Smart city design in learning science to grow 21st century skills of elementary school student

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Abstract. The impact of technological developments, especially information and communication technology (ICT) has impacted on various aspects of life including education. The dynamics of technological development demand new ways and cultures in people's lives as 21st century skills are becoming an important issue today. Indonesia has made a revision and innovation of the curriculum in response to these demands but that effort is not as easy as turning a palm. The results of field studies show that there is an imbalance between the implementation and the outputs and outcomes of the established curriculum. One of the constraining factors is the lack of collaboration in learning, where learning is only left to the school or teachers. Innovation of science learning by using the concept of smart city to be an alternative problem solving proposed by researchers. The concept of smart city indicates transparency in the learning process so that parents can contribute related to the progress of their children. This learning program consists of several features that enable the establishment of communication of students, teachers, and parents in synergy. Thus collaboration in implementing learning can be formed so that the education received by the child to be optimal.

1. Introduction

Natural Science is an accumulation of content, process and context [1]. Content is matters relating to facts, definitions, concepts, principles, theories, models and terminology. The process deals with the skills to acquire or discover concepts and principles. Contexts include three elements: individual, community and overall school experience (curriculum). The curriculum in science learning is a reference that is used on how to teach science well. Innovation is always happening in the curriculum towards the direction of the formation of better quality of education.

The science learning curriculum 2013 is a curriculum innovation in Indonesia. Innovation is influenced by the development of knowledge in each period, as well as 21st century skills that are developing in this period. 21st century skills lead learners to "how to learn, how to work, tools of work, and living in the word," and so the context of core knowledge instruction, students must also learn the essential skills for success in today's world, such as critical thinking, problem solving, communication and collaboration [2].

The 2013 science curriculum at the basic level leads learners to recognize, respond to, appreciate science and technology, and inculcate critical thinking, critical, creative, and independent behaviors [3].
One of the core abilities to be developed is that learners should have honest, disciplined, responsible, caring, confident, and homeland loving behaviors in interacting with family, friends, neighbors, and teachers [3]. Transparency and interactivity between students, teachers, parents is an ability that must be developed based on these competencies. Thus, in science learning should be created communication involving students, teachers and parents.

The direction of learning based on the previous analysis leads to learning that focuses on the community (students, teachers and parents). Collaboration and good communication in learning is expected to build creativity and critical thinking skills to solve the problem. However, until now no research has been developed in such a direction, as other studies have suggested that "we found that despite reduced class time, the student learning outcomes were not hindered; in fact, the implementation of the UIUC MLMs resulted in the development of multimedia learning modules (MLMs) [4]. The researcher's focus is only on students and teachers, not with parents. Parents have a very important role in education obtained by their children. Parents have a role as a manager in the education of their children, thus parents must understand the true development of his child.

Based on this, researchers focused their research on the development of science-learning programs that could facilitate collaborative learning between students, teachers and parents to achieve output and outcomes from the 2013 curriculum where 21st century skills as the core of competencies are built.

2. Experimental Method

2.1. Study existing of 21st century skills

21st century skills are the abilities that human beings must build in the 21st century. Based on the results of the research, humans are successful in this century if they have 21st century skills. The US-based Partnership for 21st Century Skills (P21) identifies the competencies required in the 21st century including "The 4Cs" - communication, collaboration, critical thinking, and creativity. These competencies are importantly taught to students in the context of core study areas and 21st century themes. Assessment and Teaching of 21st Century Skills (ATC21S) categorizes 21st century skills into 4 categories: way of thinking, way of working, tools for working and skills for living in the world [2].

Indonesia is one of the countries that quickly respond to the development of global issues. The 2013 curriculum is a curriculum innovation based on 21st century skills that are trending at the moment. Transparency and interactivity between students, teachers and parents are an ability that must be developed based on these competencies. Thus, in science learning should be created communication involving students, teachers and parents.

One focus in this research is to find out how far the implementation of the 2013 curriculum has been in building the skills of the 21st century elementary school students. The design used in this research is survey. This design does not treat or manipulate the subject of research but aims to study the population through the characteristics, opinions, beliefs, and behaviors of the population we examine [5]. The sample taken in this research is one of the private primary schools in Tasikmalaya accordance with predetermined criteria, so that the sampling technique is purposive sampling.

The research was conducted more deeply through formal and non-formal interviews of science teachers, students' analysis of responses to science learning, field observations that included observation of the learning process to learning support facilities, and document studies on the design of the learning program used. The results of the data are qualitatively processed.

2.2. Study of smart city model

Smart city can be declared as smart city or digital city where ICT usage becomes the core in its development [6]. It is said to be a smart city if the city can know (sensing) the state of the city in it, understand (understanding) the situation further, and can take action (acting) to the problem. city can be formed as smart city if smart governance, smart economy, smart people, smart mobility, smart environment, and smart living are formed [7].

Smart city is considered as the future city, managerial government and the level of mobility that is packed in a system. The establishment of complex systems will facilitate the public in assessing information about urban areas, whether related to urban conditions, mobility, to the transparency of
managerial government. Smart city establishment is inseparable in the role of government, universities and industry [8]. The concept states that there is a connection between the components of smart city with triple helix model, where in the process there is reciprocity between the role of government, universities, and industry. The government has a role in designing and managing related policies in the formation of smart city, while the industry as a component manufacturer is needed in the formation of smart city. University has a role in education, namely to form a superior human resources, which can develop smart city in the future.

Smart city in this research is used as the basis for building learning program. Transparency in smart city system becomes one of the tools of the proposed solution. This allows for the synergy of collaboration between teachers, students and parents so as to create a learning conducive.

3. Result and Discussion

School is a formal institution where children get education. The quality of the school becomes the determinant of every parent in choosing education for his child. The quality in question is reflected in the accreditation of the school. Accreditation both indicates good service and academic quality with supporting facilities, thus the enthusiasts who enter the school become high. As with one of the private schools that became the object of research, the school is one of the famous schools with good accreditation. The high quality of the school has an impact on the cost of education that is not small, but the interest from the school is very high. Schools in this study are already familiar with applying the 2013 curriculum, where 21st century skills are at the core of the competencies being built.

Researchers in this case try to see real conditions that occur in the field associated with the achievement of competence built in accordance with 21st century skills. Data collection in this study is using various techniques, including through interviews, analysis of student responses, and other relevant documents that support the implementation research activities. Based on this, there are several findings as follows.

The low contribution of parents in the process of child education becomes one of the main problems. Parents’ responsibilities are aborted after choosing the best school for their children. School is considered as the most important institution in educating children, thereby full responsibility is delegated to the school teacher. On the other hand, the limited time between students and teachers when in school becomes one of the obstacles. The impact of this, the teacher's learning becomes not optimal, the teacher cannot control fully related to the development of their students. The lack of learning gained by students is reflected in the students' understanding of science learning. Student's daily re-examination of heat transfer material can be shown in table 1.

| Students name | Test scores | Students name | Test scores |
|---------------|-------------|---------------|-------------|
| S01           | 70          | S10           | 100         |
| S02           | 30          | S11           | 100         |
| S03           | 50          | S12           | 90          |
| S04           | 60          | S13           | 85          |
| S05           | 50          | S14           | 40          |
| S06           | 55          | S15           | 40          |
| S07           | 30          | S16           | 85          |
| S08           | 50          | S18           | 80          |
| S09           | 80          |               |             |

Table 1. Recapitulation of student's daily re-examination on heat transfer material.

Based on the table 1 of students’ daily re-examination, 59% of students are under minimum completeness criteria (KKM), even for the mean score of all students are still well below the established standard (64.4 of 76 as KKM set). This indicates a low understanding of student concepts derived from less than optimal learning.

Parents’ contribution to children's education becomes very important. Family education is the most important education that children get, but there are no facilities that support it. Facts on the ground show

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that in addition to the low understanding of students resulting from less optimal learning obtained by children, most of the child's character is strongly influenced by the environment of his family. There are some children who are grouped into children who need guidance (always make the act when the class, difficult to set, tend to be dominant and do not want to work together, selfish, etc.), after being traced more deeply in general they have problems when in the family. Lack of attention from the family makes them feel like to be noticed by the surrounding environment. Thus, the ability of students in collaboration (collaborative) solve problems cannot be built properly.

Based on the above problems, researchers try to develop a learning program that can facilitate communication synergy between students, teachers and parents so that learning becomes more optimal. Communication in that case can be formed if there is a link that can connect it. The design of learning programs developed in this study using the basic concept of smart city.

Smart city is a future city concept where the use of information and communication technology (ICT) becomes basic in its formation. Communication, mobility, health, etc. are all controlled in the use of ICT, so that people can easily access the conditions associated with their own city [9]. Smart city based learning programs in this regard take the concept of using ICT in creating a learning community environment, where communication and transparency between teachers, students and parents can be formed. The learning system that utilizes ICT systematically by integrating all the components of learning, including learning interactions across space and time, with guaranteed quality [10]. ICT-based management systems can facilitate a systematic, comprehensive, integrated, and more effective learning process [11]. ICT developed in this program is the application of android smartphone, it is because android smartphone is general, teachers, parents, even students have many who have and can operate it. Figure 1 shows an overview of science learning using the concept of smart city.

![Image of smart city design in learning science](image)

**Figure 1.** Smart city design in learning science

Based on the picture above, android smartphone is used in connecting the communication facilities of students, teachers, and parents. Science programs applied in this android can be assessed by students, teachers and parents. Through this program, students' transparency and development can be controlled. For teachers, this program provides features related to how good science learning innovations, for students to be available materials as a source of learning, while for parents to control the development of children, because in this program parents can see the progress of learning children, weaknesses and things that must developed by his son, besides this, there is also a practical contextual concept in life that can be learned by his parents. Therefore, through this learning program can be formed learning communities (students, teachers, and parents) in accordance with the curriculum where the essence of competence is a 21st century skills.
In general, the function in this program is divided into four parts, namely as communication, collaboration, coordination and evaluation in learning involving students, teachers and parents. The communication in this program is built with multiple directions that include students-teachers, students - parents, teachers - parents, students - teachers - parents, students, parents - parents in general can be seen in figure 2.

![Communication built in smart city design in learning science](image)

**Figure 2.** Communication built in smart city design in learning science

Communication in this program is synchronized and non-synchronized. Synchronization communication can be formed when every user in the program is active, so that communication can occur at one time. While in non-synchronized communication built through chat and not necessarily in one time, user can reply to other communications at other times.

Collaborations in the program include interactions between students, teachers, and parents. The teacher contributes his / her knowledge in the learning of the students, in addition to the teacher's occurrence also reports the extent of his / her students related to the evaluation result to his / her parents, so that the parent understands the state of his or her students. Students can do the learning of their teachers, besides that through this program students can also request learning facilities which is one of the needs in learning to his parents. The nature of transparent in learning is to make parents understand the needs of children in learning. On the other hand, parents can make their contributions to teachers related to the characteristics of their children, so teachers can find out the right learning for their students.

Coordination in the program is limited to teacher and parent interaction. In this case there are some things that are privacy that students cannot know directly. This is related to the weakness of the students and the nature and character of the students. Weaknesses of students can parents know through the teacher through the process of learning and evaluation results. Character of students who signify, the lack of students can teachers understand through information from their parents, because parents are more understand related to it. Thus with the existence of such coordination, it enables the creation of optimal learning for students.

Evaluation is the result of achievement during the learning process. Evaluation in this program includes the results of learning in the form of repetition, tasks, and some reports related to the learning process that has been done. Evaluation in this program is informed by teachers to students and parents. The essence of the information submitted is the same, but in the case of different delivery according to its capacity. The information presented to the students is motivational while for the parents as an improvement to the deficiencies experienced by their children.

Based on the above explanation, with the development of smart city based learning program, competence on 21st century skills can be developed. Table 2 shows an overview of the association of smart city-based learning with competence in the 21st century.
Table 2. The association of smart city-based learning with 21st century skills competence.

| Smart city based learning                                                                 | 21st century skill competencies                                    |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Communication: the interaction built into this program that includes multiple student,  | Communication                                                     |
| teacher and parent interactions.                                                        | Collaborative, creative, innovative.                               |
| Collaboration: transparency in learning creates a synergic interaction situation between | Creative, innovative.                                             |
| students, teachers and parents who all contribute according to their capacity to produce | Creative learning will produce creative and innovative children's  |
| optimal learning.                                                                        | abilities.                                                        |
| Coordination: privacy is one of the things that creates coordination in this program,    | Creative, innovative.                                             |
| there are things that cannot be known directly by the students but very urgent to be      | Critical thinking skills, problem solving.                        |
| known by their parents, for example related to the weakness of children, bad character  |                                                                   |
| of the child. With a good coordination can produce learning innovations that enable     |                                                                   |
| students to develop according to their character.                                       |                                                                   |
| Evaluation: an indication of progress and weaknesses experienced by children through    |                                                                   |
| this learning program can be seen from the evaluation results. Evaluate and test the     |                                                                   |
| ability of children related just where child understanding in solving problems posed.    |                                                                   |

4. Conclusion
The 21st century skill is one of the issues that become the trend at this time. Competence in 21st century skills becomes the reference of every educational curriculum. One of our country with its 2013 curriculum, however it is not easy to implement. The facts in the field show there is still imbalance between the implementation with the outcome set in the curriculum. The low contribution of parents to the education of children is the main cause in this regard. Education seems to be the responsibility of the teacher alone, the communication synergy between students, teachers and parents are not well awakened so that the learning obtained by students is not optimal. Smart city design in the development of science learning program becomes an alternative in solving the problem. The features available in the program allow parents to control their child's progress, facilitate teacher access, even facilitate students by learning some content in addition to learning. This program connects the interaction of students, teachers and parents in synergy so that learning becomes more optimal.

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