Adjusted Framework of M-Learning in Blended Learning System for Mathematics Study Field of Junior High School Level VII

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Abstract. The 2013 curriculum requires teachers to be more productive, creative, and innovative in encouraging students to be more independent by strengthening attitudes, skills and knowledge. Teachers are given the options to create lesson plan according to the environment and conditions of their students. At the junior level, Core Competence (KI) and Basic Competence (KD) have been completely designed. In addition, there had already guidebooks, both for teacher manuals (Master's Books) and for learners (Student Books). The lesson plan and guidebooks which already exist are intended only for learning in the classroom/in-school. Many alternative classrooms and alternatives learning models opened up using educational technology. The advance of educational technology opened opportunity for combination of class interaction using mobile learning applications. Mobile learning has rapidly evolved in education for the last ten years and many initiatives have been conducted worldwide. However, few of these efforts have produced any lasting outcomes. It is evident that mobile education applications are complex and hence, will not become sustainable. Long-term sustainability remains a risk. Long-term sustainability usually was resulted from continuous adaptation to changing conditions [4]. Frameworks are therefore required to avoid sustainability pitfalls. The implementation should start from simple environment then gradually become complex through adaptation steps. Therefore, our paper developed the framework of mobile learning (m-learning) adaptation for grade 7th (junior high school). The environment setup was blended mobile learning (not full mobile learning) and emphasize on Algebra. The research is done by R&D method (research and development). Results of the framework includes requirements and adaptation steps. The adjusted m-learning framework is designed to be a guidance for teachers to adopt m-learning to support blended learning environments. During mock-up prototype, the adjusted framework demonstrates how to make successful implementation of early blended mobile learning through framework. The Social area is in focus of adaptation because participation is important to improve the sustainability. From the short practice of mock-up prototype, blended mobile learning can be an effective pedagogical model in supporting students in inquiry-based learning.

1. Introduction
Education in the future is more likely in the form of education and training by applying the distance education (distance learning). The lesson materials developed tend to combine conventional learning with blended learning. [1] There is no consensus on a single definition for blended learning. Some
references define blended learning differently. Learning that combines conventional learning (face to face) with learning based on information technology is known as Blended Learning. [2]

Blended Learning does not replace the conventional learning in the classroom (face to face), but it reinforces the learning model through the educational technology. Blended Learning focuses primarily on students. Students must be independent at certain times. The learning atmosphere requires students to play a more active role in their learning. Students are encouraged to obtain enrichment materials with their own efforts and initiatives. Through Blended Learning the learning system becomes more flexible and not rigid.

In general, blended learning is implemented in the form of: 1) integration / integration of traditional learning with application-based approach (on-line web and mobile application); 2) a combination of media and equipment (eg smartphones) used in learning environments, and 3) a combination of teaching and learning approaches regardless of the technology used. In this study, blended learning is interpreted as the integration of face-to-face learning and learning methods using smartphone devices. The term used in this study is Blended Mobile Learning (blended m-learning). Blended Mobile Learning (m-learning) consists of several tools; learning materials, software, instructional planning, learning media, and smartphone devices. The learning process does not stop in the classroom, but students can continue it at home and even start learning from home.

Mobile learning itself has rapidly developed in the last ten years and many initiatives have been conducted worldwide. However, few of these researches have produced any lasting outcomes. It is evident that mobile applications are complex, and hence will not become sustainable. Long-term sustainability results from continuous adaptation to changing conditions [3]. Frameworks are therefore required to avoid sustainability pitfalls. The framework defines the life-cycle of a mobile learning initiative and identifies the importance of emphasizing the concepts of scalability and sustainability during the development processes.

The former result research [4] defines the life-cycle of a mobile learning initiative and identifies the importance of emphasizing the concepts of scalability and sustainability during the development process. The resulted framework could reduce the complexity of mobile learning and its settings, and a means to improve the outcomes of mobile learning initiatives in terms of long lasting usable results. This framework was analyzed from eight scientific publications that have been presented at different international conferences. Five of the them explore the field of mobile learning and its practice while the other three publications present the central ideas that serve as the basis for the proposed framework, how it has been developed, and the motivations behind its creation.

This framework will be examined in junior high school 7th grade in Mathematics at SMPN 77 Jakarta Pusat. 7th grade of SMPN 77 has implemented 2013 curriculum and its learning has been using a scientific approach. However, the implementation of mathematics with a scientific approach still difficult. This is caused by the participation of students in learning are poor.

Mathematics for junior high school (SMP/MTs) is directed to encourage students to find out knowledge from various sources, able to formulate problems, and solve simple problems. Mathematics aimed to have math skills. Math skills are part of the life skills that students must possess especially in the reasoning, communication, and problem solving encountered in students’ daily lives. [4] Therefore, Blended Learning is potentially developed for Mathematics subjects. There are some materials which is essential in mathematics in 2013 curriculum. Algebra is essential to students, because students have not received this material in Elementary School. The material on algebra should be mastered by the students before the material of linear equations and linear inequality of one variable were delivered. The scope of algebra includes: variables, coefficients, constants, similar tribes to its operations (addition, subtraction, multiplication, and division).

2. Related Research

The “Framework for sustainable mobile learning in schools” that [5] was developed in the context of an Australian school. The school’s efforts sought to introduce and sustain an mLearn programme using personal digital assistants (PDAs), and the school allocated resources to internally fund the
programme. Sustainability of mobile technology integration in schools has thus been researched in other countries. However, a sustainability framework where teachers and district officials’ perspectives were applied to refine a sustainability framework in the context of resource-constrained environments is novel. This framework worked as full mobile learning initiative.

[8] propose an analytic self-regulated learning (SRL) model of mobile learning as a conceptual framework for designing and analyzing mobile learning. SRL notion of self-regulation as the core (Figure 1).

![Figure 1. SRL model for Mobile Learning](image)

The centre of the model referring to the students’ characteristics that function as internal driving forces initiating and sustaining a self-regulated mobile learning process. The key personal factors include domain knowledge, prior experiences, motivation, and metacognitive awareness, epistemological beliefs, and so on. Mobile learning processes that are regarded as manifestation/exercises of agency (fundamentally composed of motivation and metacognition) can be understood, analyzed, and assessed from the theories and methodologies of SRL. Mobile learning activities are supposed to be mediated by mobile technologies and devices, which presumably function as social, cognitive, and metacognitive tools. The existing studies in mobile learning largely focus on the social and cognitive functions but ignore the metacognitive function.

In [1], the use of Blended Learning in Indonesian Language Learning at SD Insan Amanah was conducted in the classroom. Observations made on student motivation and activity and also students’ learning ability. Learning begins with apperception activities by inviting all students to access (logging in first) the website [http://elearning.insanamanah.sch.id](http://elearning.insanamanah.sch.id) and then students begin to open the lesson material and work on. The student's enthusiastic starts from the beginning of the lesson. Students’ passion is also visible when online questions is marked with right answer. Sustainability to improve motivation and ability to learn in SD Insan Amanah depend from these supporting factors. These are:

1. great student enthusiasm for learning with Blended Learning;
2. the percentage of students which has Internet access is increasing;
3. many schools have facilities that support Internet access in computer lab;
4. online assignment makes students more independent;
5. learning process will become more innovative and interactive with no time limit so that students feel enjoy learning compared when learning is done conventionally; and
6. good cooperation and responsiveness from the principal and other teachers.

This was blended learning alternative using website.

The framework [4] consists of a life-cycle that divides an initiative into four stages: Idea, Trial, Project, and Release. The purpose and key activities of each stage are summarized in Table 1. Each stage is divided into four Areas of concern: Technology, Learning, Social, and Organization. These represent the four major groups of stakeholders as well as the four main sources of risks. The four areas are linked together and depend on each other. A change to one will affect the others. In order to
reason about these propagating changes, the concept of Equilibrium is used to reason about the state of a stage. If a stage is in equilibrium, all changes have propagated and the effects of this propagation have been dealt with (or at least considered). Equilibrium is reached for a stage when there is no longer a need for reaction and adjustment.

Table 1. Result of Adjusted Development Framework

| Stage | Purpose | Outcome | Key Activities |
|-------|---------|---------|----------------|
| 1 Ideas | Establish soundness of the idea | Plan of how to go ahead | Investigate technology |
| | Establish technical platform | | Investigate feasibility Surveys |
| 2 Trial | Test the idea | Information about what works and what does not | Produce learning materials |
| | Elaborate the learning | Considerations made on what needs to change to move ahead | Produce learning tools |
| | Small scale testing | | Offer the learning material |
| 3 Project | Speed launch/display | Expand beyond initiators | Measure how well it is received |
| | Large scale testing | Information on how the material is received, both in terms of students and teachers experience | Similar to trial but larger scale |
| | Formalized in terms of resources and outcome | | Report to funding organization |
| | Establish social interplay | | |
| 4 Release | Hand over to target organization | Implemented and in use | Integrate into the organization (training) |
| | Remove reliance on initiators | | Establish facilities (servers, studios, etc) |

In order to reduce the complexity introduced by the areas of concern and the propagating changes, the concept of Focus is used. During each stage of the evolution, one (or at most a few) area of concern is in focus. The area in focus represents the area where the development is currently the most active, and where the direct changes will occur. The other areas are only changed through propagated effects of a change to the area in focus. Focus thus provides a means to reduce complexity and a way to introduce a sequential work-flow to the framework. Figure 2 depicts the framework and the major concepts.

![Figure 2. The Life-Cycle and the Areas of Concern](image)

The major role of the framework is to guide the development practices not to tie down the models, methods, and tools, which follows while the framework is in use. Hence, the framework is there to be a work and communication platform and provide a theoretical take on the information systems development occurring in mobile learning.
3. Method and Tools
To design sustainable blended mobile learning classroom in practices, we took research approach to address simple problems in real classroom of Mathematics 7th grade in collaboration with teachers. As researchers from the university, we serve as meso-level actors to recontextualize pedagogic discourse [8] and help the school students and teachers interpret curricula of blended mobile learning and actualize them into teaching and learning practices.

The iterative cycle of research involving four linked phases, illustrated in Figure 3 [9]. Field studies and survey research have been planned, sebagai data awal, in turn the gathering of the empirical data of student’s mobile device. Analisis data awal tersebut help to increase the competence and self-help ability in the field of mobile learning.

Concerning the curricular commitment, Blended Mobile Learning use of the 5E Instructional Model [10]. This 5Es model consists of the following phases: engagement, exploration, explanation, elaboration, and evaluation. The model is used to sequence the learning activities in Mathematics 7th. Blended mobile learning is designed to provide opportunities for the student in the engagement phase of 5E using Mobile Learning Environment (MLE). In the Engage phase, the teacher motivates the inquiry by doing some video demonstration and posing some questions. These experiences engage the students with an event or question.

We designed four Lesson Plan (RPP: Rencana Pelaksanaan Pembelajaran) units in the first semester of Algebra emphasized on engagement and exploration. Before, during and after first cycle for RPP unit, we reflected upon the lessons and apply such understanding to inform the design of the next RPP unit (iterative as shown at Fig. 3). This was to facilitate the students’ gradual changes in their habits towards learning seamlessly. For example, while the earlier activities involve the students expressing their understanding using MLE or capturing artifacts of the classroom and insert them to the RPP. [8]

The designed RPP was developed with the use of software apps on the Moodle MLE (Mobile Learning Environment) that runs on an Android operating system. The Moodle MLE enables teachers to create courses easily via its online learning management system and it enables students to easily personalize their learning experiences. Moodle MLE supports teachers in creating complete, coordinated, curriculum-based lessons that employ multiple media and applications (e.g., video, images, documents, animations, and the like) also multiple activities. All types of files can be uploaded and accessed through Moodle, but the student needs to have the correct software to be able to open them. There are 14 different types of activities in the standard Moodle, e.g., Assignments, Chat, Choice, Feedback, Forum, Quiz, and Survey.

The site of research is domained https://lipursukardjo.moodlecloud.com/. MoodleCloud supports the most recent versions of browsers (Google Chrome, Firefox, Safari, and Internet Explorer). To access MoodleCloud sites on mobile devices, students should install the Moodle Mobile app. The latest version of our Moodle Mobile app for Android (Moodle Mobile 3.3.2, release date 29 September 2017) can be obtained from the Google Play Store (recommended). Moodle Mobile was hosted on 27 July 2017. The research was conducted in SMPN 77 Jakarta Pusat.
4. Result and Analysis
The teachers’ challenges faced in blended mobile learning assessed in school. During interviews, the teachers raised these concerns:
1. They are not sure if the designed lesson plans in the right way. Some teachers expressed doubts on the students’ ability for doing self-directed learning.
2. Some teachers expressed that they needed help in developing and practicing questioning skills in the classroom.
3. Students’ smartphones were varied.
4. Some regulations need to be reviewed.
The first response provide support to the teachers by giving personalized feedback after prototype lesson, and by helping the teachers to adapt the lessons for different ability students. The second response was for sharing in weekly meetings to discuss skills via analyzing recorded classroom sessions.

4.1. The Adaptation Scenario
The socio-technical system for mobile learning consists of three systems: the social, the personal and the technical [11]. Technology is the hardware and software used, Learning includes the pedagogy and teaching goals, while Social includes how students and teachers use and interact using the technology.

The Social area is more focus because teachers and students’ participation needed to improve the sustainability. The adaptation scenario was starting from a few users (teacher and students) with mock-up prototypes. At the SMPN 77 Jakarta, we have set 35 students (1 teachers) as mock-up prototype. Thus, in going to scale, the issue is learning process and infrastructure – how do we provide blended mobile learning supports and Internet access and make it more reliable and more stand-alone. The scale-up comprises these multiple dimensions:
1. Mobilized curricula (to lead students to self-directed learning and to bridging informal learning spaces),
2. Teacher facilitation skills,
3. Teacher readiness,
4. Student facilitation skills, and
5. Student readiness,
6. Technology infrastructure, e.g. WiFi and 3G/4G Connectivity; availability of mobile devices in 1:1.
From the short practice, the area of social is an effective pedagogical aspect of blended mobile learning model in supporting students with inquiry-based learning. Developed inquiry-based learning features equipped with learning media such as;
- a summary of the subject matter;
- learning videos created according to Engagement, Exploration and Explanation phase targets (drama, speech, poetry reading, etc.)
- animation;
• images from various sources on the internet to aid the learning process; and
• various interactive quiz questions with various models such as: multiple choice, short field, true false, matching, and TTS.

Video material is the most suitable/popular media for students. Students can replay on certain parts to see a more focused picture. This is difficult to achieve when video is delivered through media such as television. It is suitable to teach the material and faster to deliver messages than text media.

To be able to take advantage of mobile technologies, the revised lesson plan and the formative assessments of current learning processes need to be adjusted.

4.2. The Adjusted Adaptation Framework
The former result research will be adjusted framework ( [11] ) and summarized in Table 2. The adjusted framework was created with a focus on Engagement activities, lesson plan, and its supporting materials.
### Table 2. Result of Adjusted Development Framework

| Stage | Purpose | Outcome | Key Activities |
|-------|---------|---------|----------------|
| 1 Ideas | Establish soundness of the idea | Plan of how to go ahead | Investigate technology Investigate feasibility Surveys Investigate the migration/blended scenario |
| | Establish technical platform | | |
| 2 Trial | Test the idea | Information about what works and what does not | Produce learning materials Produce learning tools |
| | Elaborate the learning | Considerations made on what needs to change to move ahead | Offer the learning material |
| | Small scale testing | | |
| 3 Project | Speed launch/display | Expand beyond initiators | Similar to trial but larger scale |
| | Large scale testing | Information on how the material is received, both in terms of students and teachers experience | Report to funding organization |
| | Formalized in terms of resources and outcome | | |
| | Establish social interplay | | |
| 4 Release | Hand over to target organization | Implemented and in use | Integrate into the organization (training) |
| | Remove reliance on initiators | | Establish facilities (servers, studios, etc) |

The migration scenario will take portion more stage 1, 2, and 3 (see table below).

| Social | Entities involvements (teachers, students, parents). |
|--------|---------------------------------------------------|
| Technological | Android based (based on majority smartphones used in school). Get used to mobile learning applications. |
| Pedagogical | Set the roles (teachers, parents, students, lesson plans, learning materials, assesments). |

**Figure 7.** Focus for adaptable mobile learning in the 7th grade of Mathematics

In the revised lesson plan, the engagement activities help students to make connections with what they know and can do. During the engagement phase, the teacher can stimulate students’ curiosity through:

- Create a need to know/create an interest
- Focus on a problem/ask questions

In the Evaluate phase, the teacher reviews the work done on MLE to detect students’ developing conceptions of the Algebra. The four Lesson Plan (RPP: Rencana Pelaksanaan Pembelajaran) units in the first semester of Algebra emphasized on engagement and exploration. Before, during and after first cycle for RPP unit, we reflected upon the lessons and apply such understanding to inform the design of the next RPP unit (iterative as shown at Fig. 3). This was to facilitate the students’ gradual changes in their habits towards learning seamlessly. For example, the earlier activities involve the students expressing their understanding using MLE should inserted to the RPP. [8] The designed RPP was developed with the use of software apps on the Moodle MLE (Mobile Learning Environment) that runs on an Android operating system.
5. Conclusion

As an enabler of new teaching learning activities supported by mobile technologies. The research implemented innovations of former research was adjusted for adoption of blended mobile learning by schools in formal learning of SMPN 77 7th grade. This adjusted framework demonstrates how to make successful implementation of early mobile learning sustainability through blended mobile learning adaptation framework. The Social area is in focus of adaptation adjusted framework because participation is important to improve the sustainability. From the short practice of mock-up prototype, blended mobile learning can be an effective pedagogical model in supporting students in inquiry-based learning.

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