On the Key Factors in Higher Education Classroom Design: Physical Aspects of the Undergraduate Teaching and Learning Experience in Malaysia

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Abstract

The design, facilities and conditions inside a classroom play a significant role in the teaching and learning experience for both students and lecturers. Prior studies of primary schoolchildren indicate three design principles affecting student learning, namely: naturalness, individualisation and stimulation. The current study extends these investigations to Higher Education through a survey of undergraduate students and university lecturers aimed at determining the most critical factors in undergraduate classroom design. One-to-one interviews were conducted with students and lecturers (n. 31) at the University of Nottingham, Malaysia Campus. Interviewees were encouraged to express their opinions, comments, concerns and suggestions through open-ended questions. The interviews were recorded and then transcribed and coded using NVivo10. Results show a strong desire among lecturers and students for improved classroom equipment, greater flexibility in classroom arrangement, more attractive decoration and for the addition of natural elements to the classroom environment. Of the three design principles, individualisation and naturalness emerged most strongly from the interviews and appear to be more important factors for undergraduates than stimulation. These findings could make a novel and significant contribution to the physical aspects of classroom design in Higher Education settings. Educational institutions are increasingly employing non-traditional classroom designs, which are expected to provide for more flexible, collaborative, and active learning and teaching experiences. Taking into consideration the environmental psychology of teaching and learning, several of the reported design attributes can serve as benchmarks for upgrading current classroom design and facilities in the future, as institutions look to upgrade their physical infrastructures to meet the changing demands of teachers and learners arising from technological innovations and shifts in our understanding of the methods and purposes of Higher Education.

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Classrooms used for undergraduate teaching in universities have traditionally been designed in the form of flat seminar rooms and flat or stepped lecture theatres. Large groups of students are often accommodated in these classrooms, which are often built rigid, painted in a single solid colour, fitted with a centralised air conditioning system, and in some cases lacking ventilation or windows, equipped with basic audio-visual systems and so on. Activities such as lectures, demonstrations and class discussions are often conducted with chairs and tables arranged in a fixed and systematic manner. The layout and facilities are not necessarily most conducive for teaching and learning purposes.

Several studies have investigated the importance of classroom design attributes on student learning (Barrett, Davies, Zhang, & Barrett, 2015; Barrett, Zhang, Moffat, & Kobbacy, 2013; Fisher, 2005; Tanner, 2009; Tomasi, n.d.), looking at the selection of classroom design attributes for teaching and learning activities and the implications for student achievement. Barrett et al. (2013, 2015) carried out studies of the impact of school building design on the rate of learning of primary school students. They developed an Environment-Human-Performance (E-H-P) factors model taking into account the design principles of naturalness, individualisation and stimulation (Table 1).

[Table 1: E-H-P Factors Model (Barrett et al. 2013)]

Barrett et al. carried out their studies in two phases, namely Phase 1 which involved 751 students from Blackpool, England (Barrett et al., 2013) and Phase 2 which involved 3766 students at two further geographical regions in the UK (Barrett et al., 2015). Outcomes from Phase 1 studies indicated that design parameters such as light, choice, flexibility, connection, complexity and colour have a clear impact on learning progression among students. Also, the features leading a classroom to be considered ‘good’ could be related to design, to usage, or to both design and usage (Barrett et al., 2013). Furthermore, results from Phase 2 revealed a 16% impact of school design on the rate of learning of students, of which naturalness

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accounted for around 50% while individuality and stimulation accounted for roughly 25% each. The researchers identified seven key design parameters that together explained 16% of the variation in learning progress: light, temperature, air quality, ownership, flexibility, complexity and colour (Barrett et al., 2015).

Prior to the aforementioned studies, Tanner (2009) compared student achievement with three school design classifications: movement and circulation, day lighting, and views. The results showed a significant impact on student achievement in reading vocabulary, reading comprehension, language arts, mathematics and science. Movement and circulation patterns significantly influenced the variance in reading comprehension, language arts, mathematics and science scores; spaciousness was found to allow freedom of movement and circulation which correlated with better test scores. Day lighting significantly influenced the variance in science and reading vocabulary scores, while views significantly influenced the variance of scores in reading vocabulary, language arts, and mathematics.

Tomasi (n.d.) reported that evidence-based design is increasingly focusing on educational facilities and is an emerging influence on the design of schools. Studies indicated that students inside classrooms with the most daylight progressed 15% faster in mathematics and 23% faster in reading. Carpeted classrooms resulted in students having higher test scores in mathematics and language compared to those in rooms with hard surfaced floor coverings. Students with adjustable furniture could improve their posture and were more satisfied due to a reduction in neck and head pain, and improving indoor air quality increased the presence of both students and teachers in class.

Studies that link pedagogy and the design of learning environments have reported that intentionally designed classrooms were able to support active learning and increase student engagement (Fisher, 2005; Scott-Webber, Strickland, & Kapitula, 2014). Comparisons between older and newer classroom styles were statistically significant based on all 12

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measured factors: collaboration, focus, active involvement, opportunity to engage, multiple means, in-class feedback, real-life scenario, ways of learning best, physical movement, stimulation, comfortable to participate and enriching experience (Scott-Webber et al., 2014). Fisher's (2005) review of studies carried out in the UK, New Zealand and Australia concluded that more research is needed into the relationship between pedagogy and design of learning environments. However, the aforementioned studies, in particular those reported by Barrett et al. (2013, 2015), focus on the requirements of primary school education. Therefore, the current investigation was conceived to collect data from undergraduate students and lecturers, to understand the key factors in Higher Education classroom design. The findings from this research can contribute to knowledge of the physical design requirements of undergraduate classrooms from the point of view of students and lecturers.

Method

Thirty-one interviews were carried out and recorded, upon obtaining participants' consent, over a period of three months during the autumn session of the 2014/15 academic year. Twenty of the interviewees were students and eleven were lecturers, spread across all three Faculties of the University of Nottingham, Malaysia Campus (UNMC): Faculty of Arts and Social Sciences, Faculty of Engineering, and Faculty of Science. Lecturers were interviewed at locations according to their preference (usually in their office or in the interviewer's office). Students were given a series of time slots to choose from but interviews were carried out in a specified room. All students and lecturers participated on a voluntary basis, and students were given tokens of appreciation for their participation. Approval was obtained from the Faculty Ethics Committee prior to the commencement of interviews.

Interviews were semi-structured. As a guideline, each interviewer was given the following list of questions:

1. "What do you think of the classrooms in this campus?"

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2. "Which classrooms (in UNMC) have you been using?"
3. "Any suggestion to improve the current set up?"
4. "Any example of well-designed classroom that you have experienced before?"
5. "How does an ideal classroom look like?"
6. "Any special requirement that you wish to have for teaching and learning?"

The questions were open-ended to give participants the freedom to express any opinions, comments, concerns or suggestions they might have about the physical learning environment of UNMC classrooms. Interviews lasted for an average of 15-30 minutes. All interviews were then transcribed from audio recordings and coded using NVivo10 (QSR International, 2012).

Results

Participant responses were coded into three main categories: areas of satisfaction, areas of dissatisfaction, and desires for a different learning environment. Some of the more frequently mentioned elements were present across two or three categories, reflecting the large variations between different classrooms in UNMC.

The element that was most frequently mentioned by both lecturers and students was the quality and user-friendliness of equipment. It can be seen that 28.6% of lecturers declared they were satisfied with the current equipment, while 23.8% declared they were dissatisfied. 47.6% mentioned that they wished for improved equipment. Amongst students, only 15.4% expressed satisfaction with the equipment, while 38.5% expressed dissatisfaction. 46.2% of students reported they desire better classroom equipment (Figure 1).

[Figure 1: Summary of Responses on Classroom Equipment]

The second most frequently mentioned element was the flexibility of furniture, classroom layout, and equipment. Flexibility, or the desire for greater flexibility, was widely mentioned by both lecturers and students. Both groups expressed satisfaction towards the

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present situation, but also desire for an even more flexible learning environment. From Figure 2, it can be seen that 6.3% of lecturers declared they were satisfied with the current level of flexibility of UNMC classrooms, while 59.4% wished for improved flexibility and 34.4% declared they were dissatisfied due to current flexibility issues. Amongst students, only 8.7% expressed satisfaction with regards to current classroom flexibility, while 39.1% expressed desire for more classroom flexibility. 52.2% of students explicitly stated that they are dissatisfied with the current flexibility of the classrooms (Figure 2).

[Figure 2: Summary of Responses on Classroom Flexibility]

The third most frequently mentioned element was the level of naturalness of the learning environment. The lack of naturalness was often mentioned by both lecturers and students, mainly in terms of dissatisfaction and desire for a better learning environment (Figure 3). No lecturer (0%) and only 15% of students were satisfied with the current natural environment. It can be seen that 37.5% of lecturers and 35% of students expressed dissatisfaction with regards to the level of naturalness on campus, and 62.5% of lecturers and 50% of students expressed the desire for a more natural environment, giving rise to some suggestions to be explored in the discussion section following.

[Figure 3: Summary of Responses on Naturalness]

The last element to be consistently reported was classroom decoration, especially the colour of walls. Interestingly, there was a large divergence in opinion between lecturers and students with regards to this element. In fact, most lecturers (50%) declared they were satisfied with the current state of decoration, even if the same percentage declared that things could still be improved (Figure 4). None of the lecturers declared they were dissatisfied with the current décor. Amongst students, on the other hand, only 18.8% declared they were satisfied, 12.5% clearly expressed dissatisfaction and 68.8% expressed desire for a better

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learning environment, with some suggestions, on wall colour especially, that will be discussed later.

[Figure 4: Summary of Responses on Decoration]

Discussion

The three school classroom design principles of Barrett et al. (2013): individualisation, naturalness, and appropriate level of stimulation, proved to be a good fit for our data analysis. Of the three principles, individualisation and naturalness seemed to be more important for the quality of Higher Education teaching and learning compared to stimulation, both for lecturers and for students. Stimulation elements (such as classroom décor) were not often given high importance by the respondents.

Individualisation

One element was consistently reported as most important: the presence of good equipment in classrooms. The importance given to the quality of equipment was very often linked, for both lecturers and students, to the concept of 'individualisation', by which we follow Barrett et al. (2013) to mean the potential to experience a sense of ownership over the equipment that is being utilised, a potential which is related to its flexibility and accessibility. Lecturers and students mentioned the importance of well-functioning, flexible and user-friendly equipment both when expressing satisfaction ("So far, all the lecture halls in F1 in UNMC are a good example—can use the whiteboard and can control the length of the screen", Staff 10), when expressing dissatisfaction ("But the ones with one screen – encountered problems with visualizer—the speaker is difficult to turn on", Staff 9), and when talking about their ideal classroom ("Sound system is good—but in between the tables, [we] can put a microphone there so that students in a bigger class can ask questions", Student 4; "More plugs to work on for laptops, with Wi-Fi, monitor, screens Wi-Fi—so that [it is] easier for us to do research", Student 18).

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The fact that responses revealed both satisfaction and dissatisfaction with the current equipment, as well as a desire for better tools, implies great variability in the quality of equipment from classroom to classroom (those who have had lectures in certain classrooms are satisfied, whereas those who had lectures in other classrooms are not and wish for better equipment). This result suggests the importance of consistency in the quality of classroom equipment, and is consistent with previous studies conducted on classroom design in Higher Education (Christensen Hughes, 2002).

The second element of high importance for both staff and students was furniture and equipment mobility. Within the theoretical framework proposed by Barrett et al. (2013), individualization therefore seems to be the most crucial design principles for our sample of university lecturers and students in Malaysia. The possibility of moving pieces of furniture (such as chairs, whiteboards etc.) around the classroom is perfectly in line with the goal of individualisation, as it gives users a chance to employ their own individual judgment on the best possible position and orientation of equipment for optimal teaching and learning.

The importance of furniture and equipment mobility was brought up mainly when expressing desire for improvement in the current state of things, on the part of both lecturers and students. For instance, Lecturer 1 stated: “the tutorial room (at Room BA10) is a bit inflexible (because of its long thin shape) and difficult to arrange in seminar format”; “in the central teaching room (at Room F3), for discussion and tutorials it is hard to get around the room, when we have to divide ourselves into groups, because the seats are very structured, so it’s hard to discuss things with your group”, Student 13; “some classrooms are good for traditional styles lectures, but for tutorial, not that good. Not much space for tutors to walk around if tutorial is done in an elevated classroom”, Student 6.

More specific suggestions for improved mobility of furniture and equipment were also provided. For example, Lecturer 11 described an ideal classroom as containing “foldable

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chairs or things that can move around, for discussion—something that can move and put them back easily", and Lecturer 4 mentioned that it should have "very flexible tables and chairs (rearrange-able)". Lecturer 8 suggested that "the venue of the classroom should cater to different lectures—e.g. group-based ones"; Lecturer 11 wished for the adoption of "flexible ones that can be moved around which will be better to facilitate the discussion". Student 2 (among others) stated that "microphones should be mobile and portable", and Student 3 said "maybe we can have movable chairs".

The concerns expressed by interviewees about furniture and equipment mobility have distinct implications from their concerns about the general quality of equipment. It does not appear to be as crucial for all classrooms to have mobile pieces of furniture, as it is for all classrooms to have good quality technological equipment. But it is essential to have a correct assignment of classroom per activity. As many lecturers and students pointed out, in fact, classrooms which are good for lectures might not be good for tutorial-style activities. The importance of mobile furniture has been highlighted in previous literature on classroom design in Higher Education by Molnar (2007), in his report on the development of the "classroom of the future". According to Molnar, it is crucial to have chairs and desks on wheels, which allows easy rearrangement into many different sitting orders, suitable for different teaching and learning activities.

Naturalness

Next to individualisation, the naturalness of the classroom was brought up by both lecturers and students as important for an environment conducive to effective teaching and learning. A minority of participants reported satisfaction with regards to naturalness elements (e.g. Student 17, who said "there's a lot of light in the classroom—natural light"), but the majority talked about a lack of naturalness and a need for improvements in this area. Lecturer and student concerns and suggestions about naturalness could be divided into three types:

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1. Naturalness of lighting. For example, Lecturer 3 mentioned that: “classrooms could be with more light (natural)”; Lecturer 11: “there should always be a window”; Lecturer 1: “Natural light is preferable”. Student 11: “there is no natural lighting—fall asleep easily. There should be natural light all the time”; Student 2: “we should have rooms with exposure to sunlight, which doesn’t make you sleepy, compared to the bulb, and big glasses around to allow the sunlight to come in”. Student 6 declared a preference for "classrooms that have natural lightings, if possible".
2. Ventilation. For example, Student 15 mentioned the importance of “windows and ventilation”, and Student 2 of “Good circulation of air”.
3. Presence of greenery or other natural items. For example, Lecturer 2 stated that he would like to be “able to do courses outdoor. The environment can help (especially for my field). I would like to take them outside if I could (in a beautiful place in the campus)”; Lecturer 9 suggested to insert “waterfall outside the classroom—students can feel ‘fresh’ when they exit from the classroom”. Student 2 wished for “more green plants surrounding the windows”, similar to Student 15, who would like “some potted plants—to make personal learning environment”, and to Student 3, who suggested that “the corridors should have some greeneries”; Student 4 mentioned that: “Maybe can make one side of the walls into transparent glass so that students can view the trees (not cars)”; Student 9 suggested to have "green plants inside the classroom / hanging potty plants".

The importance given to naturalness being perceived as a crucial element for teaching and learning on the part of both lecturers and students is not surprising considering that previous studies involving large numbers of students revealed that naturalness has a strong effect on student learning (Barrett et al., 2015). However, given that the bulk of the previous literature focussed on elementary schools, it is necessary to conduct further studies in Higher

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Education to further investigate the present result. It would be interesting to explore the relationship between the presence of natural elements and actual learning rates of university students, thus going beyond their perception of the importance and pleasantness of such elements. It is worthy of note that UNMC is already a highly green environment, being located far from main roads and surrounded by fields and plantations. Buildings are low and arranged in a circle, such that moving from one classroom to another always requires walking outdoors and thus being exposed to natural elements. This suggests that the location and layout of the campus should be taken greater advantage of, in order to allow lecturers and students even more contact with nature. It also raises the question of what the ideal level of naturalness might be: would naturalness eventually reach a plateau after which its effect on learning would be no longer beneficial? Further studies into the benefits of naturalness could be of much use to designers.

Stimulation

Almost half of the lecturers mentioned wall colour at some point in their interviews, but, interestingly, they mostly went on to state that it is not an important element ("Neutral colour is perfectly fine; colour doesn’t matter", Lecturer 5; "Light colour would be good, décor—will only give good impression", Lecturer 8), or that a generic white or bright colour is the best option ("ideally it should be bright and it has to be bright"; "Undergrad and postgrad—not so colourful—more adult type", Lecturer 11), and that too much colour or other forms of decoration would be a distraction for the students ("I would prefer a light colour classroom with not too much design because I think they would be distracting. Plain, light, very minimal design is good. Better to have all focus on the speaker or projection...", Lecturer 4). Only Lecturer 7 expressed a preference for a specific colour ("light blue"), while Lecturer 11 specified that "A classroom setup should be different to facilitate the learning type. For School of Education, maybe more colourful rooms".

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Some students reported similar ideas on the topic: "Colour is ok", Student 6; "Classrooms look spacious by using white colour which is good in promoting space", Student 17; "Colour—e.g. white—makes room more spacious", Student 9. The majority of students, however, had ideas that were completely opposite to the lecturers in terms of colour for the walls. For example, Student 1 wished for "yellow, green or white colour"; Student 2 suggested to "make the classroom more alive by painting colourful colours e.g. green, blue, red—lower tone colours, not too bright such as green lime"; Student 3 stated: "the wall shouldn't be white; it should be cream in colour"; Student 5 declared to be displeased with the "colour of the walls—it would be better to have a colourful room"; Student 15 said that: "colour is dull—add some leafy plants or decorations in order to make learning more fun; something to put on the wall rather than having empty walls"; Student 19 stated that "Light orange would be good, light and pastel colours would be good as well". One even mentioned a desire for more colourful chairs: "The colour of the seats shouldn't be blue. It should be bright, maybe red", Student 3. Only a few lecturers and students mentioned décor elements not related to wall colours or wall decorations. Their statements reflect their opinion on wall colour, being consistent with the preference for plainness on the part of lecturers, and the preference for stimulating elements on the part of students: "It doesn't need to be fancy", Lecturer 1; "it would be good to have background music, instrumental", Student 20.

The divergent preferences of lecturers and students in relation to decoration can be interpreted through the generational gap in addition to the difference in roles. Many scholars have observed that exposure to technological devices might be leading a greater need for stimulation among contemporary youth (Goleman, 2013; Rowan, 2010a, 2010b). If this is not properly tackled, it could make it more difficult for contemporary youth to concentrate on tasks, thereby having detrimental effects on many areas of their lives, including academic achievement. Whether or not inserting different (non-technological) elements of stimulation

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(such as colourful walls) would have a beneficial effect on students, possibly helping them to reach optimal levels of stimulation (Raju, 1980) while reducing real distractions, is still unclear and calls for further research.

Conclusions and Future Prospects

This study brings out the perceptions of lecturers and undergraduate students in Higher Education towards a number of attributes of classroom design, including equipment, flexibility, naturalness and decoration. These attributes are to be used as a reference for building new classrooms providing flexibility, interconnectedness and inspiration while maintaining the historic integrity of the University of Nottingham's three campuses. The lecturers and students surveyed for this study stressed the importance of individualisation in classroom design, supporting the trend towards flexible classroom environments supportive of active learning. A more novel element that emerged from our interviews was a desire for naturalness. Future research into optimal Higher Education teaching and learning environments should examine the benefits, in terms of both academic outcomes and general wellbeing, of more closely integrating classrooms with their natural surroundings.

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Design principles	Design parameters
Naturalness	Light (quality/quantity/lighting control)
	Sound (noise/loudness)
	Temperature (comfort/temperature control)
	Air quality (contamination/ventilation)
Individualization	Choice (sense of ownership)
	Flexibility (size/space for activities)
	Connection (accessibility)
Stimulation	Complexity (diversity/novelty)
	Colour (colour mood)
	Texture (view/varieties)

Table 1

E-H-P Factors Model

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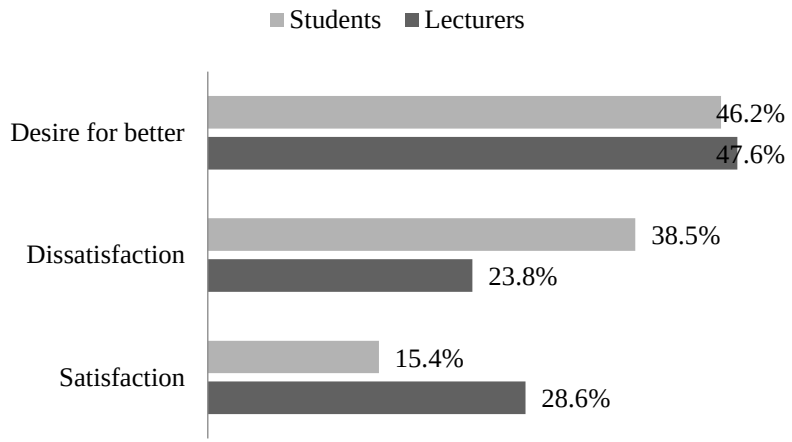

Figure 1. *Summary of Responses on Classroom Equipment*

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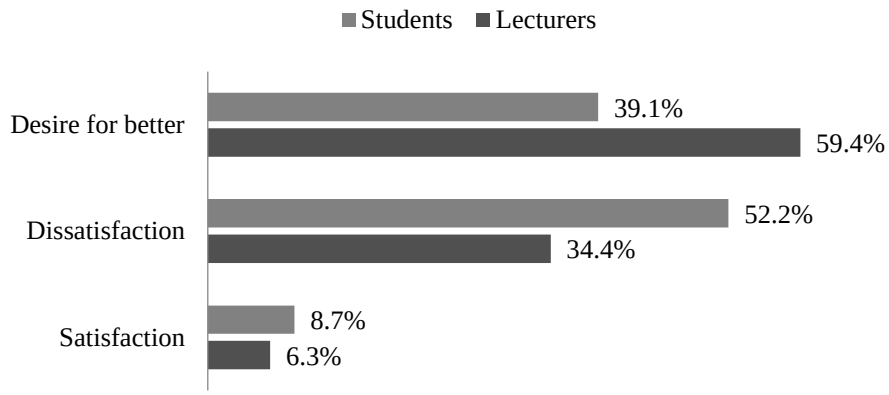

Figure 2. *Summary of Responses on Classroom Flexibility*

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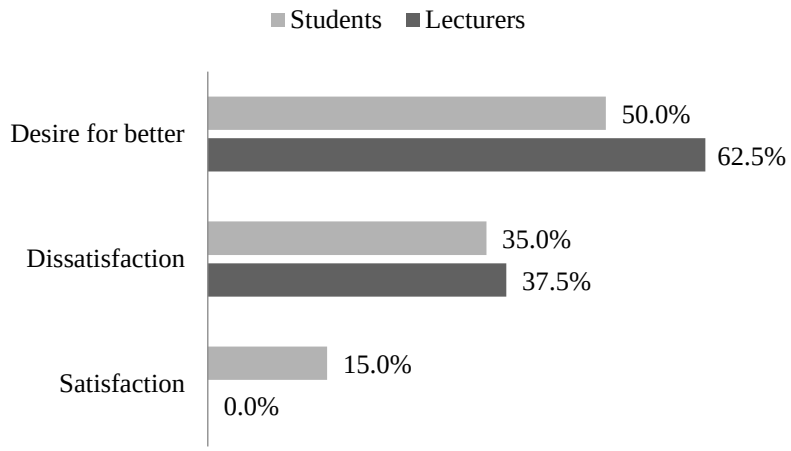

Figure 3. *Summary of Responses on Naturalness*

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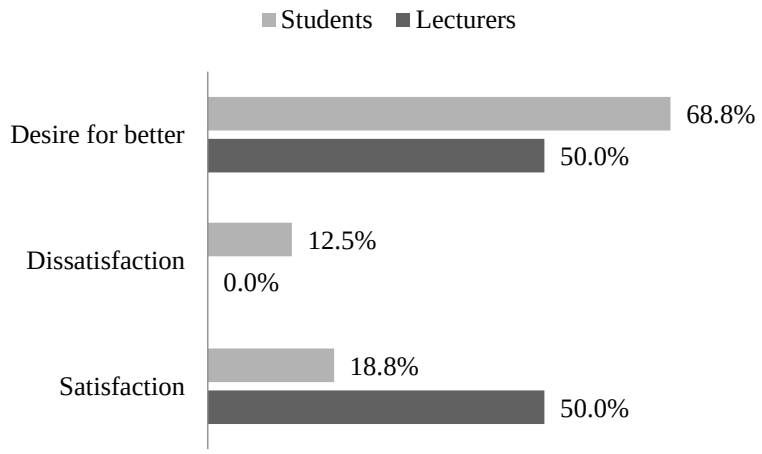

Figure 4. *Summary of Responses on Decoration*