

FUN AND STRESS: INVESTIGATING STUDENTS' EXPERIENCE OF FOUNDATIONAL DESIGN COURSES

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ABSTRACT

Project based design courses are central to both architecture and engineering education. The objective of this study was to investigate the issues and challenges faced by students in three foundational design courses focusing on introductory design, architectural design and engineering design at the Singapore University of Technology and Design (SUTD). A survey comprising both quantitative and qualitative questions was administered in three courses. A principal component analysis conducted on the response data revealed five factors that primarily contributed to students' experience of these design courses: (1) the fun aspects of design, (2) the stressful aspects of design, (3) Course Pressures, (4) Student personality, (5) Teamwork experience. Content analysis of the two open-ended questions provided insights into the main aspects that contributed to the stress and fun factors for each course. We present initial recommendations to enhance student experience in design courses.

Keywords: Design education; architectural design; engineering design; student experience

1 INTRODUCTION

Design education usually employs project-based learning, in which students learn to research, plan, design and reflect on the creation of technological projects. Students work in teams to identify the user needs, find solutions, and design and build a final product [1]. Investigations in the experience of students are crucial, as these provide insights into students' perspectives of design courses. Studies have pointed out that students are often ill-informed about design education when entering university [2]. Issues students experience may influence their design process, as well as their knowledge development. Student experience surveys can be used to drive forward changes in curriculum or pedagogy [3]. In the field of design student surveys have been used to analyse design thinking skills [4] and design literacy [5]. However, these studies are primarily used to assess knowledge and skills, not to investigate students' experiences of their design courses. Studies assessing affective variables are far fewer in number.

We present an exploratory study into student experiences, specifically the issues and challenges faced by students in three foundational design courses – an introductory design, an architectural design and an engineering design course at the Singapore University of Technology and Design (SUTD). The research questions addressed are:

- What are the major issues that negatively impact student experience in the three design courses?
- What aspects of the design courses were considered fun, and what was stressful for the students in the three design courses?

Based on our findings, we provide recommendations for improving student experience.

2 BACKGROUNDS

Design courses are central to both architecture and engineering education. Design typically consists of analysing a problem and of generating, evaluating and testing alternative solutions. Design courses primarily utilize project-based learning in which students, individually or in teams, transform a field of inquiry into a proposition or scheme. They address problems that are usually open-ended with no single, correct answer and often address real-world challenges [1]. Whereas introductory courses may be more guided and involve teaching of process and methods alongside working on the project, subsequent courses tend to use a studio setting with no or only minimal guidance on process and methods to use. Students play an important role in studio pedagogy with its learner-centred point of view. In a design

studio, groups of students have designated classrooms in which they meet regularly with their instructor(s), who guide their work on given assignments [6]. In architecture this feedback, called critiquing, is at the heart of their education. Students learn from sharing information with one another and instructors, and from their feedback [7].

Several authors investigating design education have argued that 'learning should be enjoyable' and that students should have a good time while they work [8, 9]. In Engineering design education literature, the notion of 'fun' and 'enjoyment' has been discussed in the context of design process [6], as well as design education [8]. At the same time, several studies investigated the difficulties faced by undergraduate students such as high learning pressure, heavy workload and feelings of uncertainty about the future. A related concept is learning anxiety [10]. Studies of student experiences of open-ended problems noted that students found open-ended problems both 'difficult' as well as 'fun' [11]. Chen's study with industrial design students revealed that students considered the most difficult design tasks to be concept generation, design presentation, and design research [12].

3 METHOD

3.1 Foundational design courses at SUTD

All three analysed design courses involved studio-based projects that covered task clarification, concept generation, evaluation and refinement, detailed design of preferred concepts, and communication of results. The first-year foundational Introductory Design course (ID) is specifically developed for all the university's first-year students to introduce the concepts of design, design related skills, mindset of innovation, entrepreneurship, and methodologies in design. This course is the foundation for the other two courses that we analysed. The Xth-year foundational architectural design course (AD) establishes foundations for architectural design through a series of projects that build in scope and complexity to have students engage issues of 3-dimensional geometry and drawing, space and component aggregation, ordering systems, structure, circulation and narrative, and tectonics. The Xth-year foundational Engineering Design course (ED) helps students develop a holistic view and competency in the combined interactions of engineering design and engineering project management. Students learn design, analysis, prototyping, testing, and project management methods to effectively plan, organize, and execute an engineering project.

3.2 Survey design and administration

The survey comprised 25 questions: two open-ended questions and 23 closed questions. The closed questions were used to survey students' experience of instruction mode (8 questions, semantic differential scale), class content (8 questions, semantic differential scale) and challenges affecting performance (7 questions, Likert scale). The semantic differential questions measured two aspects: (a) the fun aspect that ranged from *Lot of fun* (2) to *Very boring* (-2), and (b) the stress aspect, that ranged from *Very stressful* (-2) to *Very relaxed* (2). The 23 items were chosen from literature and then refined further with research team members, a selection of students and ex-students. Face validity was conducted with PhD students and Teaching Assistants on the course, who went through the questionnaire and provided input on the terminology used. The questionnaire was then pilot tested with a subset of students (n=10). The survey was conducted in the three foundational design courses, in both online and paper format nearing the end of the term. With the help of the course coordinators, 15 minutes of class time was allotted to the students to do the survey.

3.3 Data analysis

We employed a principal component analysis (PCA) on the closed questions to reveal factors that primarily contributed to students' experience of foundational design courses: (1) the fun aspects of design, (2) the stressful aspects of design, (3) course pressures, (4) student personality, (5) teamwork experience. The open questions were analysed using a content analysis synthesising strategy aimed at investigating the reasons for student responses in rating questions. Themes emerged from the data using an inductive approach. Descriptive coding followed by topic coding was used [13]. From the review of the data, 10 patterns were identified, coding was reviewed, discussed, and refined by researchers.

4 RESULTS

Respondents consisted of 246 students from the ID course (93 female, 153 male; 56% of students attending this course) 48 students from the AD course (27 female, 21 male; 61%) and 71 students from the ED course (27 female, 44 male; 59%).

4.1 Principal Component analysis

A PCA was conducted on the 23 items with orthogonal rotation (varimax). The Kaiser–Meyer–Olkin (KMO) measure verified the sampling adequacy for the analysis (KMO = .837 and all KMO values for individual items > .77, which is well above the acceptable limit of .5). Bartlett’s test of sphericity ($\chi^2(253) = 2935.032, p < .001$) indicated that correlations between items were sufficiently large for PCA. An initial analysis was run to obtain eigenvalues for each component in the data. On the basis of the results from the first round, we reduced the number of items in the exploratory factor analysis. The revised version had 20 items, and five components. Two items had cross-loadings to two factors. Figure 1(a) shows the factor loadings after rotation, and 1(b) shows the interpretation of factors that contribute to students’ experience of design courses.

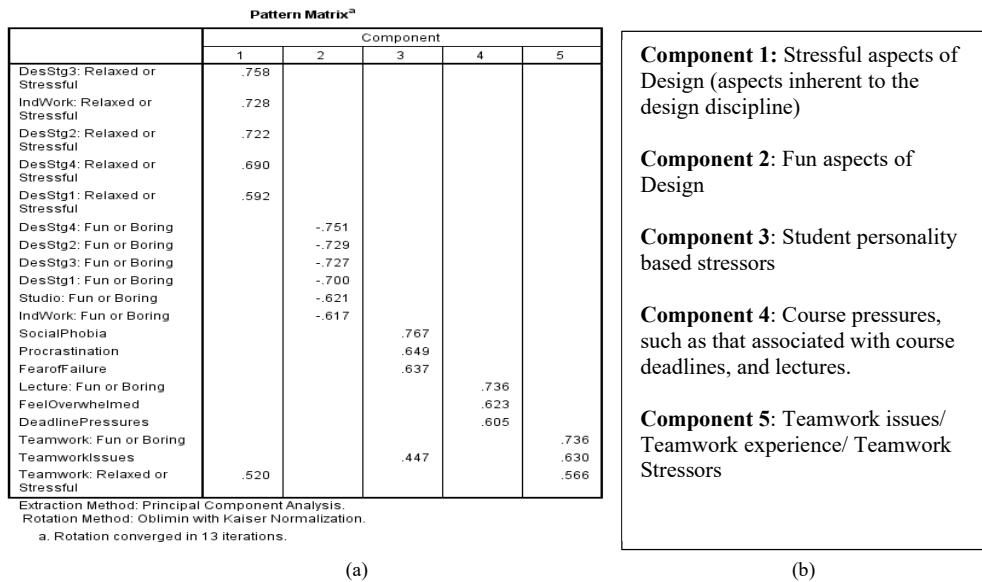


Figure 1(a) Principal component analysis, (b) interpretation of factors that contribute to students’ experience of the analysed design courses (*“DesStg”= Design Stage; “IndWork”=Individual Work)

4.2 Average factor scores for each course

Average factor scores for each course measured by means of factor scores (obtained by multiplying the standard scores for the original variables by the factor score coefficients). These scores were normalized to facilitate interpretation. Figure 2 shows quite different trends for the courses with regards to stress and fun of designing.

The ID course does not stand out, apart from being the only course for which the design-related stress factor was very low. The AD course was the course most enjoyed by its students and having the lowest course pressure. Nevertheless, the students experienced a fair amount of design-related stress and teamwork issues, but the fun scores are higher than the stress and teamwork scores. The ED course was experienced as very stressful, with a lot of pressure (both scored highest for the three courses), and a low score for fun. Student personality was found to play a relatively small role in the experience of the design courses.

4.3 Content analysis

The content analysis of the two open-ended questions provided the following insights into the main aspects that contributed to the stress and fun factors for each course.

Stressful aspects of design

The most frequently occurring themes in a course in terms of percentage of answers of the respondent of that course, are the following:

- **Subjectivity (ID – 19% of students):** For the first year ID students the most frequently occurring theme in the category stress was the issue of subjectivity in design---that different people would have different opinions on the same design, which led to confusion. As pointed out by one student, “...the professors constantly said things that contradicted each other or even themselves... we never know who and when to listen, which made it difficult...”
- **Uncertainty and vagueness (ID- 14.3%):** Students seemed to be struggling with the vagueness that is inherent in design problems. This ranged from being unsure of ideas and getting stuck while designing, as voiced by a student “(I dislike) Uncertainty if ideas will materialise...”. Another student had issues with “getting stuck at other dead ends that cannot be solved that easily”.
- **Rules and restrictions (ID – 9.5%):** The first-year students complained about the restrictions in design briefs that “...shut down avenues [students] can explore...” (ID-01).
- **Self-learning issues (ID- 9.5%):** The first-year students reported difficulties in self-learning and articulated the need for greater guidance from professors.
- **Lack of foundational/ technical knowledge (AD – 8.3% - and ED – 17.1%):** In ED, Design related stress in students was also due to student unpreparedness, lack of prior knowledge, and lack of technical ability. As expressed by one ED student: “The theme is way beyond our league until we are forced to come up with ideas that has to be innovative and novel, but we have barely the technical ability or knowledge to execute them (sic).

Fun aspects of design

The most frequently occurring themes in a course in terms of percentage of answers of the respondent of that course, are the following:

- **Freedom, imagination and Experimentation (ID – 28.6%, AD – 20.8% and ED - 10%):** Students from all three courses mentioned that they liked to have ‘freedom’ in design, especially the ‘freedom to choose their topics of interest’ and experiment with ‘impossible or silly concepts’ (AD). They liked that ‘the course provided an avenue for us to be as innovative and creative with our ideas,’ (ID).
- **Learning new skills (ID – 14.3%, AD – 16.7% and ED – 10%)** Students in all three courses mentioned enjoying learning new skills, such as technical and software skills, and ‘learning about new technology’ (ED). AD Students enjoyed learning skills such as ‘making presentations’ (AD) and ‘learning how to communicate ideas clearly’ (AD).
- **Hands on (ID - 14.3% - and ED – 12.9%):** Students in ED and ID especially enjoyed hands-on work and liked ‘exploring methods of fabrication’. One student pointed out that they particularly liked the course as “it is not content heavy, more hands-on work” (ID).
- **Enjoy the design process (ID – 14.3% - and ED – 7.1%):** Students in all three courses mentioned that they enjoyed the design process including ‘conceptualization’, ‘thinking critically about design’ and the ‘exposure to a variety of design problems’ (AD).
- **Multi-disciplinarity (ID – 4.8%):** Students liked that their design course was multidisciplinary and “allowed them to showcase their multiple talents” (ID).
- **Design thinking (ID – 4.8%):** Students in ID mentioned they liked using design thinking ideas and methods for streamlining ideas, as well as learning about user empathy and user centric design.

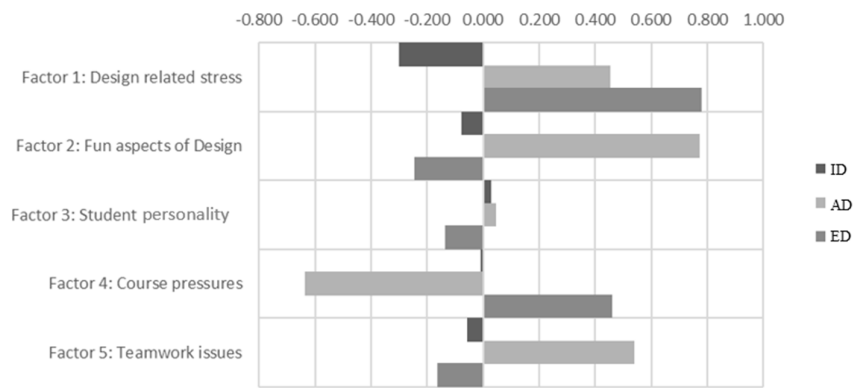


Figure 2. Mean factor scores for each course for Introductory Design (ID), Architectural Design (AD), and Engineering Design (ED) courses

5 DISCUSSION AND CONCLUSION

The objective of this study was to investigate the issues and challenges faced by students in project-based foundational design courses as a basis for improving their experiences. We conducted a survey in three project-based design courses at the Singapore University of Technology and Design to gain insight into student experiences. While previous studies have investigated ‘fun’ and ‘enjoyment’ in the context of the design process [6] and found open-ended problems were perceived as both ‘difficult’ and ‘fun’ [11], in this study we provide insights into students experience of the “fun” and “stress” aspects of design projects. The experiences differed considerably between the courses. The first-year introductory design course was not experienced as stressful, but not particularly fun either. A possible reason, based on comments about rules and restrictions, is that in this course students are guided through the process while learning various design concepts and skills. A further possible reason is that this course is taken by all first-year students at the university: their design experience and hence expectations may vary and not all of them may be equally interested in design. The foundational engineering design course scored highest in design-related stress, with low scores for fun and high scores for course pressures. A possible explanation is the amount of technical knowledge that novel solutions in engineering can require which students probably have not encountered yet.

The foundational architectural design course was considered very enjoyable, despite a fair level of design-related stress and team issues. A possible explanation is the very low level of course pressure the students experienced, and the fact that in comparison to ID, this course focuses on their area of interest, architecture (although this did not seem to have played a role for ED students), and the very visual and interactive nature of architecture courses. The design-related stress in AD may have been caused by an inner drive to perform and come up with novel solutions, or by the team-issues they experienced to a higher degree than the other courses. Overall, students liked design when it allowed them to ‘push limits’ and challenge them, but in a good way, i.e. without them feeling overwhelmed. Based on our results, in Table 1 we provide some initial recommendations to enhance student experience in design courses.

Table 1. Recommendations for improving student experiences of design courses

Instruction mode	<ul style="list-style-type: none"> • Greater interactive and visual content delivery. • Content delivery through seminars or workshops rather than lectures. • More studio time and guidance from instructors.
Course structure	<ul style="list-style-type: none"> • Better connection between design and other courses. • Integrating assignments of other courses into design projects • Customizable deadlines, no-deadline ‘dream projects’
Knowledge provision	<ul style="list-style-type: none"> • A list of high-quality online sources suitable for students to acquire the necessary knowledge within the time constraints of the design project and their level of competency. • Learning resources, training in technologies and processes that include AI

This study primarily focused on investigating students' experience of design course instruction and content. Other components that affect student experience, such as presentations and assessments, were outside the scope of this study. The survey being anonymous allowed students to express their opinions more freely but did not allow us to link their responses to their actual performance. Future research includes a more comprehensive understanding to examine variables such as assignments and assessments.

This study addresses a very fundamental issue in design education: how do students experience their design courses? Recent advances in Artificial Intelligence have specially made it important for instructors and researchers to understand how it impacts students learning in design education. While this study uses data from one university, the issues reported here are probably generic and relevant for instructors developing design courses in other countries. We look forward to conducting comparative studies to understand students' experiences of design education in different parts of the world.

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