

# Improving student's technical drawing in building technology course with shared and digital enrichment material in order to support green technology

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**Abstract.** Technical drawing is a step that is absolutely necessary to be mastered by the architects in presenting their product in design development phase. The easy readiness and completeness of information in a drawing determine the quality and timeliness of a project. An incomplete engineering drawing is difficult to read by foreman or craftsman, and the risk of misunderstanding of the drawing will cost expensive and have potential risk to create many bad implications in the project. Unfortunately, the knowledge and skill of drawing technique are often not completely mastered by most students. On the other hand, according to the regional development situation in architectural and construction issue, the drawing standards must be fully utilized in international standards in order to facilitate cooperative work involving workers and engineers from these region countries. This research will be described some errors that often made by students and of international drafting symbols that supposed to be well used by students and then insert multi-media resources as digital enrichment material that supposed to be used as an additional material. The goal of this study will be to examine how multi-media is employed to positively impact student learning in a Building Technology course.

**Keywords:** Architecture student, building technology course, design development drawing, green technology, technical drawing.

## 1. Introduction

In an architectural design phase as well as in document's project preparation, when a design has been approved, the next step is the design development stage. At this stage, pictures of the concept or the idea began to be developed with technical drawing techniques that come with the notation, the size and the information that is required at the time of the construction phase. This technical drawing is very crucial and used as the reference drawing or drawing's guide on the development process. Therefore, the drawing techniques, standard of notation, standard of information etc. become very important and should be easy to be read by foreman or leader of a craftsman. The wrong perception or misunderstanding of the drawing can be a disaster in a project and even possible to create chaos of project process. The construction process can be very efficient or even wasteful depends on the quality of its technical drawing project. Many international projects in South-East Asia always using international construction term or English construction's term and considering that ASEAN free trade

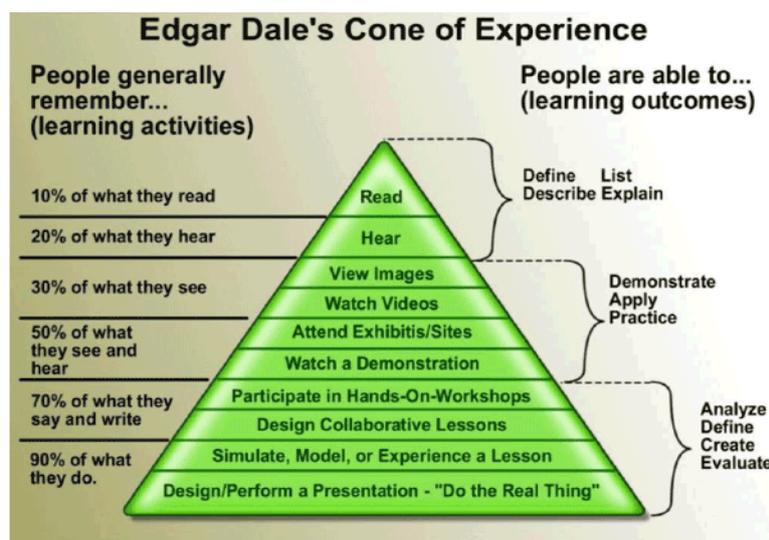


area has already regulated and much joint cooperation for architect that will be arranged in the future. It is very important for an architect to be able to produce technical drawings or pictures work very well.

The technique of depiction of drawing techniques taught in the Department of Architecture of Bina Nusantara University courses on Building Technology 1, 2, 3 and 4. The teaching material is manifested in the form of self-contained tasks for every student through his project types. In the course of Building Technology 1, a project that should be studied is 1-2 floor building, 2-4 floor level or low-rise buildings for Building Technology 2, building with wide-span structure for Building Technology 3, and high-rise structure for Building Technology 4. As for output product, students have to produce all technical drawing of site plan, floor plan, elevation, section, detail and building's services.

The method of teaching is conducted with directly delivered in front of the class (lecturing) and then continuing with drawing supervises session in the class. On the lecturing session, structure and construction were taught with international standards of technical drawing and English architectural terms that are common in architecture and construction field.

Considering that many study activities in architecture are also familiar in Dale's cone of experience, the steps of teaching and learning process will be adopted according to Below Edgar Dale's Cone of Experience [1].



**Figure 1.** Edgar Dale's Cone of experience.

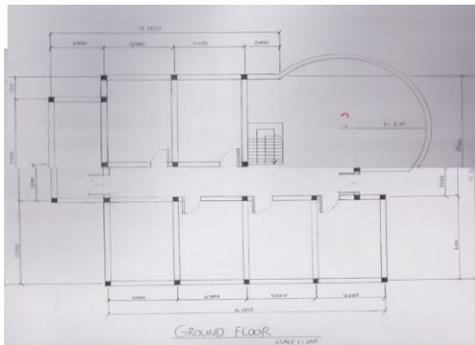
Regarding to the Dale's theory, to reach second learning outcome level which was defined as ability to demonstrate, apply and practice, it can be applied that teaching and learning in the course of Building Technology has to conduct variety of activities such as read, hear, view images, watch videos, attend exhibits/sites and watch a demonstration.

Today students in higher education are as the Net Generation. It places increasingly greater demands on educators, students and teachers must jointly consider innovative ways of teaching and learning. In this, educators are supported by the fact that the Net Generation wants to learn. However, these same educators should not fail to realize that this generation learns differently from previous generations. Educators should be adapted teaching in order to guarantee effective learning by a generation of digital natives [2].

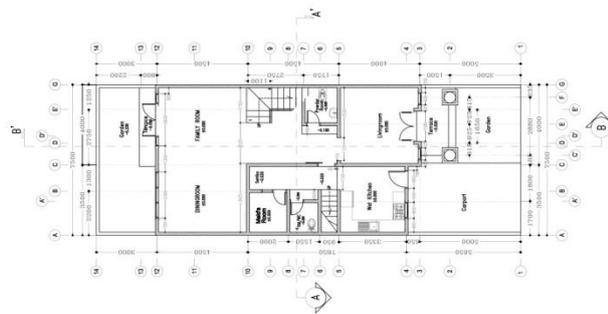
In architecture culture of study, those activities were very common. Almost all of the course in architecture include read, hear, view images, watch videos, etc. So these are like an advantage of architecture and if we want to pursue the best result of architecture study by adopting this Dale's Cone of experience, firstly, we need to prove the impact of these activities on the student's. In this case, view images and watch videos are the main activities that be emphasized as additional tools or material to help students in their study process. We need to prove if the students able to remember 50% of what they see and hear even they have never had direct experiences in the construction field. Today situation in the class, there are only 30-40% of students that are able to understand and remember what they see and hear in the lecturing session. And the applications of that knowledge in the technical drawing are mostly under average score. So far success can be said to be only if we are able to achieve more than half of the number of students reach B score instead of C score as an average score in the class. So that this becomes a background of research on this paper.

A professional architect is expected to be able to create the design and the produce it's technical drawing so it is able to be constructing in the field. So even though construct or build the building is not the task of an architect, but they are expected to understand and be able to provide solutions related to the problem in the construction process. Some problems that occur in the field demand a change in design and concept due to construction and its situation, so as to be able to maintain a design and concept, then an architect is also required to understand how a design will be built, and what kind of obstacles or any other issues that may arise related their design in the construction process. To produce more Architecture Bachelor with ready to work qualification, the university has to teach a train the students to known many problems related the design in the construction phase. The students need to be introduced to technical problems associated with the process of construction of a building and are trained to be able to create solutions that can be delivered on site.

To illustrate how the difference between the current and target of quality see at the illustration bellowed (figure 2 and figure 3):



**Figure 2.** Student's drawing plan.



**Figure 3.** Industrial standard drawing plan.

Current quality of student's assignment and commonly the technical drawing has many lack of:

1. Completed drafting symbols such as the name of material, floor level notation, hatching of material.
2. Column reference.
3. Completed doors and windows symbol.
4. Notation on section and elevation completed with page information.
5. International standard of paging system.

In this target of quality, technical drawing plan should contain:

1. Standard notation of material, including wood, glass, walls and floors.
2. The notation of length and width of space as in standard measurement.
3. Name of material and its standard of hatching and additional information.
4. The drafting symbol of doors and Windows is accompanied with the code and technical requirements of windows and doors.
5. Column reference.
6. Floor level notation.
7. Section and elevation drafting symbols.
8. International standard of paging system.

## **2. Research problem**

Many student's assignments have low-quality standard especially in technical drawing while the first ability that needed in the work field is the ability to produce a good technical drawing.

The purpose of this study was to improve the student's ability in understanding the structure and construction and produce technical drawing according to international standard. Much education literature state that the effectiveness of teaching will be increase if experiential components are integrated into the course. The study identified the relationship between projects, learning and Dale's Cone of experience as well as investigated the relationship between student activities and multi-media approaches to learning.

## **3. Research method**

In Building Technology subject, the experiential learning activity was designed using site survey on the real building project. But this activity is not enough because it can only be arranged one time in a semester and there are many topic and structure member that students have to analyze Therefore, in creating better understanding, the multi-media resources are inserted to help a student in building better and holistic concept of a structure and construction system of a building. This multi-media resource was also designed to help students construct a model for effective drawing skills.

To accomplish this we will examine student individual assignment Building Technology 1 at Bina Nusantara University, Jakarta in which students interactively analyze the structure and construction of low-rise building by design and material system and developing a low-rise construction drawing with practical recommendations.

In addition, the authors will survey students who have completed his project assignment and measure student achievement of learning outcomes as defined as what the student should know and realistically be able to do by the end of the course. This approach will focus on a quality of student individual assignment as assessment survey to gather an in-depth understanding of learning and the reasons that student learning occurred as a result application of multi-media resources.

This study basically conducts using lecturing system as main material resource and video as an additional medium of learning. This video is shared in internal university's portal for students. Every student can log in this website and doing many interactive activities regarding their study's subject. With the ease of internet access that is relatively reaching almost all areas especially in urban, the students will be able to access the uploaded material in [www.youtube.com](http://www.youtube.com). It can also access repeatedly if the material is difficult to be understood.

By using a common internet path, it makes easier for the student to access material with many different devices such as laptop/notebook or mobile phone. In addition, this material can be accessed by using various software platform and operating system. This method does not require a registration

system or membership requirements so that it is relatively easy to be accessed by anyone and in anywhere. It also provides the possibility of material as a matter of discussion online via the internet. Standard assessment in the course of Building Technology refers to the assessment rubric standards agreed upon in the Department of Architecture as below (Table 1).

Shared material that can be accessed by students at *binusmaya* website as well as distributed as an additional book (Figure 4 and Figure 5):

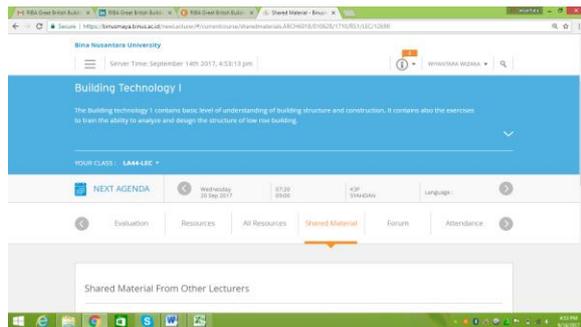


Figure 4. Binusmaya website.



Figure 5. Digital enrichment material.

Table 1. Assessment rubric of Building Technology 1

LO	Indicators	Proficiency Level			
		Excellent (85 – 100)	Good (75 – 84)	Average (65 – 74)	Poor (≤ 64)
LO1	Ability to choose structure design.	The structure system is correctly & clearly defined in logical order	The structure system is correctly defined but not in logical order	Some structure system is correctly defined	Inadequate to define the structure system.
	Ability to choose construction drawings.	The construction system is correctly & clearly drawn in logical order	The construction system is correctly drawn but not in logical order	Some structure system is correctly drawn	Inadequate to draw the structure system.
LO2	Ability to design structure systems in three dimensional form.	The structure system is correctly & clearly drawn in three dimensional form according to logical order	The structure system is correctly & clearly drawn in three dimensional form but not according to logical order.	Some structure system is correctly drawn in three dimensional form.	Inadequate to draw the structure system drawn in three dimensional form.
	Ability to design Building Service.	The Building Service system is correctly & clearly design in logical order	The Building Service system is correctly design but not in logical order	Some Building Service system is correctly defined	Inadequate to define the Building Service system.
LO3	Ability to calculate simple structures	The Volume of materials is correctly &	The Volume of materials is correctly	Some Volume of materials is correctly	Inadequate to calculate the Volume of

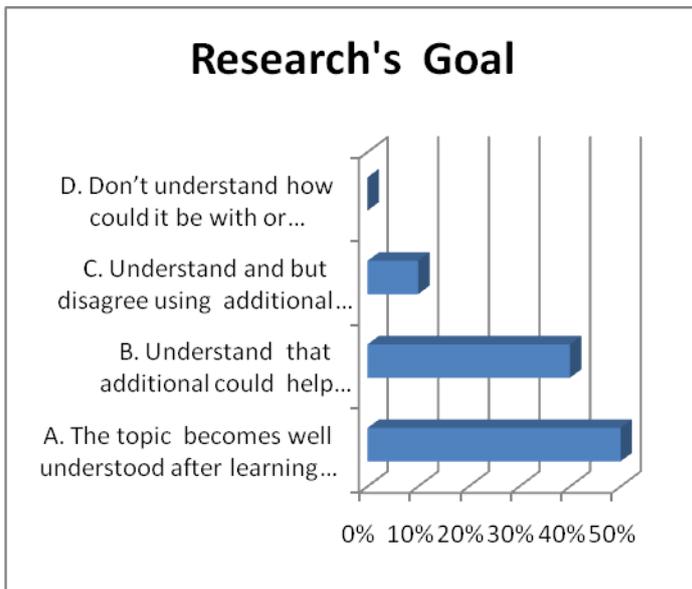
		clearly calculated in logical order	calculated but not in logical order	calculated.	materials
LO4	Ability to produce construction drawings.	The working drawing is correctly & clearly produced according to International standard of working drawing.	The working drawing is correctly produced but not according to International standard of working drawing.	The working drawing is correctly produced.	Inadequate to produced working drawing.

#### 4. Discussion

In the class, all students are informed about additional material that is attached to their Binusmaya account as shared material. This material should be studied by the student during the semester. The students are able to view and download all the shared material and study the material as much as they can.

At the end of the semester, the result of this research can be measured through student assignment score. The score is compared to the score of a student in academic semester 2015 with a student in academic semester 2016. This comparing method is conducted to find how significant is the role of additional material (shared material and digital enrichment) in increasing student's understanding of the topics. The goal of the research is also informed to the student before the semester begins in order to make the student aware of these additional materials as another resource for their study.

Generally, almost all of the students understand the purpose of this research's goal, however, there are nearly 10% of the group of students who doubt that shared material and digital enrichment will provide a significant understanding for their study. They are in the opinion that learning through video and additional material can be categorized as a single learning system. That is meaning that if they have a lot of question, they cannot ask the lecturer or supervisor directly. So this method still needs to be supervised by the lecturer. But almost 90% students agree that additional material is just like tools in helping their level of understanding.



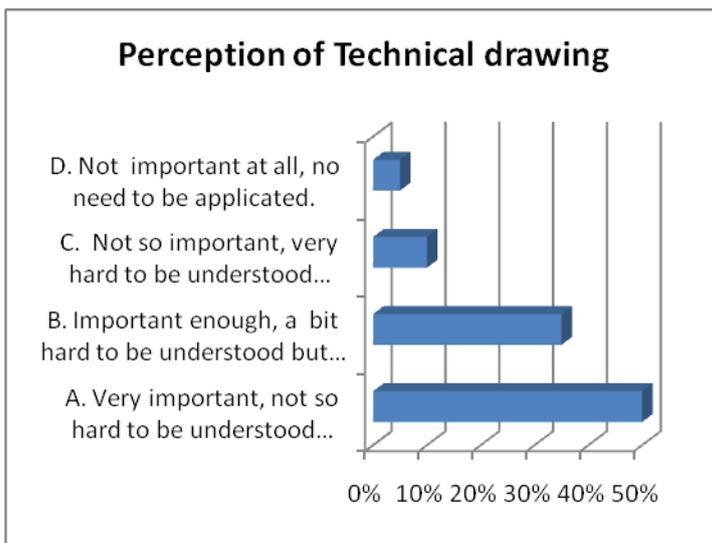
**Figure 6.** Research's goal: Basic preparation and knowledge.

A. Understand and agree that additional material is a tool in helping student to study more easily.

B. Understand that additional could help student to study more easily.

C. Understand and but disagree using additional material as tool in helping student to study more easily.

D. Don't understand how could it be with or without additional material.



**Figure 7.** Perception of technical drawing: level of skill

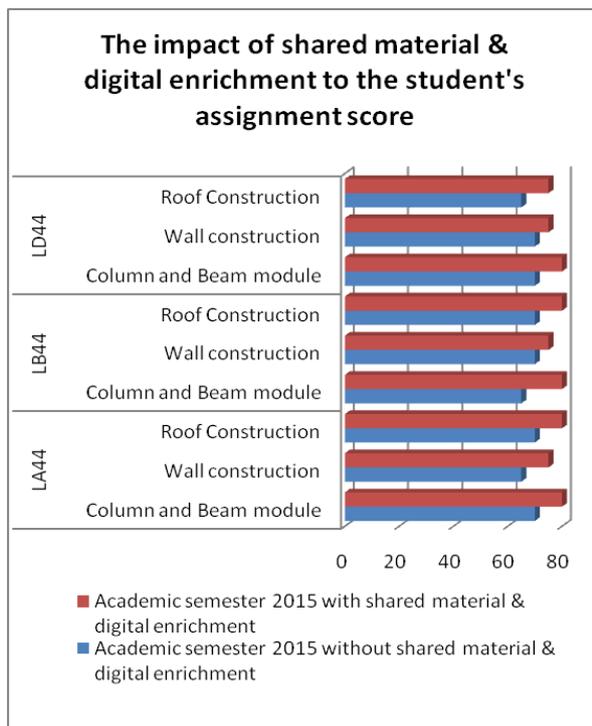
A. Very important, not so hard to be understood and applicable.

B. Important enough, a bit hard to be understood but applicable.

C. Not so important, very hard to be understood even though applicable.

D. Not important at all, no need to be applicable.

On the level perception of technical drawing, 55% are in the opinion that technical drawing is very important not so hard to be understood and applicable while 40% of them stated that technical drawing is a bit hard to be understood. 8% of the students have difficulties in understanding technical drawing and what was a surprise that there 5% of students on the opinion that the international standard of technical drawing no need to be applied in Indonesia. The reason for this opinion was not really clear.



Topics that used as additional materials :

1. Column and beam module.  
The material is uploaded as shared material in Binusmaya in video format and PDF file.
2. Wall construction.  
The material is uploaded in Binusmaya as shared material in video format and PDF file.
3. Roof construction.  
The material is uploaded in Binusmaya as shared material in PDF file.

**Figure 8.** Average score of student's assignment.

## Conclusion

This study was only a small part of the topic but the results continue to contribute in creating a better quality of students especially in Building Technology course. Although Dale's Cone experience shows those study activities through reading and hear, and enrich with view images, watch videos, attend site and watch demonstration will help student to be able to demonstrate, apply and practice level, but in architecture discipline these all activities should be made on a regular schedule and in a strictly way due to the topic that full of technical requirements which are a new experience for most of the students.

Developing a teaching method depending on the structure of teaching material, however, to enrich the teaching method with shared material and digital enrichment is a good way in order to increase the student's assignment quality. The other thing that important too is that student can study the material anywhere and as much as they need.

In order to support green technology through effective timeline project, students are prepared to be a part of the team in industrial project that able to work effectively and precisely. The better technical drawing is produced, the more effective project can be delivered.

Binusmaya is a system that really supports the student in preparing all the material they need and help create schedule and study method according to their situation. Lecturing of project examples in the field must be packed in a very interesting, interactive and integrated directly with the theory so that the process of understanding continues from theory to application in the field.

In the future, after we made this workshop, we realize that there are possibilities and still many ways to do any variation and combination in architecture teaching and learning method, especially in

structure and construction topic. Our workshop is only one from many possibilities today and maybe arises with any kind of variation and combination in the future.

### References

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