Bridging Mathematics and Financial Literacy Through Flipped Classroom

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Abstract: Integrating financial literacy into mathematics education is essential for helping students make informed financial decisions. However, many teachers struggle to design lessons that meaningfully connect mathematical concepts with financial contexts, often due to limited content and pedagogical knowledge. This study addresses this issue by developing a flipped classroom–based model, the Math Fina-Flip Classroom, to enhance teachers' professionalism in creating financial literacy–integrated activities. Using a design research approach, the study followed three phases: preliminary, prototyping, and assessment. The model incorporates key features—content, coherence, active learning, duration, collective participation, and ICT integration—that structure a flipped learning environment. Teachers engage across three stages: before class, during class, and after class. Findings show improvements in teachers' content knowledge and pedagogical content knowledge, including a 19% increase in understanding and applying financial contexts in mathematics lessons. Collaborative learning communities further support professional growth. However, limited time in the "during class" phase indicates a need for extended reflective and practice-based activities. This study provides a practical framework for integrating financial literacy into mathematics education and responds to professional development challenges faced by Indonesian teachers. Future research should refine and expand the model for broader implementation and long-term sustainability.

Keywords: flipped classroom, financial literacy, teacher professionalism, blended learning, mathematics education.

INTRODUCTION

Nowadays, several countries emphasize the importance of financial education in school curricula, particularly in the field of mathematics, such as Australia, Canada, Denmark, Estonia, Finland, Japan, Korea, Norway, and the United Kingdom (OECD, 2019). Financial literacy is a complex

and multidimensional concept involving various elements and disciplines. In assessing 15-year-old students, the OECD simplified this concept by selecting the most relevant components. Financial literacy is defined as the knowledge, skills, motivation, and confidence to apply financial understanding in making effective decisions, improving personal and societal financial well-being, and participating fully in economic life (OECD, 2019). As an interdisciplinary field, financial literacy is closely related to other competencies and domains, such as reading, numeracy, mathematical literacy, social studies, and civic education. Recently, the OECD expanded its study of financial literacy through the 2021 framework, highlighting the intersection between financial literacy and mathematical literacy. This intersection includes basic arithmetic tasks that require students to apply their knowledge in everyday financial contexts.

Mathematics tasks with financial contexts are not only used to provide a relevant context for learning mathematics. At the same time, students also gain knowledge and attitude about finance. Sawatzki provides an alternative for teachers to use financial literacy contexts in mathematics lessons by using problems that students can imagine (Sawatzki, 2017; Sawatzki & Sullivan, 2018). Preliminary research indicates that teachers deal with challenges when designing and developing lesson plans. Considering that mathematical knowledge starts from problems, the teacher's ability to build problems is very important (Leavy & Hourigan, 2020). When teaching mathematical concepts using a financial context, it is important for teachers to base the context on students' daily activities to ensure it is meaningful and not merely superficial (Savard, 2022; Savard & Polotskaia, 2017). Learning that involves such contexts may require a more careful approach or instructional design to ensure its effectiveness (Burgos et al., 2024). In doing so, students will make mistakes in making financial decisions, for example not knowing the application of percentage discounts (Sagita et al., 2023; Savard, 2022).

Teacher Professional Development (TPD) programs that focus on financial literacy can significantly improve teachers' self-efficacy and their capacity to integrate financial literacy into classroom lessons (Blue & Grootenboer, 2019). Unfortunately, these programs are often not widely accessible, thereby leading to inequality in the level of preparation among educators (Jorgensen & Savla, 2010). For example, short workshops and seminars are not enough to change teachers' teaching practices. It is optimal for educators to engage in collaborative learning, sharing, collaboration, and support in order to enhance the quality of their instruction. The establishment of professional learning communities is one way to achieve this goal.

TPD is designed to enhance the competence and expertise of teachers, with the goal of maximizing their positive influence. Currently, there is a growing acknowledgment that teacher learning is a continuous and integrated process, which is shaped by the environment in which professional development occurs (Guskey, 2000; Timperley et al., 2008). This suggests that there is no universally-effective TPD (Teacher Professional Development) approach that can be applied in every country, school, or classroom. Instead, professional development efforts should develop to the particular content, process, and context (Guskey, 2000).

Prior studies in the general professional development process developed a framework or key features to effective TPD. Desimone and Garet outlined five core features of effective professional

development: content focus, active learning, coherence, duration, and collective participation (Desimone & Garet, 2015). Building on this general framework, Compen et al. adapted and refined these components to develop a specialized TPD model tailored to financial education, which serves as an important theoretical foundation for this study (Compen et al., 2019). In line with Burn, there are six characteristics that a TPD learning environment should have, including developing teachers' competencies, based on an understanding of teachers' needs and their work environment, focusing on deepening teachers' content knowledge and pedagogical skills, solving important problems related to the teaching and learning process, and building a professional learning community (Burn et al., 2023).

TPD frameworks that have been generated from previous research do not specifically include the use of technology as a supporting component, indicating a potential area that is less explored. Meanwhile, some argue that such technologies have the potential to transform classrooms (Goos et al., 2020). Online learning, e-learning, and blended learning in TPD mathematics education are relatively new areas of research (Goos et al., 2020). Moreover, the flipped classroom model as one of blended learning approach is an innovative approach to teaching and learning that involves a pedagogical shift from the traditional academic process. In this model, students are introduced to the subjects outside the physical confines of the classroom, before engaging in face-to-face instruction (Lopes & Soares, 2018).

Potential future studies are recommended to examine the implementation of various TPD initiatives using the key features of the prior literature (Compen et al., 2019; Desimone & Garet, 2015). Our objective is to create a model for mathematics teacher professionalism in the development of mathematics activities that incorporate financial literacy concepts. This model encompasses various essential elements that can enhance teachers' expertise in both content and pedagogy. These elements include the provision of comprehensive content, the promotion of active learning, the establishment of coherence, the consideration of duration, and the encouragement of collective participation. Furthermore, the incorporation of technology is essential to enable universal access for all educators.

The importance of this research is that teachers, as facilitators, must be able to design appropriate learning for students according to the characteristics of their students. However, when teachers lack sufficient knowledge of mathematics and pedagogical skills, particularly in integrating financial literacy, they may utilize financial contexts merely as a backdrop, without fully engaging with the meaning or relevance of the content in the learning process. This can lead to student errors in applying mathematics to solve financial problems. Furthermore, it is important for teachers to create effective and efficient learning. This research further applied a framework for developing teacher professionalism by Compen et al., (2019) and Desimone & Garet (2015), designed with blended learning and optimizing the learning community at school. Based on empirical data and previous research studies, this study formulated a research question: 'What are the flipped classroom stages of a mathematics teacher professionalism training program in designing student activities with financial literacy content in mathematics learning?'.

METHOD

Research Procedure

The design research procedure was adopted to address the research questions formulated in this study. Design research aims to develop high-quality interventions through an iterative cycle of design, implementation, and refinement (Plomp, 2013). A high-quality intervention can be achieved when the research systematically follows key stages, namely preliminary research, a development or prototyping phase, and an assessment phase (Plomp & Nieveen, 2010; Plomp, 2013). The preliminary research stage involved analyzing the problem and conducting a comprehensive literature review covering the domains of financial literacy, mathematics teacher professional development, mathematics content for first-grade junior high school, and the identification of mathematics learning objectives relevant to financial literacy. This literature review was not limited to textual sources but was enriched through the collection of additional supporting information, including interviews and discussions with mathematics teachers. The outcomes of this stage provided the theoretical underpinnings necessary for designing the core components of a financial literacy learning environment model. Building upon the preliminary research, the prototyping phase focused on developing a prototype of a mathematics teacher professional development program. This phase involved iterative cycles of testing and refinement across different groups of participants to enhance the quality and relevance of the intervention. The final stage, the assessment phase, aimed to systematically evaluate the extent to which the developed intervention met the specified design criteria and objectives.

Formative Evaluation

The intervention process emphasized the importance of formative evaluation as a key activity for gradually developing and refining the intervention (Plomp, 2013). To support this process, three main criteria were used to assess the quality of the intervention: validity, practicality, and effectiveness (Ploom & Nieveen, 2010). The formative evaluation in this study followed several stages based on Tessmer (2013), including self-evaluation, expert review, one-to-one evaluation, small group evaluation, and field testing, as illustrated in Figure 1.

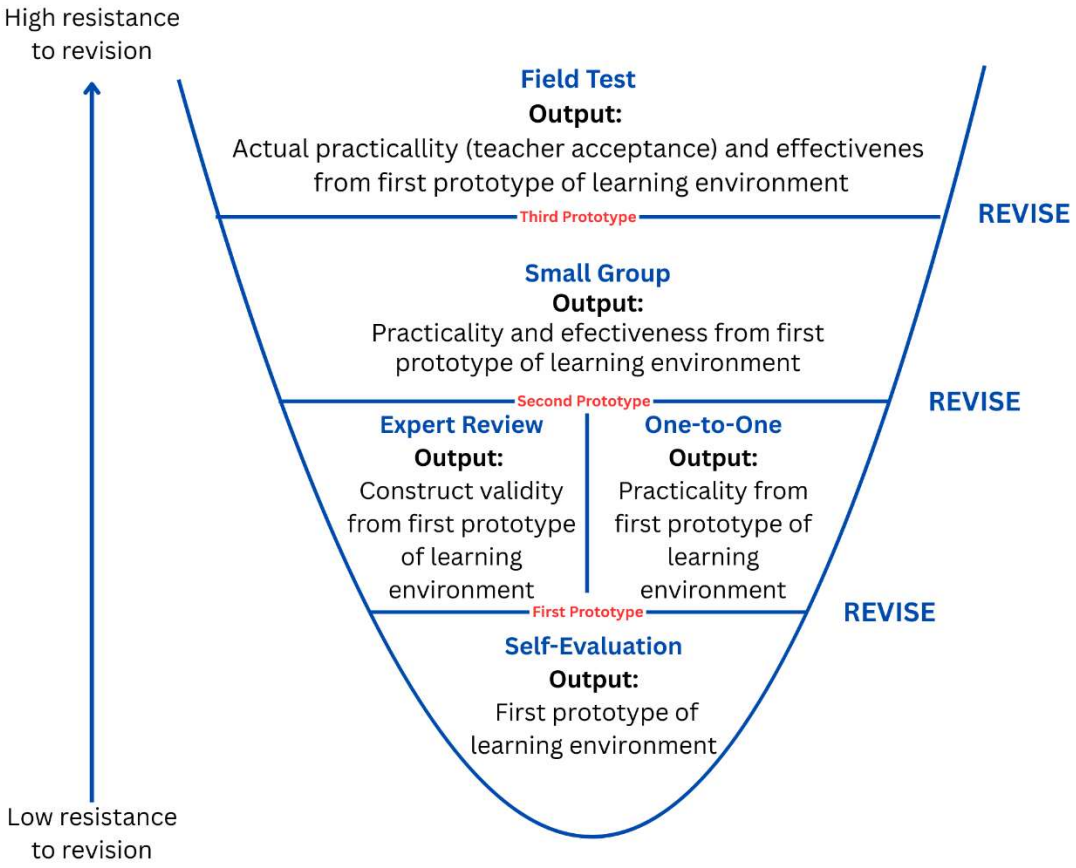


Figure 1: Layers of Tessmer's formative evaluation (taken from Plomp, 2013)

The self-evaluation stage involved the researcher independently reviewing and revising the draft of the learning environment model, which consisted of the financial literacy content guide, training module, Learning Management System (LMS), and the sequence of activities within the teacher professional development program. The product generated at this stage was referred to as the first prototype.

The second layer of formative evaluation consisted of one-to-one testing and the construct validation of the first prototype. The one-to-one phase aimed to assess the practicality of the initial draft of the learning environment model. Data were collected through observations, focusing on the practicality criteria of clarity, ease of use, and the appropriateness of the sequence of activities for supporting teachers' pedagogical mastery. Comments and suggestions gathered during the expert review and one-to-one evaluations were used to revise the first prototype.

Simultaneously, expert reviews were conducted to evaluate the content, construction, and language aspects of the components of the learning environment model. The experts involved included university lecturers specializing in financial literacy content, university lecturers in realistic

mathematics education, widyaiswara (professional trainers) specializing in number content, learning development experts, and teacher learning community representatives. The results from both the one-to-one testing and the expert review served as the basis for revising the first prototype.

Subsequently, the second prototype was tested in a small group trial involving a limited number of participants. If the intervention at this stage could be implemented smoothly and produced the expected outcomes, the second prototype would be considered to have achieved an adequate level of practicality. The second prototype was then revised based on the findings from the small group trial, resulting in the third prototype. Finally, a field trial was conducted to evaluate the effectiveness of the final prototype of the developed learning environment model.

The evaluation criteria used to measure effectiveness are based on Guskey's (2000) five levels of professional development evaluation. The first level, *participants' reaction*, assesses teachers' satisfaction with the program through post-activity surveys. The second level, *participants' learning*, measures teachers' acquisition of knowledge using worksheets and their responses to content-related questions in mathematics and financial literacy. The third level, *organizational support and change*, evaluates the commitment of operational management through interviews to determine institutional backing for sustaining the model. The fourth level, *participants' use of new knowledge and skills*, examines how teachers implement financial literacy within mathematics instruction, assessed through classroom observations and supporting documentation such as photos and videos. The fifth level, *student learning outcomes*, determines whether students achieve the intended learning objectives by analyzing the results of assessments administered after instructional activities. Collectively, these five levels provide a comprehensive framework for evaluating both the process and impact of the implemented professional development model in this study.

As shown in Table 1, the stages of design research are systematically connected to the three main quality criteria for evaluating the developed intervention.

Phase	Criteria	Short description of activities
Preliminary	The primary emphasis was placed on content validity through the researcher's own evaluation	This stage involved conducting a literature review and developing an initial design of the intervention.
Prototyping	The focus at this stage was on construct validity and practicality, while the effectiveness of the prototype also began to be considered.	The prototype was developed for limited testing, validation, and refinement based on the results of formative evaluations. The initial prototype underwent formative evaluation through expert reviews and trials to assess its construct validity and the expected level of practicality.
Assessment	The focus was on assessing practicality and effectiveness.	Practicality was evaluated by determining whether the target users were able and willing to use the intervention. The assessment also examined the extent to which the intervention was effective.

Table 1. Research Phases and Intervention Criteria

Participants

Participants were selected using a probability sampling technique, namely random sampling. As defined by Wellington (2015), random sampling is a technique in which each member of the population has a known and generally equal probability of being selected. In this study, the target population comprised 58 public and private junior high schools that had implemented the Merdeka Curriculum and exhibited similar characteristics.

From this population, participants were involved in three stages of formative evaluation. In the individual trial phase, two mathematics teachers from two different schools were engaged to review and provide feedback on first prototype of the learning environment model. This was followed by a small group trial, which involved three mathematics teachers from three different schools who tested second prototype, developed based on findings from the previous phase. Lastly, the final prototype was evaluated during a field trial involving fifteen mathematics teachers from fifteen different schools.

RESULT

This study resulted in the development of a learning environment model designed to improve mathematics teacher professionalism, hereafter referred to as the Mathematics in Financial-Flipped Classroom (Math Fina-Flip Classroom). The development of this learning environment was carried out through three phases: preliminary, prototyping, and assessment.

Preliminary: First Prototype

The learning environment design created in this study adopted one of the blended learning implementation models proposed by the Christensen Institute, namely a flipped classroom with the Before-During-After stages. In this case, the stages of improving teacher professionalism were carried out synchronously and asynchronously. The workshop methods were applied at the stages of the learning environment model being developed. Figure 2 below presents the concept of implementing the Math Fina-Flip Classroom with the stages before-during-after class in the in-class and out-of-class environments.

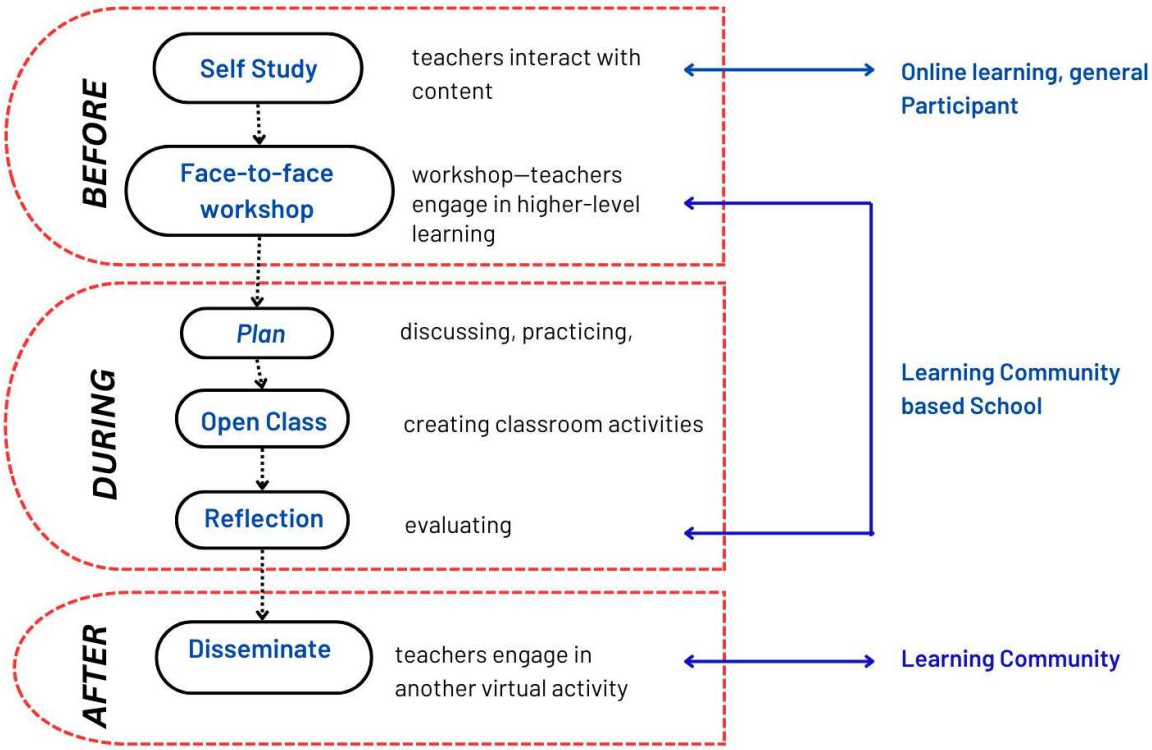


Figure 2: First Prototype Design Math-Fina Flipped Classroom Learning Environment

The duration of the implementation planned is 30 credits or equal to 25 hours. In addition, the ratio between total online and offline activities credit is 17 online credit (65.38%) and 9 offline credit (34.62%). This total credit that 30% to 70% blended learning interaction on the content is carried out online.

Prototyping: Second Prototype

The prototyping stage consists of five formative evaluation activities: self-evaluation, expert review, one-to-one evaluation, small-group evaluation, and a field test. Participant satisfaction and learning are addressed in the field test and subsequent assessment phase.

Self-Evaluation. At this stage, researchers examined the completion of six main components in the learning environment design. First, in terms of content, the development of a relevant financial literacy and mathematics learning module based on financial literacy was evaluated. Second, active learning was supported through the design of a teacher worksheet, which utilized a backward design approach to foster engagement. The third component, coherence, involved ensuring that the model aligned with the latest education policies, such as the Independent Curriculum. Regarding duration, the implementation of the flipped classroom model was set to last for 32 credits, equating

to 26.7 hours. The fifth component, collective participation, focused on involving teaching communities in designing learning activities that reflected students' characteristics. Finally, the technology component was assessed by evaluating the LMS, which included features such as pretests, posttests, modules, and evaluation tools.

Evaluation was conducted on the completion of the design component that has been developed. The evaluation result gives significant input, such as the need for adding effective activities supporting the achievement of learning objectives in the module. In addition, features on the LMS need to be improved to make it more user-friendly and able to support optimal offline learning process. These improvements include the addition of guidelines of using LMS, integration of evaluation tools, such as interactive quiz and content enrichment in order to improve the participants' involvement.

Expert Review. Validation was carried out through directed group discussion with mathematics experts, financial literacy experts, and teacher professional development. Material drafts such as the content of financial literacy numbers and learning modules were evaluated based on legality, substance, language, and presentation aspects. The evaluation of the validity of the material shows that the material developed reaches the high to very high category. However, some input from experts is the basis for improvements to improve the quality of the material, including:

a) Addition of material depth: The materials on integers and rational numbers need to be deepened to be more comprehensive and in accordance with learning needs at the junior high school level.
b) Revision of material presentation: Material presentation should be more adjusted, in order to become more relevant to Junior High School Students' characteristics, both in terms of difficulty level and learning context.
c) Improvement of language and content integration: the language used in the material needs to be improved to be more communicative and in accordance with the standard language rules. In addition, the integration of content with the theme of Social Sciences (IPS) was carried out to create more holistic and contextual learning.
d) This improvement aims to ensure that the material is not theoretically valid but also practical and effective when applied in the learning process.

One-to-One. At this stage, two teachers from the participating school were involved to test the practicality of the prototype. The teacher implements a series of activities as designed in Figure 2 above. The professional development process followed several structured stages. First, through self-study, teachers independently learned the material provided via the LMS and completed the corresponding teacher worksheets. This was followed by a face-to-face workshop, where teachers reviewed the materials that they had studied and engaged in discussions and collaborative activities. In the designing contextual problems phase, teachers developed collaborative learning tools that integrated financial literacy concepts. In the practice in class stage, teachers implemented their learning designs in the classroom setting and recorded the sessions for later reflection. Finally, during the reflection and sharing knowledge phase, teachers evaluated their classroom practices

within their learning communities and exchanged experiences across schools to enhance collective professional growth.

This stage produces several inputs aiming to improve the prototype 1 learning environment model. Teachers were generally satisfied with the activities in the learning model that was implemented. However, suggestions are given to increase the duration of online discussions so that teachers have more time to explore the material collaboratively. Analysis of the teacher worksheet showed that the average learning achievement reached 78%, indicating that most teachers were able to understand and implement well-designed activities. Furthermore, the posttest results showed an increase in teacher understanding of 19% compared to the pretest. This reflects the effectiveness of the learning model in improving teacher abilities, especially in mastering financial literacy and the application of mathematical concepts. Several errors were identified, especially in the analysis of financial literacy and the application of mathematical concepts. These errors provide important insights for improving the prototype, including adjusting learning activities and refining materials to support deeper understanding. The proposed improvements aim to ensure that the learning model is not only effective but also able to have a significant impact on teacher competence in integrating financial literacy into mathematics teaching.

Small Group. At this stage, an 11-day small group trial was conducted on the revised version of the second prototype, which was developed following the one-to-one evaluation stage. The small group trial sample consisted of three schools, including two public schools and one private school. The small group trial stage was carried out 11 days. Figure 3 presents an illustration of the Math Fina-Flipp Classroom learning environment model.

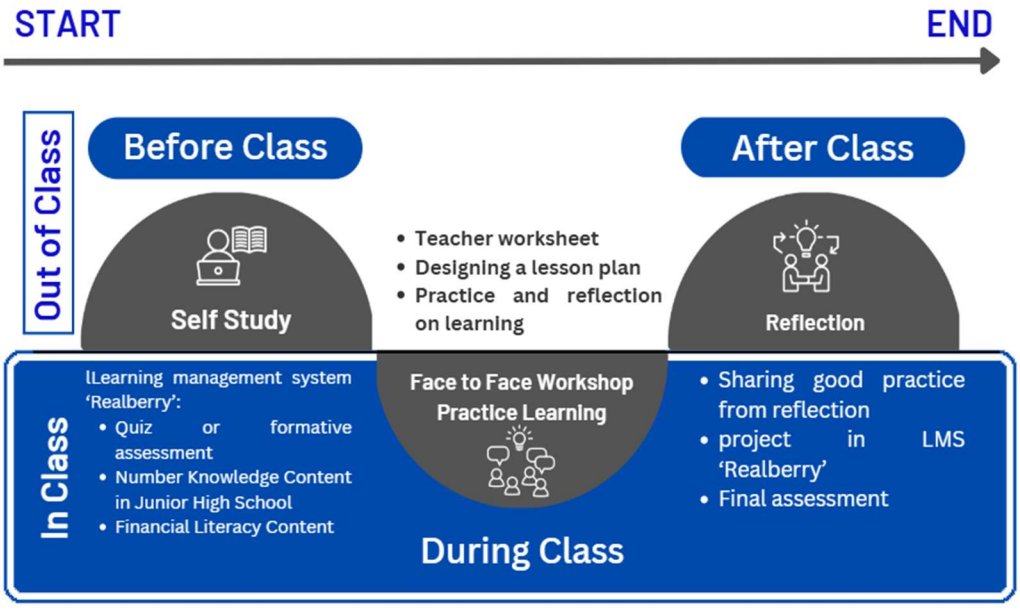


Figure 3. Second prototype learning environment model of math fina-flipp classroom

Changes in the activity stages result in changes in the number of credits. In prototype 2, the comparison of the number of online and offline activity credits is 16 online credits (48.64%) and 19 offline credits (51.35%) as presented in Appendix 1.

Field Trial. The field trial stage constituted the final field testing of the third prototype of the Math Fina-Flip Classroom Learning Environment Model. This phase was implemented over a period from January 18 to February 2, 2024, involving fifteen teachers from seven different schools. The formative evaluation of third prototype identified a significant recommendation for further refinement, specifically concerning the insufficient duration allocated for offline activities. The offline components, conducted during in-class sessions, comprised several key phases: a face-to-face workshop, contextual problem design, classroom practice, and reflective discussions. Meanwhile, the activities during the online phase were integrated into the existing school-based professional learning communities, aligning with their regular weekly meeting schedules. In order to ensure the effectiveness and efficiency of each stage of the intervention, a minimum duration of approximately four weeks (one month) is recommended.

Findings from the field trial were analyzed through a combination of observations, interviews, and comprehension tests administered to teachers during the workshops. The results of this analysis are presented below.

Participation' satisfaction. Satisfaction among participants was gauged using a response questionnaire administered at the conclusion of the field test phase. The questionnaire results revealed that 95% of respondents answered "Yes" to 20 positive questions posed. This indicates a high level of alignment and satisfaction among teachers with the Math Fina-Flip Classroom Learning Environment Model and its five features for teacher professionalism development. However, there were some "Uncertain" responses regarding the duration aspects. The comments section provides further insights, summarized in column 1.

- *The duration of offline activities was too short, resulting in limited time for discussions.*
- *I faced difficulties uploading teaching videos due to large file sizes.*
- *Your feedback would be appreciated; perhaps extending the duration would allow more time for thinking, designing, and implementing activities in class. As teachers, we often struggle to find spare time for learning and completing tasks/worksheets during regular hours.*
- *After attending this training, I've realized that students' success isn't just about their visible results in answering worksheets but also about fostering a desire to learn, curiosity, and active participation in discussions. These changes show their enthusiasm and motivation to learn.*
- *Financial literacy is not limited to social arithmetic content; it can be applied across all subjects, especially in mathematics.*
- *This training program has broadened my knowledge in the field of education*.

Column 1: Participant Comments Summary

The analysis of comments from column 1 leads to the conclusion that participants in the Math Fina-Flip Classroom have demonstrated an enhancement in teachers' competency to design and implement mathematics lessons integrated with financial literacy. Moreover, teachers have recognized that designing "Student Worksheets" effectively and tailored to students' characteristics can stimulate students' interest in learning, curiosity, and active engagement during discussions. Valuable feedback has been given regarding the short duration and scheduling conflicts with school activities.

Participation' learning. The first criterion for assessing learning participation is teachers' engagement during the training sessions. Their understanding of the material was evaluated through the completion of the teacher worksheet. The average scores of participants' professional development improvement using the Math Fina-Flip Classroom, as presented in Table 2 indicates that all participants were able to analyze financial literacy content within the sample teaching modules provided, select appropriate mathematics content aligned with financial literacy, set learning objectives, and determine suitable assessments to measure learning outcomes.

Teacher Worksheet Activities	Assessment Criteria	Mean	Standard Deviation
Conducting analysis of learning objectives and learning objectives direction	Accuracy in formulating objectives, analyzing the sequencing of learning objective flows, and analyzing student characteristics	77.86	4.88
Conducting analysis of financial literacy content	The accuracy and suitability of the selection of financial literacy content with mathematical content accompanied by comprehensive analysis.	67.14	5.67
Conducting analysis of learning objectives and financial literacy content on learning module	The explanation of the reasons is very clear and in accordance with the questions of each question.	73.57	14.35
Determining the learning objectives and objectives measurement indicators	Objectives and indicators are in accordance with KD/CP	91.43	2.44
Constructing assessment proof in accordance with learning objectives	1) The assessment evidence is in accordance with objectives 2) Activities are in accordance with assessment evidence and objectives	85.71	7.32
Constructing *learning plan*	1) Prior knowledge possessed by students 2) Mathematical models to be used 3) Containing students' conjectures of thought	81.43	8.02

Table 2. Recapitulation of assessment result on each teacher worksheet

Looking at the standard deviation (SD) in Table 2. The highest SD value was observed in the activity of analyzing learning objectives and financial literacy content in the teaching modules. The high SD value suggests significant variation among teachers in this specific ability. This does not necessarily imply that teachers were unable to analyze the teaching modules effectively. However, it indicates that the explanations provided may be somewhat unclear and not entirely aligned with the questions for all objectives presented in the teaching modules.

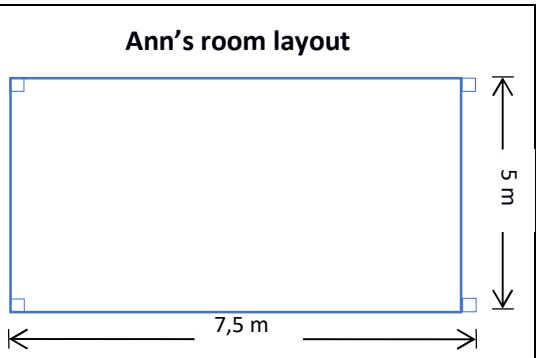
The second criterion for evaluating learning participation is based on criteria outlined in Table 3, assessing teachers' professionalism after completing all stages of the Math Fina-Flip Classroom. Table 3 shows an 8% increase in the "correct answer" level from pretest to posttest, alongside an 85% decrease in "incorrect" answers and a 13% decrease in "wrong" answers. This indicates that participants still made mistakes in problem-solving or failed to provide explanations for their answers.

No	Question Item/Context	Correct Answer		Incomplete Answer		Incorrect Answer	
		PR	FA	PR	FA	PR	FA
1.	Rational or irrational	5	7	0	0	3	1
2.	Car selling price	3	3	0	0	5	5
3.	*Wallpaper border*	4	5	3	2	1	1
4.	Currency	8	8	0	0	0	0
5.	Definition of fraction, decimal, percentage	6	7	2	1	0	0
6.	Misconception of fraction, decimal, percentage	6	8	2	0	0	0
7.	Summation of fraction, decimal, percentage	6	6	2	2	0	0
8.	Sequencing fraction, decimal, percentage	8	8	0	0	0	0

Table 3. Result of Pretest and *final assessment*

Below is a discussion of the responses to the final assessment during the field test phase, focusing on the variety of "correct," "incorrect," and "wrong" answers provided by participants.

Ann is planning to install a continuous wallpaper border on the walls of her living room, as shown in the picture. She has three wallpaper options available for purchase:

1. A roll priced at Rp25,000, measuring 5 meters in length (features: waterproof, comes with wall-paper adhesive). *2. A roll priced at Rp17,000, measuring 10 meters in length (features: waterproof).* *3. A roll priced at Rp10,000, measuring 2.3 meters in length (features: waterproof, comes with adhesive).* *Which wallpaper should Ann choose to maximize her budget efficiency?* 

Column 2. Question Context: Wallpaper Border (source: TEDS-M)

The accuracy of answers is assessed based on the ability to correctly understand the "wallpaper border" problem, utilize the perimeter concept to solve it, and make precise calculations for each of the three types of "wallpaper border" options, resulting in an effective decision on which wallpaper to purchase.

Aspect of MCK Show whether each of the following numbers is rational or irrational.

Column 3. Context of the issue: Rational or Irrational

Figure 5 depicts a participant's "incorrect answer" in solving the rational or irrational context problem during the post-test small group stage.

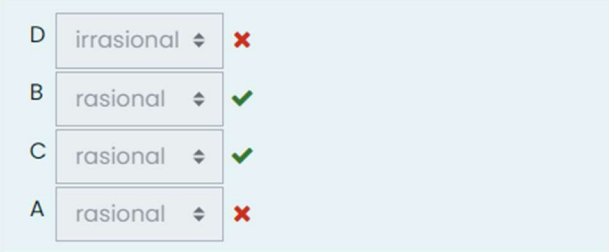


Figure 5: MYR's answers to the context of Rational or Irrational.

Following confirmation by the researcher, the error can be attributed to a misinterpretation regarding the definitions of rational and irrational numbers. One participant erroneously assumed that irrational numbers invariably bear a negative sign. Moreover, the confusion regarding the classification of pi (π) as a rational number stemmed from misconceptions about its representation, either as a fraction (22/7) or a decimal (3.14).

Participants' Use of New Knowledge and Skills

The initial criterion for evaluating participant engagement in learning was examined through the lesson plans articulated within the hypothetical learning trajectory. The presented Table 4 below is a synopsis of the financial literacy and mathematics content formulated by the participants.

Teacher	Financial Literacy Content	Mathematics Content	Context
SBH	*Financial Awareness*	Rational Numbers	Price difference of chili
SNV	*Financial Awareness*	Rational Numbers	Price difference of chili
RKD	*Financial Awareness*	Using percentage concepts	Online shopping
TWA	*Budgeting Plan*	Using percentage concepts	Discounted prices
APR	*Financial Awareness*	Using percentage concepts	Discounted prices and online fruit trading
FAW	*Financial Awareness*	Using percentage concepts	Discounted prices and online fruit
IST	*Budgeting Plan*	Using percentage concepts	Up to 50% off: Becoming a smart consumer
MMR	*Budgeting Plan*	Rational Number arithmetic operations	Monthly shopping
NRA	*Financial Awareness*	Rational Numbers	Planning for Hajj early
RKW	*Budgeting Plan*	Ratio and comparison concepts	Profit or loss
SRU	*Budgeting Plan*	Ratio and comparison concepts	Profit or loss

Table 4. Summary of financial literacy content and mathematics content

The hypothetical learning trajectory and the design of a sample lesson plan are described as follows. At one public school in Yogyakarta, mathematics education revolves around ratios and comparisons, while financial literacy covers budgeting plans. The financial literacy content, exemplified by the scenario "market day: profit or loss?", aims to help students apply ratios and

comparisons in financial contexts. The learning design includes two structured activities: determining product selling prices based on capital and calculating profits or losses for different beverages.

Additionally, teachers must possess knowledge of mathematics to create effective learning materials aligned with student needs. This specific design, termed knowledge of mathematics, particularly in integrating financial literacy into structured activities, showcasing teachers' abilities in lesson design that merges financial literacy with mathematics. The assessment of teachers' ability to apply acquired knowledge and skills is crucial. This level of evaluation was conducted using an observation sheet during the "practice in class" phase, this session lasted for three teaching hours (3 x 40 minutes), divided into two hours for activities based on the student worksheet and one hour for formative evaluation. Teachers began by outlining the learning objectives and presenting financial literacy scenarios that students must solve. For instance, column 4 showed RKN's introduction of ratios using the class's gender distribution aided students in completing subsequent activities.

Ratio and Proportion
Number of girls in class 7A = 18
Number of boys in class 7A = 16
Ratio of the number of boys to the number of girls = 16 : 18
Value of the ratio = 16/18

Column 4. Perception of the ratio of the number of men and women in the situation.

Figure 6 illustrates that at the 29th minute, the students had not yet realized that they could apply the concept of ratios or proportions to solve the given problem situation. To address this, RKN provided assistance by introducing a simple modeling approach for equivalent ratios using a ratio table. This was demonstrated using a scenario involving the purchase of markers.

RKN	*: "...Let's do an illustration. Suppose the price of one marker is ten thousand, what would be the price for two markers?"*
Student	*: "Twenty thousand."*
RKN	*: "And for three markers?"*
Student	*: "Thirty thousand."*
RKN	*: "How about four markers?"*
Student	*: "Forty thousand."*
RKN	*: "Good, now can you see a pattern here? One marker is ten thousand, two markers are twenty thousand, three markers are thirty thousand, and four markers are forty thousand. So, if you need to find the price for 100 markers, do you add ten repeatedly?"*
Student	*: "No, we multiply."*
RKN	*: "Exactly. So, what would be the price for 100 markers?"*
Student	*: "One million."*

RKN : "Very good! It's the same concept as the example in student worksheet where two oranges require 50 grams of sugar. If you have 1 kg of sugar, how many oranges can you get? You can use these patterns in various situations."

Figure 6: Overview of the classroom situation during the 29th minute of the lesson

Another approach, which is more intuitive, is the unit-rate method. This method involves finding the unit value and then multiplying it by the known rate to determine an unknown value. RKN's explanation to assist students demonstrates knowledge of mathematics and pedagogical skills. This competency includes a teacher's ability to present mathematical concepts appropriately for students' cognitive levels, have a deep understanding of mathematical topics, and effectively connect different topics.

Organizational support and change. The Math Fina-Flip requires support from school management, teacher mathematics learning community, and School Supervisors specializing in Mathematics. The school's endorsement of the developed learning environment model is evident in the active involvement of the school's learning community during the stages of designing contextual problems, in-class practice, and reflection. The principal plays a role in evaluating the learning environment model to ensure its successful implementation. Additionally, the learning community

and School Supervisors contribute by sharing knowledge to bolster effective teaching practices. These collaborative efforts contribute to the sustainability of the Math Fina-Flip Classroom.

Students' Learning Outcomes. Assessing the achievement of learning goals from the designed lesson plans involves administering tests to students. Throughout the learning process, teachers conduct formative assessments aligned with the learning objectives' criteria. Research findings indicate that students successfully meet the defined learning goals as outlined in the student worksheet and evaluation questions. This demonstrates the potential positive impact of the Math Fina-Flip Classroom, specifically tailored for teacher leaders, on students' learning outcomes.

DISCUSSION

The duration of the Math Fina-Flip Classroom learning environment model's implementation is planned for a total of 30 credits, equivalent to approximately 25 hours. This duration is aligned with the recommendations of Compen et al. (2019), who emphasize that teacher workshops are more effective when conducted for at least 14 hours. The model integrates the three phases of the flipped classroom approach—before, during, and after instruction—within a school-based professional learning community (see Figure 7).

These phases have been shown to effectively meet the ongoing needs for teacher professional development (Guskey, 2000; Timperley et al., 2008). Findings from this study further indicate that the structured implementation of these phases significantly contributed to enhancing teacher professionalism, particularly in designing student activities that integrate financial literacy content within mathematics instruction.

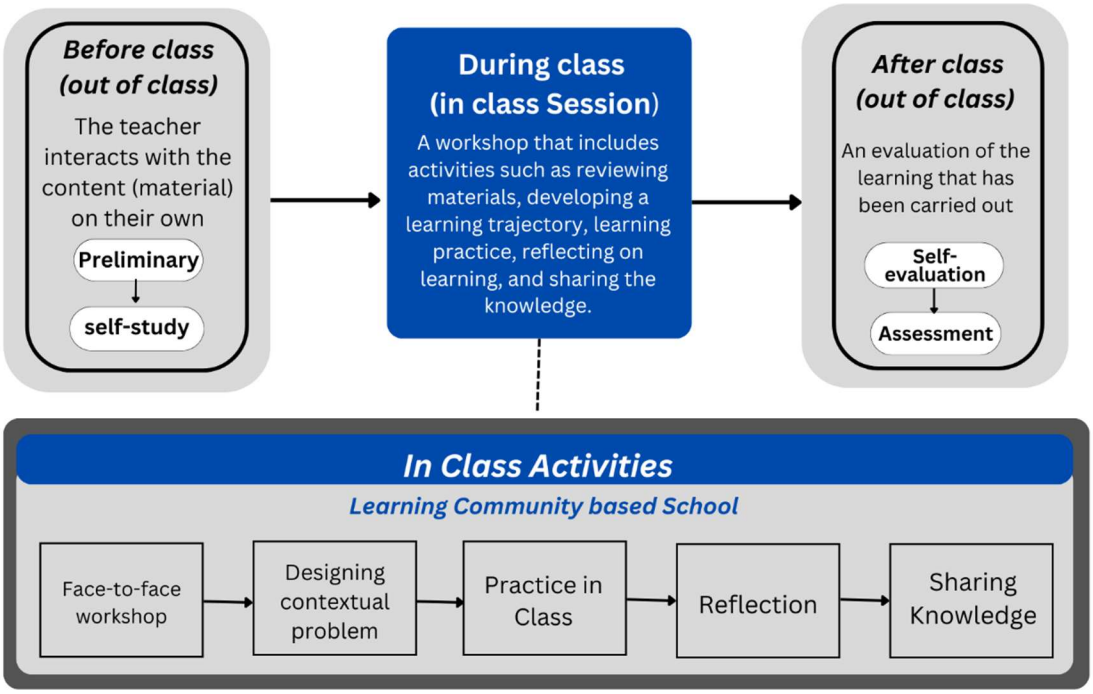


Figure 7: Math Fina-Flip Classroom Learning Environment Model

A detailed explanation of each phase, along with the underlying concepts and theoretical foundations, will be presented in the subsequent sections.

1. **Flipped Classroom Environment Out of Class: Before Class**

   The "out of class" environment was implemented through the Learning Management Systems (LMS) for a total of 13 credits or 585 minutes. In this phase, teachers engaged with content independently, allowing them to review material, take breaks, and then return to their studies (Burns, 2023). Firstly, there's the Self-study phase where teachers interacted with provided content autonomously. The aim is to establish foundational knowledge about numerical content (fractions, decimals, and percentages) and financial literacy content for secondary education. This includes learning objectives for each financial literacy content, sample activities integrating financial literacy into percentage-related math content, and examples of assessments for math content integrated with financial literacy.

   Based on observations at the end of the "out of class" phase, teachers gained basic understanding of financial literacy terms and how mathematics content integrates financial literacy elements after reviewing the provided material. This aligns with previous research emphasizing the significance of self-directed learning in teacher professional growth (Loughran, 2005), as it empowers teachers to tailor their learning to student needs and interests (Vanassche et al., 2021).

2. **Flipped Classroom Environment in Class: During Class**

The "during class" phase of the in-class environment involves face-to-face workshop activities where teachers engaged in advanced learning with their peers. These activities were designed to empower teachers to actively design mathematics lessons infused with financial literacy, practice, evaluate, discuss, and refine their lesson plans. Through collaborative learning, sharing experiences, collaborating on curriculum development, and providing mutual support, teachers can grow and develop professionally. Engaging in a learning community to enhance teacher professionalism is an effective method for improving the quality of education (Paramita et al., 2020). Establishing a professionally run learning community can create an environment that fosters the exchange of ideas and best practices, ultimately benefiting the student learning experience.

The "during class" phase spanned 19 credits (with 1 credit equivalent to 45 minutes) and comprised five stages within the school-level learning community: face-to-face workshops, designing contextual problems, in-class practice, reflection, and knowledge sharing. During the face-to-face workshops, teachers reviewed the materials covered during self-study through discussions and collaborative lesson design activities facilitated by the learning community. This activity, grounded in methods suggested by Burns (2023) and Van Campenhout (2015), enables teachers to collaboratively apply the theories they have learned. Teachers developed draft lesson plans using a teacher worksheet designed according to backward design principles, which included prompting questions to guide them in setting learning objectives, identifying assessment evidence, and designing learning activities. Workshops have consistently proven to be an effective method for enhancing teachers' abilities to design instruction that incorporates financial literacy (Burns, 2023).

Following the workshops, the stage of designing contextual problems aimed to assist teachers in developing lesson plans that align with predetermined learning objectives and are tailored to students' characteristics. Within the school's learning community, teachers collaboratively designed mathematics lessons that integrated financial literacy, creating a hypothetical learning trajectory based on the teacher worksheet.

The practice in class stage involved teachers implementing their developed lesson plans with their learning community peers. This aligns with research findings indicating that learning community-based professionalism is most effective when it includes opportunities for practical application (Sims & Fletcher-Wood, 2021). During this stage, teachers executed their lesson plans while their peers observed and recorded the learning process for subsequent reflection.

The conversation transcript during classroom implementation revealed that students were able to determine an unknown value (the price of markers) by using a method called cross-multiplication. This method involves multiplying the quantity of markers by their price; however, cross-multiplication is considered relatively abstract and not very intuitive. According to Van de Walle et al. (2021), it is typically introduced only after students have successfully solved proportional problems using more accessible reasoning strategies and visual aids, such as tape diagrams, double number lines, or ratio tables. Another, more intuitive approach is the unit-rate

method, which involves finding the unit value and then multiplying it by the known rate to determine an unknown quantity (Van de Walle et al., 2021).

Following the practice stage, the reflection stage was conducted through collaborative online activities within the school's learning community forum, where teachers collectively reviewed and discussed the learning activities they had implemented. Finally, the knowledge sharing stage was carried out offline, during which teachers evaluated and reflected on their instructional practices, shared challenges faced, and discussed feedback from students. This ongoing exchange promoted continuous improvement in teaching practices and strengthened the professional learning community.

3. **Flipped Classroom Environment Out of Class: After Class**

The flipped classroom learning environment wrapped up with activities on the LMS. In this "after class" setting, teachers tackled a final assessment comprising questions on mathematics content knowledge, financial literacy in mathematics content knowledge, understanding of student mathematical thinking, and familiarity with the curriculum. The final assessment phase spanned 1 credit, during which teachers worked through eight questions encompassing content knowledge, including mathematics content knowledge, understanding of student mathematical thinking, and familiarity with the curriculum.

This research underscores the importance of enhancing teachers' ability to design mathematics lessons infused with financial literacy, tailored to their students' characteristics. Aligned with prior findings, various factors, including professional development, supplemental curriculum materials, and teacher beliefs, have been identified as influential in shaping the quality of teaching practices (Sie & Agyei, 2024). Inadequate content knowledge and pedagogical content knowledge in financial literacy can lead teachers to employ financial contexts without meaningful connections, potentially causing students to struggle in applying mathematics to financial problem-solving. Therefore, effective and efficient learning environments need to be created by teachers. This research contributes a learning environment model, employing a framework for teacher professionalism development through blended learning and optimizing the school's learning community.

The Math Fina-Flip Classroom Learning Environment model aims to elevate the professionalism of mathematics teachers in financial literacy-infused number content. Unlike the existing teacher professionalism improvement programs in Indonesia, this model focuses on financial literacy-infused number content, facilitated through blended learning and involving the school's learning community. However, integrating financial literacy into mathematics education poses challenges. Nevertheless, interventions through the Math Fina-Flip Classroom Learning Environment model show promising effects, measured using Guskey's five levels. This aligns with Blue & Grootenboer's (2017) view that professional development programs emphasizing financial literacy

can significantly enhance teachers' confidence and skills in integrating these topics into their curriculum.

CONCLUSIONS

This research emphasizes the need to improve teachers' ability to design math lessons that integrate financial literacy tailored to students' characteristics. Without strong content knowledge and pedagogical content knowledge in financial literacy, teachers may use financial contexts without meaningful connections, leading to student errors in applying math to financial problem-solving. Therefore, effective learning environments must be created. This study developed a learning environment model using a framework for teacher professionalism, designed with blended learning and optimizing school communities. The Math Fina-Flip Classroom enhances math teachers' professionalism in financial literacy-infused content. Unlike the existing programs, it focuses on financial literacy in math through blended learning involving school communities, though introducing financial literacy in math education is challenging.

Findings from discussions and evaluations with Math teachers in Yogyakarta City reveal several insights. First, enhancing professionalism with specific content positively impacts knowledge of mathematics and pedagogical skills, particularly in integrating financial literacy. Second, the model includes six professionalism features: content, program coherence, ownership, active learning, duration, participant engagement, and ICT integration. Third, the model follows a flipped classroom approach: "before, during, after" phases. Collaboration within learning communities supports lesson planning, observation, reflection, and sharing best practices. While the research follows procedures, weaknesses such as inadequate duration in the "during" phase were noted. This may impact program effectiveness, as participants may lack time to fully understand and apply materials. The model's continuous learning cycle could be improved to enhance teacher professionalism further.

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APPENDIX

Stage (Syntax)	Material	Activities	Objectives	Credit
Preliminary				
Preliminary	Program Design	Initial meeting to coordinate the activities	Delivering the program flow and schedule making	2 credits
Environment of Flipped *Classroom*: *Before Class (out of class)*				
Quiz	Materials that are in accordance with the training	Teacher work on questions consisting of *mathematics content knowledge*, *financial in mathematic content knowledge*, *knowledge of student mathematical thinking*, dan *knowledge of the curriculum*	Knowing the participants' initial knowledge about teachers' knowledge consisting of *mathematics content knowledge*, *financial in mathematic content knowledge*, *knowledge of student mathematical thinking*, dan *knowledge of the curriculum*	1 credit
Self-study	▪ Financial literacy guidelines ▪ Number book ▪ Learning module example	Teacher interacts with the content (material) that has been provided independently	▪ Teacher receives initial knowledge concerning the design of number content learning (decimal and percentage), financial literacy content, and learning module example of financial literacy-contained learning module for VII Class	4 credits
	▪ Teacher Activities Sheet -1 (LK-1) * ▪ Teacher Activities Sheet -2 (LK-2) * ▪ Teacher Activities Sheet -3 (LK-3) *	Teacher interacts with the Teacher Activities Sheet independently	▪ Teachers are able to determine learning objectives and essential questions by working on activity 1 ▪ Teachers are able to determine the achievement of number content learning competencies, financial literacy learning competency achievements, and are able to analyze the appropriate financial literacy content ▪ Teachers are able to formulate indicators of learning competency achievement.	8 credits

Stage (Syntax)	Material	Activities	Objectives	Credit
Environment of Flipped *Classroom*: *During Class (in class)*				
Face-to-face workshop	Lesson plan draft	*Face-to-face* workshops that contain review activities of materials that have been studied by teachers in self-study through presentations of materials and discussions in order to develop learning designs. This activity is divided into two meetings, namely online and offline.	Teachers are able to make lesson plan draft based on predetermined learning objectives.	7 credits (3 online, 4 offline)
Designing contextual problem	Lesson plan making	Lesson plan making for number content containing financial literacy collaboratively in learning communities within schools.	Teachers are able to carry out learning activities based on learning objectives that have been determined based on the characteristics of students in each school.	4 credits
Practice in Class	Observation sheet	Learning practices from the lesson plan that has been developed. Teams in the learning community conduct classroom observations together.	Teachers implement learning practice in the classroom based on the designed plan and other teachers observe the class. The learning process was recorded as a joint reflection material.	3 credits
Reflection	Reflection sheet	Reflection based on learning practices was conducted in a learning community forum in schools.	Conducting learning reflection in a learning community	2 credits
Environment of Flipped *Classroom:* *After Class (out of class)*				
Sharing Knowledge	Follow-up plan	Online activities that aim to evaluate and discuss learning practices that have been carried out in the learning community	Finding and sharing best practice from each school	3 credits
Assessment *	Materials in accordance with the training	Participants work on final assessment questions that contain *mathematics content knowledge, financial in mathematics*	Knowing the participants' final knowledge about *mathematics content knowledge*, *financial in mathematic content knowledge*, *knowledge of student mathematical*	1 credit

Stage (Syntax)	Material	Activities	Objectives	Credit
		content knowledge, knowledge of student mathematical thinking, and knowledge of the curriculum	*thinking*, dan *knowledge of the curriculum*	
Total Credit				**35 credits**

Appendix 1. Prototype 2 Description of activities and total credit of Math Fina-Flip Classroom Learning Environment Model