Envisioning Science Environment Technology and Society

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Abstract. Science Environment Technology and Society (SETS) approach helps students to connect science concept with the other aspects. This allows them to achieve a clearer depiction of how each concept is linked with the other concepts in SETS. Taking SETS into account will guide students to utilize science as a productive concept in inventing and developing technology, while minimizing its negative impacts on the environment and society. This article discusses the implementation of Sundanese local wisdoms, that can be found in the local stilt house (rumah panggung), in the Building Construction subject in vocational high school on Building Drawing Technique expertise. The stilt house structural system employs ties, pupurus joints, and wedges on its floor, wall, and truss frames, as well as its beams. This local knowledge was incorporated into the Building Construction learning program and applied on the following basic competences: applying wood’s specification and characteristics for building construction, managing wood’s specification and characteristics for building construction, analyzing building structure’s type and function based on their characteristics, reasoning building structure’s type and function based on their characteristics, categorizing wood construction works, and reasoning wood construction works. The research result is the Sundanese traditional-local-wisdom-based learning design of the Building Construction subject.

1. Introduction

This research is a multi-year research to 3, the first year of research to produce Learning Devices Building Construction-Based Local Wisdom Traditional Building Sundanese visionary Science Environment Technology and Society (SETS) for Universities that are ready for empirical test. The second year study produced a Learning Device with SETS vision for SMK that is ready for empirical testing.

In this research Local wisdom refers to something that can be a special characteristic of a region either in the form of custom, dance, folksong, or local ceremony. The local potential is always related to the local culture. Culture is not the potential that only deals with art and culture but also everything related to the community’s point of view of life that has relation to faith, work, productivity, dietary, value, and norm [1].

The local wisdom of the Sundanese traditional building in West Java has not completely been recognized by the students at the level of vocational senior high school as their treasure, especially in terms of its building structure and construction. The facts are based on several things, for example: the students are not familiar with the Sundanese traditional house. They prefer modern architecture to the local one. Hence, the understanding and awareness of learning traditional building structure and construction should be instilled, for example through the process of learning local things.
The current implementation of the building construction learning has yet to give satisfying result. This results from some reasons. They are building construction is considered as a difficult lesson, lack of practical tools, and teacher still dominates the learning process (teacher-centered). On the other hand, the teacher reveals that the students’ ability is considered poor and they are distracted when learning the lesson. Based on those facts, this study explores the development of building construction based on the local wisdom of the Sundanese traditional building with Science Environment Technology and Society (SETS) as the vision.

This study focuses on the Sundanese traditional building architecture, especially the structure and construction as well as the friendly environmental, cheap, and easy created local material. The reason for choosing SETS as the vision is because the approach guides the students to relate the concept of science to the other elements of SETS [2]. The learning model of SETS that has been adjusted to the students’ interest and talent is expected to be able to arouse the students’ curiosity and support their initiative in the learning activity [3].

2. Methods
This study applies Education Research and Development (R & D) method. That is, the development of the learning equipment of building construction based on the Sundanese traditional local wisdom with the vision of Science Environment Technology and Society (SETS) for the future college students, teachers, and vocational high senior school students focusing on building engineering [4]. In this third year of research, it is the develop stage of the 4D Model procedure.

| Research Stages | Type of Methods | Research Steps | Output | Information |
|-----------------|-----------------|----------------|--------|-------------|
| **Develop**     | Experiment      | Vocational teacher training in Building Engineering skills involved in collaborative implementation of KBBKL-BTS Learning Device with vision of SETS | Description of the implementation of SMK teacher training activities in Building Engineering skills involved in collaborative application of Learning Device with vision of SETS |
| **Development** | Improvement / Revision of Learning Device with SETS vision for SMK | Trial of Learning Device with SETS vision in SMK of Building Engineering skill program | Description of implementation, advantages and disadvantages of implementation of Learning Device with vision of SETS |
| **Descriptive** | Dissemination of research results through scientific publications in journals or seminars | Analysis of the effectiveness of the application of Learning Tool SETS vision on students of vocational engineering program of Building | Engineering Description understanding of building structure and building concepts of students SMK building engineering skills program |

3. Results and Discussion

3.1. The local wisdom of the Sundanese traditional building
The most recognizable Sundanese traditional building architecture is imah panggung. It is a house that has a space under the first floor which is about 40-60 cm in height. Panggung stems from the words pang and agung meaning something that is put on the most upper part [5]. In the Sundanese’s point of view, a house symbolizes female because female is the one that does all the activities at the house. The form of the Sundanese house is panggung. That is, a house that has a space under the first floor and uses unpak –i.e. a pillar alike- as the foundation. Moreover, panggung is the most important part for the Sundanese people, with the long ceiling and jure. The form of panggung that dominates the building system in the Sundanese culture has technical and symbolic functions. Technically, rumah panggung
has three functions: it does not inhibit the water infiltration, the space under the first floor is used to control air horizontally —i.e. to make the space either warm or cold, the space is also used to restore firewoods and the other things [6].

Generally, the firmness system in the rumah panggung uses pupurus joinery and paseuk (peg). The blocks in the floor frame, walls, and sawhorse, are set up and connected, either vertically or horizontally, using a tenon called pupurus joinery (tenon and mortise). Meanwhile, the joints are robe fiber, rattan, and pegwood. In the traditional house, the Sundanese custom prohibits the use of nails, nuts, and bolts because the use of those things opposes the ancestors’ rule (taboo). Peg has the efficiency level as many as 60% and considered to have a better quality compared to bolts with the efficiency level are 30% or nails with the efficiency level are 50%. Structure and construction have a strong relationship because the joints will not work well if one of them is absent [7].

The division of structure and construction in the Sundanese house —i.e. rumah panggung—is based on the form of stage (panggung). The Sundanese people divide the structure and construction into two types: handap and luhur. Handap refers to the structure that can be found under the house floor. It consists of lelemahan/lemah (ground), and umpak/tatapakan (foundation). Luhur refers to the structure that can be found in the upper part of the house floor such as pangadeg/adeq (wall), lalangit/palapon (ceiling), and rarangka (sawhorse). Structure is the part that cannot be separated from the construction because its function is to support the firmness of a building.

Based on the material, the Sundanese traditional building has already met one of the earthquake resistant building requirements. That is, the building consists of some light materials such as wood and bamboo. The strength of wood as the building material is wood consists of two parts, including the center and outer ones. The center part can resist compression while the outer can resist the tension. The wood that contains less water has a better quality to resist the compression. The wood cell can continue the compression pressure. Wood is a structural material that can support the development of green architecture [8].

The other material that is mostly used for Sundanese traditional building is bamboo. Bamboo has many strengths as the construction material. That is, bamboo is a fast renewable material and has mechanical characteristics like wood. Bamboo fibers are various so that bamboo can be used as either the interior or exterior material [9]. Bamboo is the most flexible source and can be found easily. Bamboo needs to be adopted as the engineering material for house or other buildings [10].

3.2. The competency of building construction for vocational senior high school students focusing on technical drawing

Building construction refers to a lesson that is categorized into the basic programming skills (C2) for technical drawing skill. Building construction is taught in the tenth grade, either in the odd or even semester. Building construction contains some main materials such as the basics for simple building construction science, including natural science, the method of construction implementation, the utility of simple building, and etc. The learning of building construction can be in the form of practice or theory. There are some basic competencies that need to be achieved through the practice because learning without any practice sometimes can be an inhibitor to achieve the required basic competency.

The building learning materials are categorized into stone construction, wood construction, steel construction, road and bridge construction, and hydraulic building construction which can assist the students to analyze, plan, and construct a building. This study analyses a building construction based on the Sundanese local wisdom. The result shows that the material, used in the Sundanes traditional building, is directly made of the natural one such as wood or bamboo. Based on the analysis, the developed building construction competency is limited to the wood construction. The basic competency, main materials, and learning activities can be seen in Table 2.
### Table 2. Basic competency, basic material, and learning activities.

| Basic competency                                      | Main material                                                                 | Learning activities                                                                                                                                 |
|--------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.1. Implementing the specification and characteristics of wood for building construction | The nature and characteristics of wood | • Reading materials about the building materials in accordance with SNI (Standar Nasional Indonesia / Indonesian National Standard)  
• Observing various building materials  
• Observing the information about the technology and building development  
• Describing the physical nature of wood  
• Describing the mechanical nature of wood  
• Describing the quality of wood  
• Understanding the checking procedure of wood  
• Conducting the visual checking of the wood’s physics and mechanics  
• Analysing the visual checking of the wood’s physics and mechanics  
• Presenting the result of the visual checking of the wood’s physics and mechanics in the oral and written forms or through the other media. |
| 4.1 Processing the specification and characteristics of wood for building construction | Processed wood | • Identifying the product of processed wood  
• Identifying the process of creating some processed wood  
• Presenting the conclusion of how the processed wood is created  
• Conducting the visual physical and mechanical checking of processed wood  
• Analysing the result of the visual physical and mechanical checking of processed wood  
• Presenting the result of the visual physical and mechanical checking of processed wood in the oral and written forms or through the other media. |
| 3.2. Categorizing various job desks of wood construction | Various joints as well as the wood relationship | • Observing various job desks of wood construction  
• Collecting data about job desks of wood construction  
• Identifying types of wood joints  
• Identifying wood joinery tool  
• Observing various joints and wood relationship  
• Creating various types of wood joints  
• Presenting the result of the creation process of various types of wood joints |
| 4.9 Understanding job desk of wood construction | Various wood frame | • Identifying various wood frame  
• Identifying parts of wood frame  
• Observing the procedure of setup up door and wood frames  
• Presenting the result of the procedure of setup up door and wood frames |
| | Wooden construction | • Identifying parts of wooden trust  
• Observing the procedure of wooden trust setting up  
• Presnting the result of the procedure of wooden trust setting up |
| | Ceiling construction | • Identification of ceiling function  
• Identifying the shape of ceiling construction  
• Observing the procedure of ceiling construction setting up  
• Presenting the result of the procedure of ceiling construction setting up |
| | Wood attic construction | • Identifying the material used for wood attic production  
• Observing the procedure of wood attic setting up  
• Presenting the result of the procedure of wood attic setting up |
| | Wood wall construction | • Identifying the material used for wood wall production  
• Observing the procedure of wood wall setting up  
• Presenting the result of the procedure of wood wall setting up |
3.3. The learning design of building construction for vocational senior high school with SETS as the vision

The learning with SETS as the vision refers to the combination of science, environment, technology, and society. In some literature reviews, the SETS learning is known as Science, Technology, and Society approach (STS). Basically, STS approach contributes to the understanding of the relationship among science, technology, and society and the sensitivity training of student assessment toward the environmental effect as the result of science and technology development [11]. The use of technology is usually needed by society when they are going to put their plan into action. In fact, society and science use technology as the medium to restore information. Technology functions as the medium to implement and observe Science, Technology, and Society (STS) approach. The data also imply the nature of knowledge as a field that all people have.

The SETS learning stages are:

a. **Introduction** explores the issues in society that the students reveal. Yet, the teachers can reveal the issues if their students do not give any response. This stage can be called as the initiation – i.e. starting-or also can be called as invitation – i.e. to invite the students to make them focus on the learning.

b. **The process of the concept making** can be conducted through the use of various approaches and methods. For example, the process skills approach, historical approach, life skills approach, demonstration approach, experiments in laboratory, group discussion, role play, and etc.

c. The students will be able to analyze the issues or to resolve the problems that are known as the **concept application** if they understand the concept.

d. During concept-making, problem solving, and problem analysis, teachers need to guide students, so there is no misunderstanding. This activity is referred to as the consolidation concept.

e. Assessment

4. Conclusion

The firmness system in a Sundanese traditional building called rumah panggung is supported by the use of rope, pupurus joinery, and paseuk (peg). The blocks, that are used for the frame of floor, wall, and sawhorse, are set up and connected either vertically or horizontally using pupurus joinery (tenon and mortise). Meanwhile, the blocks are strung up using rope fibers, rattans, and pegwoods. None of the nails, nuts, and bolts are used because the use of nails, nuts, and bolts is not in accordance with their ancestor (taboo).

The learning material development is based on the syllabus of building construction lesson. This study inserts the concepts of structure and construction based on the local wisdom into the material that the teachers develop. The concepts of the Sundanese traditional building structure and construction can be implemented in some materials / concepts such as the wood beam joinery construction, the wood board joinery construction, wood and door frame construction, wood stairway and floor construction, and wood framed ceiling construction. The learning media developed for supporting the learning is the learning media that is based on Information Technology and Communication (ITC). The learning development is realized through the use of SETS approach with some stages including introduction, the process of the concept making, concept application, concept consolidation, and assessment.

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