, research on the expansion of social arithmetic becomes its attraction to be researched and explored again, especially contexts that can be used to stimulate students to enjoy learning mathematics, understand concepts, and be able to solve problems that occur in everyday life.

This research aims to design PMR-based learning in entrepreneurship arithmetic content using the context of three contexts, namely traditional markets, offline and online malls, and 3D printing companies to foster students' learning interest, conceptual understanding, and problem-solving abilities. This paper presented the initial stage of this research design, namely at the preliminary design stage. At this stage, researchers design the initial hypothetical learning trajectory of students in learning about the topic of entrepreneurship arithmetic content.

2. METHODS

This research uses design research methods. In this case, researchers develop a sequence of learning activities and understand how they work following predetermined goals. [10] makes it clear that design research methods aim to develop Local Instruction Theory (LIT) with cooperation between researchers and teachers to improve the quality of learning. This study is the first study that aims to obtain a Hypothetical Learning Trajectory (HLT). Gravemeijer (in [11]) states that HLT consists of three main components, namely 1) the purpose of mathematics learning for students, 2) learning activities and devices/media used in the learning process, and 3) the conjecture of the learning process. In testing HLT and obtaining LIT, this study conducted the initial stage of three stages of design research, namely the preliminary design stage.

Collecting data at the preliminary design stage is done by field observation, interview, Focus Group Discussion (FGD), and documentation. Observations were made at SMP Widiatmika, which aims to know the learning climate, policies in schools related to learning in the Covid-19 period, teaching schedules used as references in determining research schedules, knowing the curriculum, and learning implementation plans previously used in social arithmetic materials. Furthermore, observations were carried out in four places, namely Badung Market, Level Twenty-One, Tiara Dewata, and 3D Printing company in Denpasar, Bali. Interviews are conducted with semi-structured techniques to teachers and business people when making observations. Furthermore, FGD is carried out with a team of researchers and teachers in designing learning devices and HLT. All of these activities are documented for data analysis. The above is reinforced by the statement [12] which states that preliminary research is the activity of analyzing contexts and problems to develop a conceptual framework foundation through literature review.

Data analysis is done by reducing data and conducting literature reviews, where the results of observations, interviews, FGDs, and documentation are used to produce learning devices tailored to the HLT design.

3. RESULTS AND DISCUSSION

This study produced HLT and learning tools in the form of learning implementation plans, worksheets, presentation slides, and learning videos. Table 1 showed the prototype Hypothetical Learning Trajectory (HLT) is produced.

Table 1. Learning trajectory, student activities, and entrepreneurship arithmetic content

Students' Learning Trajectory	Learning Activities	The Entrepreneurship Arithmetic Content
Engagement with content and context	Experience shopping in traditional markets, modern markets, and 3D printing companies and position themselves as merchants	Term of the selling price, purchase price, profit, loss, discount, cashback, net, gross, tara, and percentage
Story of Entrepreneurship on Video	Watch videos of transactions between merchants and buyers and answer questions	selling price, purchase price, profit, loss, discount, cashback, net, gross, tara, and percentage
Concept Deepening	Provide an understanding of each concept and construct a formula	selling price, purchase price, profit, loss, discount, cashback, net, gross, tara, and percentage
Collaborate to Solve Problems	Applying formulas to solve problems together	Solve problems of a traditional market, modern market, and 3D printing companies
Making Conclusions	Make statements related to what has been learned and the perceived benefits	selling price, purchase price, profit, loss, discount, cashback, net, gross, tara, and percentage

In its implementation, the above HLT is equipped with learning tools developed by researchers. These learning tools include learning implementation plans, worksheets, presentation slides, and learning videos. Here is a detailed presentation related to the learning tools developed.

3.1 Design of Learning Implementation Plan

The learning implementation plan is designed based on the results of observation and FGD with teachers at SMP Widiatmika and literature studies from various sources, especially from Kemdikbud-Risk. The learning implementation plan is designed as many as 3 pieces, which are adjusted to the context raised. The first learning implementation plan elevates the traditional market context, secondly uses the context of the modern market and the third uses the context of corporate 3D printing. The elements in the planned learning implementation plan, namely: the identity of the school and subjects, which contain units of Education, subjects, classes/semesters, year of study, subject matter, and allocation of time. Furthermore, Basic competencies (KD) are: 3.9 Analyze social arithmetic (sales, purchases, deductions, gains, losses, single interest, percentage, gross, net, tara), 4.9 Solve problems related to social arithmetic (sales, purchases, deductions, profits, losses, single interest, percentage, gross, net, tara). Then compiled indicators of competency achievement with the intended cognitive aspect is to identify, understand, explain, apply, analyze problems, construct formulas and solve problems related to entrepreneurship arithmetic content.

Then designed a learning scenario that is associated with a previously designed HLT. Table 2 showed the learning scenario designs using the context of the Modern Market (Offline Mall and Online Mall).

Table 2. Learning scenarios on entrepreneurship arithmetic content

Learning Stages/ Syntax	Teacher Activities	Student Activities
Engagement with content and context	• Greetings *"Good morning"* • Convey learning *objectives "understanding* the concepts of buying and selling, discounting, *cashback,* and percentages and using them to solve problems in real *life"* • *"Have you ever shopped at the mall? Where's the mall? What is usually purchased? Kalua mall online / e-commerce ever? "What do you think makes buyers interested in buying things at the mall?"*	• Answering greetings • Listen to the teacher's presentation • Answering teacher questions and/or responding to answers from other friends

Learning Stages/ Syntax	Teacher Activities	Student Activities
	"If one... Sold at 50,000 and 20% off. How much should I pay?" What if the discount is 15% + 5%, how much should be paid?"	
Story of Entrepreneurship on Video	• Play a video about entrepreneurship transactions and ask students to listen • Ask students to answer questions in the LKPD related to the concepts of buying and selling, discounts, cashback, and percentages • Ask students to communicate the concepts of buying and selling, discounts, cashback, and percentages contained in the video	• Students watch videos of people making entrepreneurial transactions • Students analyze the mathematical concepts contained in the video • Students communicate the concepts of buying and selling, discounts, cashback, and percentages contained in the video
Concept Deepining	• Divide students into each room • Ask students to do LKPD in groups, especially about deepening the concept • Ask students to discuss LKPD in each room • Ask students to return to the main room and communicate the answers found	• Students enter the room provided. • Students pay attention to the problems that exist on the topic of deepening the concept • Students discuss with their friends in each room that has been provided
		• Students return to the main room and one of the groups communicates the answer, the other group listens and gives a response.

Learning Stages/ Syntax	Teacher Activities	Student Activities
Collaborate to Solve Problems	• Ask students to solve EAC problems about buying and selling and profit-loss according to the context of daily life • Ask students to communicate their answers in each group • Ask each group to present the answer.	• Students solve EAC problems about buying and selling and profit-loss according to the context of daily life • Each student worked on a different problem to then explain to all his colleagues on the team. • Each team presents the answers that have been found.
Making Conclusions	• Ask students to make conclusions in accordance with the learning objectives that have been made	• Students conclude the conclusions of the learning conducted at their respective LKPD

The learning trajectory designed through these five stages is in line with Fauzi's statement [13] which states that the Realistic Mathematics Education (RME) learning stage begins with understanding context problems, then explaining context problems, solving context problems, comparing and discussing student answers and conclude.

Then designed assessment and assessment, namely: Authentic self-performance when given the responsibility of solving problems in the group and liveliness during the learning process and group performance authentically on the LKPD collected.

3.2 Worksheet Design

Researchers designed three worksheets tailored to three different contexts: traditional markets, modern markets, and 3D printing companies. Each worksheet consists of 3-4 pages consisting of four major themes, namely: 1) Understanding concepts through the story of entrepreneurship on video, 2) Deepening concepts, 3) Collaborating to solve problems, and 4) Making Conclusions. Figure 1 showed the worksheet designs designed.
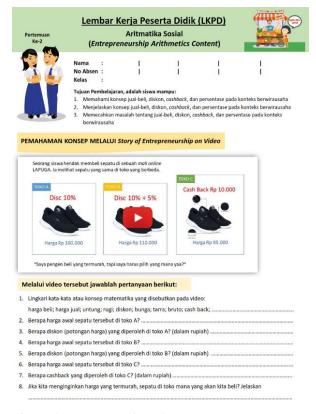
Figure 1 Worksheet of the first page.

Figure 2 Worksheet of the second page.

This is a worksheet design for the second meeting with the modern market context. In the image next to it appears that the student must fill in the identity first, then the student is directed to understand the purpose of the learning to be done. Furthermore, students are directed to watch the learning video that has been prepared by the teacher, to then answer the questions given directly on the worksheet. The questions presented aim to stimulate students to independently try to understand the topics discussed through the learning video that is played. In addition to stimulating the student's understanding, the questions presented also triggered students to be able to provide analysis of the situation that occurred.

Figure 2 showed the worksheet on the second page of the four pages was designed at the second meeting. In the worksheet, it appears that the big topic discussed is the deepening of the concept where students are stimulated to be able to create definitions using their own concepts, which are then directed to construct formulas independently through discussions with their groups. After that, students are directed to solve problems with situations that are different from previously constructed formulas. Once able to solve the problem, students are expected to be able to construct the formula back from the situation. Problems on the problems presented, require a level of knowledge, ranging from understanding, applying, and analyzing the problem.

Figure 3 Worksheet of the third page.

Figure 3 showed the third of four pages designed at the second meeting. On the worksheet, it appears that the big topic discussed is collaborating to solve problems. Researchers included instructions for students to do a second break room through zoom meetings. Then it lists the way of working, which hopes that students are able to divide themselves, where each student in each group gets one responsibility that solves the problem. To continue discussing together in one group. At the bottom, the researcher also came up with an answer design, so that students write the answer in the column.

In this worksheet, the researcher directs students to be able to understand and interpret the topic being studied. Researchers relate it to everyday life and place it at the beginning of learning. This is in line with Freudenthal in [14] that mathematics must be connected with the world of students' reality, even those that are very close to students and relevant to their social life. Therefore, the researcher invites students to tell their experiences of shopping at traditional markets and slowly relate them to the topics discussed.
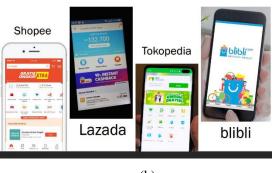
3.3 Video Design Learning and Presentation Slides

In designing the learning video researchers created three videos that each used the context of traditional markets, modern markets, and corporate 3D printing. The first video uses a traditional market context that contains interactions between sellers and buyers, the second video uses a modern market context that contains about the

problems faced by buyers because they have a dilemma in choosing a product purchased because of the three stores that sell the product provides different discounted models. And the third video uses the context of a 3D printing company which contains how a 3D printing entrepreneur in selling his product must pay attention to the concept of gross, net, and tara in order to still get the appropriate and maximum profit.

The preliminary design stage is designed for online learning, so it requires additional design in the form of presentation slides. In the presentation slide, the researcher lists the topics discussed, the purpose of learning, and continued with the materials. Figure 4 showed some of the uniqueness of this presentation slide.

(a)

(b)

Figure 4 Engagement stage presentation slide view *with content and context.*

Through the slide above, students are expected to be interested in the topic to be discussed and reveal their experience visiting and shopping at offline malls located in Denpasar and online malls. This slide is a form of student activity designed at *the Engagement with content and context stage.* Next is the presentation slide at the Story of *Entrepreneurship on Video stage,* where through the PowerPoint teachers can play learning videos that can trigger students to answer the questions given. Figure 5 showed the video and the questions students should be answered.

Figure 5 Presentation slides show videos and questions.

Through the slide above, students are expected to be able to watch and listen to videos about entrepreneurial activities and answer the problems provided. In addition to the slides above, researchers also designed presentation slides by bringing back worksheets that have been created. Where the goal is to discuss together after students independently and the group solves the problem. In this case, in writing the results of the student's answer later, the teacher is assisted with a digital pencil-type Huion H430P.

The use of learning videos and presentation slides is very effective to be applied to online learning [15]. Through videos and presentation slides, learning is more varied and students are interested and motivated to learn, especially students who have an audio-visual learning style.

4. CONCLUSION

Based on the results and discussions, it can be concluded that at the preliminary stage of design, researchers design a hypothetical learning trajectory (HLT) and learning devices. HLT is designed through five stages namely *Engagement with content and context, Story of Entrepreneurship on Video, Concept Deepening, Collaborate to Solve Problems, and making conclusions.* The learning community is designed based on the context of the life around students that aims to attract students in learning entrepreneurship arithmetic content. In addition, researchers designed a worksheet so that students can understand the concept well by instructing independently and formula groups about profit, loss, and percentage based on selling price, purchase price, discount, cashback, and cashback and cashback. In the final stages, researchers design problem-solving types of problems based on real situations in traditional markets, modern markets, and 3D printing companies. The contribution of this research is to provide an overview of HLT and learning tools based on realistic mathematics education in entrepreneurship arithmetic content as an extension of social arithmetic material so that it can be continued to the next stage, namely teaching experiment and retrospective analysis.

AUTHORS' CONTRIBUTIONS

All authors conceived and designed this study. All authors contributed to the process of revising the manuscript, and at the end all authors have approved the final version of this manuscript.

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