Collaborative Facets in Design Learning for Potential Adoption in the Architectural Bim Studio

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Abstract: Architectural design-based learning (ADBL) is a tutoring practice that mentored the process of developing a solution to design problems. The tutoring activity is an interactive problem-solving session that includes refinement, analysis, synthesis, assessment and evaluation of students design by tutors. However, the potentials and structure of this interactive problem-solving process as a collaborative learning strategy happen to be under research. This study uses video observation of ADBL sessions and interview validation of 7 final year undergraduate student and 1 design tutor. After careful retrospective video data analysis and subject interview, the study discovered progressive iterations, productive criticism, design transformation, cognitive functions and idea development as the 5 key characteristics of collaboration in the ADBL environment. Subsequently, the study recommends integration of the 5 key characteristics of collaboration in the ADBL environment with BIM-based (Building Information Modelling) collaborative features that entail workspace sharing, virtual interaction, object augmentation and simulation as well as cloud-based communication to comprehend the potential BIM-studio for product development. Other findings revealed that design students understand their design better especially when they effectively collaborate with their tutors and peers. For this, enhancing collaboration in the ADBL correlates with adequate design knowledge transfer designers.

Key words: Architectural Design-based learning • Design learning • Collaborative learning • BIM Studio

INTRODUCTION

Architectural design-based learning (ADBL) is a learning system where problems are solved and effectively communicated through a collaborative set-up of tutorials between students and tutors. Another role of ADBL is to provide students with the required skills and experience for effective design and construction management [1, 2]. However, any needs the effective integration of ADBL with BIM Building Information Modeling (BIM) concept, cloud-based networking, urban design (UD) and development in Information and Communication Technology (ICT) is a potential upgrade of ADBL-BIM studio. The integration of these contemporary issues could fetch a remarkable development in the ADBL paradigm. Adequate understanding and training of collaborative facets in architectural design learning is one of the platforms that could help in providing architecture student with the required skills, knowledge and experience of design management as required in the contemporary world [1, 3, 4].

However, the conventional educational research offers a pedagogical perspective about designing as opposed to the ‘grounded’ outlook of the dedicated design research which led to oversimplification or misconception to the role of design. For example, there is a tendency to circumscribe design learning under the pedagogical framework of problem-based learning. In contrasts, design researchers consider the design learning paradigm as markedly different from the problem-based framework regarding cognitive operations and behavior. This study expounds research possibilities based on design learning by examining exemplary cases in architectural education. This study has identified ADBL as a learning process that entails progressive and productive transformation through iterative activities of knowledge integration that transpire between stored,
The LBD framework encourages the integration of design-based classroom attributes such as collaboration, learner-centred learning and inquiry-oriented into the LBD set-ups.

According to Furtuset et al. [13] ‘Design-based Science (DBS)’ encourage students to use design-based methods to solve scientific problems.

A study on design-based approaches in secondary education revealed substantial empirical evident that design learning support the enhancement of reasoning, self-direction, teamwork and skill in teaching science.

There is no doubt that the outlined literature studies have indicated that design learning is a significance learning process for students. To be more specific, it has been understood that design learning is the most effective learning method for the ill-structured problem. However, the characteristics of design learning in higher institutions of learning are still unclear. Knowing the characteristics of design learning in higher institution of learning remain a strong factor that will make it a critical subject for research studies so that it can be clearly understood and improve an effective tool for preparing the student with knowledge, skills and professional mentality to face real-life challenges after graduation.

In ADBL, set-up student normally solves problems of projects that are based on real-life issues and professional practice. These projects undergo cognitive conflict and experimentation of solutions before achieving the actual result. By working on this kind of problem, students improve on design and communication knowledge [14]; they also adopt a thinking process similar to that of an expert [15]. The student also improves their investigative skills, scope/context understanding, constraint/problems exploration and refinement, products/systems development [16,17] and finally the development of their reasoning skills [18]. Tutors also have a role to play in student development in a typical ADBL set-up. Tutors help the student to develop from novice to a certain level of expert designers. The student also learns domain-specific knowledge, self-directness, process-orientation and the development of knowledge-in-action and reflecting-in-action from their tutors.

Collaborative Facets in Design Learning: Literature studies carried out across Europe, Asia and USA [19, 20, 21] on collaborative teamwork in design learning has proving to be an important aspect of learning platform

Architectural Design-based Learning (ADBL): Collaboration between tutors and design students is a working practice in ADBL. Tutors and students work together to achieve the common purpose. Through this collaboration design students accomplish knowledge development, skill acquisition and experience. Through collaboration, tutors provide students with feedback, knowledge and experience. ADBL encompasses the usage of cognitive reasoning, domain-specific knowledge, feedback and collaboration. This process works with the integration of knowledge [8] through cognitive process of scoping, generating, evaluating and creating ideas for the development of the target artifacts [9].

These are methods that are engaged in solving real-life design problem but also reflected in design learning process [10]. Therefore, ADBL prepares students for professional and practical knowledge that involve decision making using cognitive thinking for generating specification and predictions together with testing, creating and communicating solutions [9,11]. Some studies of ADBL uses different areas such as;

- Study the concept of ‘learning by design (LBD)’ is a medium for constructing new science knowledge where science student learn how to be thinkers, learners and decision makers [12].

- The LBD framework encourages the integration of design-based classroom attributes such as collaboration, learner-centred learning and inquiry-oriented into the LBD set-ups.

- According to Furtuset et al. [13] ‘Design-based Science (DBS)’ encourage students to use design-based methods to solve scientific problems.

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in architectural disciplines. Other studies indicate already some universities have developed and adopt their collaborative design course [22-25].

- To prepare students for interdisciplinary collaboration with other professions and owners in architectural design projects.
- To improved students long distance learning methods.
- To equipped student with knowledge of modern tools for design and communication such as SketchUp, Revit, Skype, GoToMeeting, Brainmerge, Box, Dropbox, GoogleDocs, Terfetc
- To help student in developing comprehensive integrated project.

In practice and real life conditions, the designer works with engineers, quantity surveyors and project managers. Therefore, it became important for designers to learn and develop collaboration and communication skills for effective interdisciplinary working practice. With the current proliferation of Building Information Modelling (BIM), the next generation of architects are expected to have a wide range of knowledge/skills of the contemporary working practice [26].

Hence, architectural design education should be examined, investigated and improve where necessary so that it can offer future architects the required training to face the ever challenging contemporary working practice around. To attain contemporary studio, there is also the need to understand tutors, students and domain-knowledge collaboration through different types and methods of assessments. ADBL is conducted in an environment where students work and communicate their ideas as peers. This community set-up helps in molding students for easy adaptation to social interactions, competitiveness and presentation skills [27]. This study examines the characteristics of design in typical ADBL.

**Methodology:** Among methods of studying design activities are protocol studies using observation and interview to investigate seven (7) final year undergraduate student and one design tutor all from architecture department in UniversitiTeknologi Malaysia. The major goal of the method is to capture the activities of a typical ADBL environment as commonly found in architectural education (design studio). The data collection methods used for this research are video recording and subjects interview. The study employed qualitative research method using video observation, verbalization, gestures as well as subject to investigate and offer a possible improvement in ADBL training.

**RESULTS**

After data analysis, certain collaborative facets are established. Also, information analyzed from subjects’ interview also verify the validity of the collaborative facets. After the analysis, this study has been able to identify five (5) classifications of collaborative facets that transcend between tutor and student. Table 1 illustrates data presentation and analysis in four different columns that include variables, examples, frequency and source. This study has found five (five) characteristics of collaboration found in architectural design learning (illustrated in Figure 1).

Cognition in design thinking represents designer thinking abilities. It is the first step designers use to formulate a mental idea of a proposed design. According to this study, both tutors’ students also make intensive used of their mental abilities to relate knowledge, experience and memory as well as evaluation and reasoning design problems in ADBL. Some of this cognitive activities are found during the process of interaction between existing design knowledge and design standards as well as natural phenomena such as site and climatic constraints. Iteration is a process of repetitive progression using such as designers iterate back on initial design ideas to sample, model or lease it in creating a new idea. The newly create idea will serve as a prototype of the initial idea. In this process designers have the abilities to further relate previous and new design ideas. Example of iteration in design learning is presented here below;

**Tutor:** how did you come-up with this?
**Student:** it was derived from the original idea
**Tutor:** okay, relate the previous & new design
**Student:** Sure!

![Fig. 1: Collaborative facets in architectural design learning](image)
Table 1: Characteristics of Collaboration in Architectural design learning

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sub-variable</th>
<th>Coding</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideation</td>
<td>Create</td>
<td>I¹</td>
<td>To generate, simulate, develop and communicate design concept</td>
</tr>
<tr>
<td></td>
<td>Evaluate</td>
<td>I²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implement</td>
<td>I³</td>
<td></td>
</tr>
<tr>
<td>Criticism</td>
<td>Directive</td>
<td>F¹</td>
<td>Design review and correct of mistakes and misunderstanding through guidance,</td>
</tr>
<tr>
<td></td>
<td>Corrective</td>
<td>F²</td>
<td>advice and instruction from discussion and presentation.</td>
</tr>
<tr>
<td></td>
<td>Review</td>
<td>F³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guide</td>
<td>F⁴</td>
<td></td>
</tr>
<tr>
<td>Cognition</td>
<td>Identify</td>
<td>K¹</td>
<td>Usage of imagery, perception and experience to generate, reflect, refine,</td>
</tr>
<tr>
<td></td>
<td>Reflect</td>
<td>K²</td>
<td>explore and synthesise design concept</td>
</tr>
<tr>
<td></td>
<td>Acquire</td>
<td>K³</td>
<td></td>
</tr>
<tr>
<td>Transformation</td>
<td>Sketch</td>
<td>T¹</td>
<td>Process of communicating abstract and spatial depictive ideas to concrete</td>
</tr>
<tr>
<td></td>
<td>Schematic</td>
<td>T²</td>
<td>spatially specific artefacts plans, sections, elevations, site plans and</td>
</tr>
<tr>
<td></td>
<td>Models</td>
<td>T³</td>
<td>perspective views.</td>
</tr>
<tr>
<td>Iteration</td>
<td>Prototyping</td>
<td>A¹</td>
<td>The usage and comparing initial ideas in generating new ideas</td>
</tr>
<tr>
<td></td>
<td>Comparison</td>
<td>A²</td>
<td></td>
</tr>
</tbody>
</table>

Transformation normally design ideas are abstract spatial depictive but, through the transformational process successfully transform and communicate them in concrete spatially specific artefacts. This transformational change occurs in magnitude, shape, appearance and detailing of the designed product or artefact, at different phases of the design such as plans, sections, elevations, site plans and perspective views. Ideation process is designers’ ability to develop, evaluate and implement design concept. Therefore, designers’ ideation abilities represent his/hers’ creative ability of idea generation, idea evaluation and finally idea development and implementation. The level of designers’ expertise in conceptualization, communication skills also affect the status of design ideation process. Criticism design students communicate their design to tutors through certain frames of activities. Mentors challenge to design with criticism such as disapproval, faultiness, correctness or mistakes. Through this criticism design mentors analysis designers’ design and make judgements’, improvements and meaningful contribution to the design.

**DISCUSSION**

Collaboration facilitates design understanding, communication and development in design. Design carried out with effective collaboration between tutor/s and student/s are better regarding innovative ideas, efficiency, commitment and accuracy when compared with works carried with less or without collaboration. Hence, collaboration in ADBL facilitates knowledge sharing, development and integration through, imagery, perception and experience to refine, explore and synthesise design concept. During the process of refinement, synthesizing, self-exploration and critiques student acquire domain-specific and practical knowledge, understand development in Lean and Sustainability construction, addressing issues and questions raised by studio mentors during presentation and consultation. The students enhance their problem-solving, reasoning and thinking skills. Results indicate that the studio environment students have high imaginative potential and score excellent results in design task when compared with design carried out in a non-studio environment. Further studies on two groups of student designers working in a different environment is a potential area of future studies. The environment that elicited high score will be more suitable for design students and also the learning strategy can be adopted for other problem-based domains.

The collaborative studio for ADBL is important because it helps in preparing the students for The collaborative studio for ADBL is important because it helps in preparing the students for interdisciplinary collaboration in future and real life architectural practice. The architectural practice involves with different kinds of works such as authorities and owners requirements, designing of all sort of projects, working and networking with people and professionals from a different aspect of the economy. During this period, the construction team players learn teamwork through meeting and constructive arguments. The study illustrated in Figure 1 a model that indicates phases of collaborative facets in ADBL studio for potential adoption of architectural BIM studio. The improvement and testing of the model depend on the outcome of the understanding and acceptability of the model in ADBL working practice.
CONCLUSION

It is suggested that collaboration could be an important aspect of the contemporary design learning because of ability to compare, communicate and generate both theatrical and practical knowledge. Therefore, collaboration in design studio could be a key aspect of developing the contemporary studio for teaching design in architectural discipline. The organization of the design studio has to satisfy the maximum requirement of effective, meaningful collaboration, personal experience together with intelligence. It does not mean that this model can be generalised as the new system of teaching design that is contrary to the conventional design teaching. Every school has their peculiar way of teaching architectural design. For the moment, the model currently described is relevant to UniversitiTeknologi Malaysia UTM, which is the case studies of this research. The collaboration was found to be a key feature of ADBL. Hence, if collaboration is developed and improved, it could provide future designers with the required skills and knowledge for dealing with the contemporary world. It is observed that final year architectural students understand architectural design especially when they collaborate with tutors and peers. Hence, our design studios are required to provide more features and facilities that will technically support and improve collaboration in architectural design education.

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