‘Time to Be an Academic Influencer’: Peer-to-Peer Learning Enhances Students’ Self-Directed Learning with Disparate Knowledge Background in CAD

Iain Choi
Fann Zhi Jie

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This paper explores how Peer-to-Peer learning can level-up students' understanding of computer-aided design (CAD) with Autodesk AutoCAD programme for Interior Design Year 1 students.

As students come from different knowledge backgrounds, they approach the module with different understanding levels, with the weaker students unable to follow the live demonstration tutorials.

A peer tutoring assignment using a student-led peer-to-peer learning pedagogy, was introduced to advance students' understanding and internalise content better by reinforcing their learning. Each group has an equal proportion of students with different levels of knowledge and capabilities, and each group member conducted self-research on a topic segment, shared their knowledge and findings within their group, and thereafter curated a 15-minute lecture and facilitation workshop for peers. Tutors provided consultation and mediation, encouraging students’ participation.

The assignment’s results showed that the peer-to-peer learning approach efficaciously empowered students and motivated learning, enabling them to be self-directed learners.

#self-directed learning

#peer-to-peer learning

#computer-aided design

#peer teaching

#peer tutoring

Current Situation

Interior Design Communication 1 (IDC1) makes up a critical part of the diploma in interior design studies in Singapore Polytechnic. The year 1 Design students have to learn computer-aided design programmes, AutoCAD in particular, and use it to produce professional presentation drawings for concept presentation or construction purposes.

The foundation year curriculum consists of fundamental subjects as shown. (fig.1)

Problems and issues faced in the past existed mainly as tutors traditionally used the instructional-based teaching method for this module, whereby the tutor goes through the basic commands and tools in class, and students will subsequently follow the steps and create the desired outcome given by their tutors. The module has been in this pedagogical format for the past 10 years.

Students frequently grumble about the pace of the instructional tutorials, claiming that it is too fast for them to follow-through and apply them as practice exercises during the tutorial.

> *"IDC is a heavy module that many people have a hard time understanding as the module requires us to rely heavily on computer software, AutoCAD. Many of us have a disadvantage especially for those who are very new to it. I feel that it can be improved by having an online tutorial demonstration by the lecturer to help us understand better."* said Student A, Secondary School Leaver.

Yet, some students find the pacing too slow, or rather, too easy for them.

> *"The lessons greatly helped me improve my drawing skills be it on AutoCAD or hand drawings. We are taught a lot of drawing techniques and hatching techniques that are fun to learn. Engaging and relevant to other modules, the module helps me in my future and I learned a lot of new functions of AutoCAD and learned how to draw environments in different perspectives,"* said Student B, ITE Graduate.

One major issue faced by the teaching team is that students come from different backgrounds, in terms of their technical and design skill sets. They are from either the traditional secondary school system or graduates from The Institute of Technical Education (ITE), who already have three years of basic vocational knowledge experience, which often includes AutoCAD for those who studied an interior design / spatial design course.

Secondly, they belong to a different generation of students, who think, and behave rather differently. Most of our recent students belong to a blend of the 'millennials' and the 'centennials' generation group.

The millennials are known to be autonomous, tech-savvy, very self-confident, sociable and diverse, but also practise extreme individuality, expect quick information, and care about their personal progress (Immerwahr 2009, 233-245). They also value reward for participation, rather than reward for achievements (Mesister and Willyerd 2010, 88).

At the same time, in Polytechnic education, students are now approaching the 'Centennials' generation group, who have their unique thinking and behavioural traits. Born after 2001, they are less self-absorbed but more self-assured, more empathetic, vigilant and more sensitive to the outside world and their peers compared with their Millennial counterparts (Jain 2015, 59).

The current didactic teaching method proves challenging for the two groups of students who belong to a blend of these two generations, to learn the subject effectively.

The teaching team felt that there is a need to test out a new approach in view of the current gap and set out the aims to achieve an active, specially

curated, way of teaching by permitting a more active role for the students themselves, which may allow a paradigm shift of student's mentality towards their learning.

Intervention Research

The teaching team strongly felt that a peer tutoring method has the potential to be introduced into the syllabus based on the students' profile, as collaborative learning can be generated by peer tutoring, which allows students to learn from their peers. In turn, they develop self-directed learning skills among themselves (Choi, Jakob and Anderson 2017).

Peer tutoring is a teaching method, conducted by people who belong to similar social-groupings (e.g. design students), to help each other acquire knowledge among themselves at the same time (Topping 1998).

Similar to peer-to-peer learning, all students have the opportunity to share knowledge. In this setting, each student will have a chance to function as a peer tutor, or tutee at differing times, wearing different hats, both as the knowledge giver and receiver (Hott, Walker and Sahni 2012, 7).

By doing so, students themselves can learn from each other's strengths and alleviate each other's weakness, through constant engagement between peers.

The benefits of peer tutoring have shown in studies that students gain better self-esteem as they feel more empowered by peer tutors to deal with homework and assignments (Eggers 1995, 216-219). Henceforth, they are more willing to query 'at the same level' with their tutors.

Among peers, through helping and learning from each other, students communicate better and special interpersonal synergy was formed (Colvin 2007, 165-181). They also instigate opportunities for peer tutors to be spontaneous, to stay alert and to respond promptly when there is a problem. As such, it helps train the student to be an adequate communicator and listener (Beasley 1997, 21-30).

As a class, the experience helps to make students more self-assured in the way they learn, they start to value what they have learnt and gain a better perspective on how to be a better learner (Colvin 2007, 165-181).

Discipline wise, studies have shown that peer tutoring allows students to be serious about punctuality, deadlines, and submission deliverables, as they are now taking charge of their peers' performance. Peer tutoring also helps to improve devotion towards team discussions and tutor's consultation, which in turn, creates a better set of outcomes as a result. (Kharusi 2016).

Malcolm Knowles (1975) defines the term self-directed learning (SDL) as;

> *"a process in which individuals take the initiative, with or without the help of others, to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes."*

SDL aims to promote self-teaching and self-motivated learning, Julian Sefton-Green and Maurice Gibbons (Sefton-Green 2004 ; Gibbons 2003) further clarify that SDL is a process that does exist to a variable degree in every individual; they take charge of their learning, take control of their thinking and manage their behaviours while dealing with knowledge acquisition. SDL does not limit itself to the individual but it can be involved as a form of collaboration between peers. This-approach further promotes extended learning, which is one of the SDL elements in the Singapore Polytechnic-SDL framework (fig. 1).

There are four key characteristics of SDL (Tan and Koh 2015):

a. **Plan learning:** set goals and outcomes, identify the key task, identify learning gaps, plan learning strategy and ascertain motivation; learning should be systematic with a defined outcome, which allows students to have a framework and direction while seeking knowledge (e.g. research stage);
b. **Manage learning:** proper use of learning strategies and exploring alternatives and making a sound decision;
c. **Review and evaluate learning:** Monitor and review progress, modify/change aspects of learning strategy based on feedback;
d. **Extend learning:** apply learning across different contexts; making connections between formal and informal learning.

Last but not least, students self-monitor their learning process to be consciously aiming towards the identified goals, in which technological learning platforms, such as the internet, email and social media platforms, help improve students' engagement through a round-the-clock knowledgebase (Rasid and Asghar 2016, 604-612).

Individuals extend their learning through activities, projects or deliverables to justify their learning and to show that the students are actively seeking out more knowledge on top of what they have learnt.

In view of the new strategy, the intent was through the introduction of peer tutoring, to allow peers to monitor each other's progress and stock take each other's learning, especially when they are facing difficulty while conducting self-directing learning among themselves.

Based on the research, SDL helps promote personal motivation and deliberate practice of knowledge acquisition (Tan and Koh 2015). Peer-to-peer learning, through peer tutoring method, on the other hand, helps reinforced learning via peer support and a surveillance system, to ensure proper personal accountability of their learning.

This blend of strategies allow students to have a stronger ownership towards their study, instead of relying too much on the module tutor's instructions and following through blindly. An assignment was introduced to facilitate the application of the strategy.

Assignment: Design Peer Learning Through Peer tutoring

The "Peer Tutor Lecture Series" is based on the SDL's influencing behaviour strategy. As a team, they will go through a set of check point reviews, to improve the students' metacognitive awareness of the topic.

In short, self-based learning is applied at the beginning and the end of the series, where peer learning is introduced to facilitate and promote intrinsic motivation and passion for learning.

It is a term-based project, which lasts five weeks in total. The series comprises pre-lecture series activities, a development stage where the team creates the assignment themselves, peer review, and editing of the assignment between peers, and moderation by the module tutors.

The pre-lecture series activities or preparation work of the assignment, starts in term 1 of the foundation year. As the cohort comprises students with different capabilities, only a set of fundamental topics such as the installation of the programme, interface management and basic navigation tools will be covered. It aims to equip everyone with basic skills to ensure an equal footing for everyone to begin with. (fig. 2)

During term 1, the teaching team observed students' behaviours and identified students who performed better, and those who have prior experience from their technical institutional days.

As the above-mentioned students form up to only a quarter of the cohort, some of the group leaders were chosen based on their working attitudes and maturity in handling daily homework instead. (fig. 3)

The development of the assignment included a short lecture assignment, where each peer student team, placed in groups of three to four students, was to curate a ten-minute exercise for the other student teams to execute, plus a five-minute troubleshooting time for the team to rectify the participants' enquiries. (fig. 4)

The team should include the following content during the presentation (fig. 5):

1. The objectives of the tools covered
2. The access to such tools (icon/shortcut)
3. A short demo of its usages
4. The task for students to practice knowledge learnt
5. A set of worksheets for the class to work on during the lecture series.

In stage 1 of the self-directed learning plan, the students were given a week to research by themselves individually, using the list of media channels approved by the tutor, such as LinkedIn, school library e-books and also blog links provided on Blackboard. Nonetheless, they were allowed to access unofficial websites/blogs, CAD-related YouTube channels, and book lists from other platforms.

They were to prepare their first draft of the assignment before meeting their peers for further discussion. At this stage, students managed their self-directed learning, whereby the review of the SDL outcome was in the week after. (fig. 6)

At Stage 2, the peer team met during the next lesson to discuss knowledge gathered and shared within their respective peer team. Each team member showed each other what they have researched so far, and they discussed the structure and content of the lecture details.

Each team filled up an assignment planning worksheet twice in the subsequent weeks for consultation purposes. Team members needed to illustrate details of the tools and commands learnt, and planed out the exercise for the cohort. It is to create an appropriate evaluation system between student team members, to monitor learning and team development (Michaelsen and Richards 2005, 17).

The teams also needed to decide the role of the individual member, both at the development stage, as well as during the presentation. For example, tasking each member to research a topic during the research stage, and to select a presenter or a facilitator during the presentation named 'The Lecture Series'.

The two consultations allowed tutors to mediate possible conflicts between peer team members. It also served a way for tutors to monitor the team's learning and development, which is strongly recommended by Osman Demirbas and Halime Demirkan (2007, 325-359). It also enabled tutors to have an opportunity to conduct a live spot check on the team's understanding of the assigned topics to cover, such as producing circles and arc, and chamfer a sharp corner of a square shape.

The worksheet was then evaluated by the tutor at the end of the discussion; it helped minimise errors to make sure that the exercise was both challenging and professional enough for all students to practise.

Other than the assignment planning worksheet, the teams were required to fill in the content of the presentation, for the peer team to work on. (fig. 7)

For Stage 3, there was a review and evaluation of learning with a series of lectures. During the actual presentation, the student's teams took over the tutors' role as a class tutor, teaching one to two modifier commands per team. Within the 15-minute period, they covered the command in ten minutes, and allocated five minutes for troubleshooting. (fig. 8, 9)

Seated together with the rest of the students, the tutors role-played as students to enact various possible mistakes commonly made by students. The intent was test the ability of the facilitators (the peer team presenting) to resolve common questions on the ground, as this was a hindrance to learning.

At the end of the session, the rest of the students evaluated their peer teaching team in three categories (i.e. clarity of explanation; the level of facilitation and the creativity of activity). Final grades and the consolidated comments from the team evaluation were shared with the respective teams. (fig. 10, 11)

As for their final grade, the module tutors then graded on the peer team's overall execution, the correctness of the command, the quality of facilitation, as well as the preparation of the worksheet and activities.

Peer evaluation was used to review teams' contribution and assess team member's performance, which accounted for 20% of their overall grades, as an individual component. Aside from using it for grading purposes, it also allowed individuals to reflect on their quality of contribution as well as their willingness to work as a team, which is an essential skill as a designer. (fig. 12)

Finally, there was an analysis of implemented strategies upon the conclusion of the assignment, where quantitative data was sought through a short survey administered to the students involved, to rate on their receptiveness and effectiveness of the assignment. A total of 52 responses were returned.

Questions involve the level of skills acquired before and after their assignment, uniqueness of the assignment, whether the assignment is manageable, the team synergy, the comfort level of providing/receiving feedback and comfort level of self-directed learning through online resources. The detailed list of questions is provided. (fig.13-17)

Qualitative data was sought from student feedback conducted at the end of the year, to analyse the module quality, as well as the teaching strategy imposed. Data from both methods were reviewed for the success of the intervention and future pedagogical changes.

More than half of the cohort (65.4%) reported that they learnt more about the subject after the assignment; 88.5% of students had a neutral to positive impression for the exercise. In total, 46.3% of students found that the concept of the assignment was effective enough for them to explore their creativity (Aggregate: 3.56/5). (fig. 13)

Some students suggested that they need more preparation time and added that resources should be in place, during the assignment, to achieve more effective learning and development of the "Peer Lecture Series."

More than 60% of the students felt that they have good team synergy among their peers. (Aggregate: 3.44/5). Around 61.5% of students felt that it was beneficial for them to provide and receive feedback from their peers. (Aggregate: 3.76/5). (fig. 14)

In terms of managing self-directed learning, student teams informed us that they utilised the recommended websites and resources as the main source of reference (60.9%). The number was more significant than those who favoured learn-

ing from a tutor's demonstration in class (30.4%). This is understandable as they are more tech-savvy than their seniors in sourcing both online and offline resources. "This module helps us to learn and improve on our manual drawings and CAD drawings, which are both important in the future when we do interior design," remarked one student.

Upon further analysis – a probing question was asked if they like to do the research – only 3.8% of the students disagreed on the statement.

A majority of their research was done online, with the top three research channels being websites/blogs, online social media/MOOC channels such as YouTube and Lynda.com (76.9%), while 43.2% of them still liked to have one-on-one consultation. (fig. 15)

Students prefered to have a balance between tutors' lessons, self-study and research. A majority (96.2%) of the students would like to have more resources, guides, and materials beforehand, be it online resources or live demonstrations. (Aggregate: 3.68/5) (fig. 16)

We can conclude that students valued the opportunity of conducting research, and they were also motivated to do so, provided there was enough resources available along with sufficient scaffolding on how to access different resources.

In this manner, a student's intrinsic motivation could be elevated before they conduct any self-directed learning.

In terms of review and evaluation of learning, a good majority (80.8%) of the cohort prefered to have more consultation before the presentation. Among those, 52.2% of them prefered an extra physical consultation, followed by 30.4% who favoured online meeting tools such as Skype or WhatsApp, and only 17.4% prefered to be consulted by emailing their work over for comments. (fig. 17)

Students commented that some form of post-presentation recap would help them to have a better grip of the concept of the commands, and allow the tutors to rectify doubts (if any) based on the exercise conducted. "Not much apart from how we need more time to understand better …… as a lot of them still do not understand how their teammates present…. A live recap will help," commented another student.

Students suggested that the lecture series videos be uploaded onto the FLIP-classroom platforms, for easy recap and access by the students. The assignment time spent could be increased so that students would be able to have a better grip on the ideas and enough time for practice and troubleshooting.

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For evaluation, analysis, and teaching team feedback, which included all quantitative and qualitative data points, the teaching team re-affirmed that quality of teaching was compromised as it was a strenuous task for the tutor to spoon-feed all instructions within such a short period. As such, the peer lecture series assignment considerably reduced the amount of individual consultation and AutoCAD troubleshooting during the tutorials, and effectively focused on those groups who were in need.

The teaching team also noted that students from the two different knowledge-based groups (ITE and secondary school) had begun to mingle more

amongst themselves. Thus, the assignment also served as a great ice-breaker activity for the cohort.

As for peer evaluation analysis, the teaching team discovered that a great majority of students actively and willingly engaged in the assignment. They proved that they were mature enough to handle the assignment, as they willingly took up tasks based on their skills and knowledge. For example, the students who had better knowledge in AutoCAD were tasked to be in-charge of the overall planning of the exercise, whereas the rest of the team members handled areas such as verbal presentation, the teaching of shortcuts, and helped troubleshoot problems during the exercise.

Peer tutoring, as a whole, allows peer tutors to empathise peer tutees' difficulties and struggles, through conversation and troubleshooting. Secondly, it can be related to the literature review by Eggers (2015) that bite-size tutorials prompted the participants to take notice and evaluate their own set of struggles and thus, an improvement of their problem-solving skills and a realisation of their proficiencies, such as patience, reasonability, and conflict management quality.

When looking at possible gaps and future improvements, it was noted that 22% (4 out of 18) of respondents commented in their feedback that the 'free-rider' issue still existed. There was on average about one student out of a typical team size of four, who does not participate actively, and these students generally have a peer evaluation score of below 50%.

The teaching team also noticed during the consultation that there were free-riders within some teams, especially students with lesser prior knowledge. The free-rider typically looked withdrawn and was not keen on participating in the discussion of the content sharing processes and also the crafting of slides.

Thus areas of improvement will be implemented for future runs of the "Peer Tutor Lecture Series":

1. Each team member is required to prepare and perform a short lecture, within their group. The purpose is to ensure that each member of the team is clear about each other's understanding of the commands so far.
2. It encourages teams to level-up each other's technical knowledge, recognise good practice (such as infographic design) and special skill set (e.g. verbal presentation), amongst the peers. By doing so, the team can task the individual student with a suitable set of tasks, and it ensures that every single team member will be contributing. Hence, this minimises the 'free-rider' effect on those with lower technical knowledge.
3. An extra session of physical consultation and e-consultation will be implemented, to allow teams to level-up team members' understanding of the topic, to reaffirm learning with tutors, and also resolve conflicts between the team members.
4. As a lecture-based presentation may not be the best way to assess the team performance, the teaching team have discussed and will subsequently relook at a better set of deliverables, and possibly integrate it into part of their studio design project deliverables.

The teaching team will observe the result of the implementation during the next run of the series and will monitor the outcome. Other than that, the team also realised the value of such pedagogical arrangement to student learning, and such arrangement has the potential to be transferred to other module assignments.

Conclusion

This assignment proved suitable for freshmen to acquire technical-based knowledge, with the help of their peers, as well as constant review by the module tutors to monitor learning, and students learnt the basic computer aided design tools, and how to prepare their presentation, through self-directed learning, as well as peer-to-peer teaching methodologies. Ultimately, students in this generation belonging to a cross between the millennials and the centennials, were more motivated and encouraged in their technical-based knowledge learning.

Mandatory schedule reviews between tutors and peer teams provided opportunities for them to investigate and seek answers dynamically. Student teams also enabled teammates to share knowledge and hence, supported each other during the execution of the project deliverables. By doing so, there was a reduction of the tutor's hand-holding of students with such a constant feedback loop.

Even though the initial time cost is huge to research and discover suitable learning resources available for self-directed learning, students can recap and learn at their own pace when tutors can use their extra hours for teaching innovations.

Despite the shortcomings, it is noted that the peer-to-peer learning set within a self-directed learning framework provided more benefits by enhancing efficiency and effectiveness in teaching and learning. In addition, this enhanced pedagogical approach of learning can be easily replicated for both technical and non-technical modules as well as varying scales across different cohort sizes. As such, the teaching team envisioned that it will likely be incorporated for other modules within the course in the future.

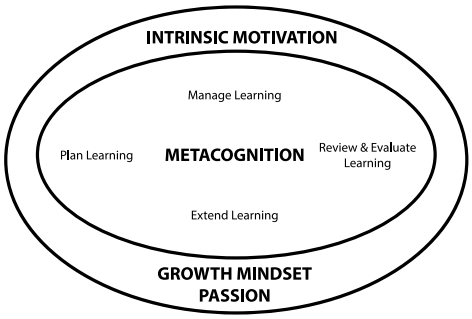


Figure 1: Self-directed learning model (Singapore Polytechnic, 2018) *Source: Department of Educational Development, Singapore Polytechnic*

Fundamentals	Beginner tools
•Introduction	•Drawing Objects
•Exploring the Interface	•Modifying Objects
•Managing files and options	•Accuracy tools
•Navigation, Line Tools	•Hatching
•Layers logics	•Text and dimensions

Figure 2: Fundamentals will be covered in semester 1 term 1, "peer tutor lecture series" will be in semester 1, term 2, covering the basic drawings and modifying object tools. *Source: author*

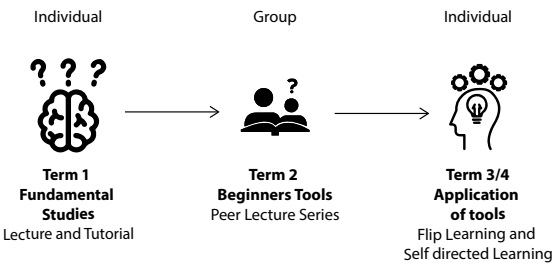


Figure 3: The "Peer Lecture Series" aims to bridge the gap and level-up students' knowledge, to ensure a more equal footing between students at the later part of the academic year. *Source: author*

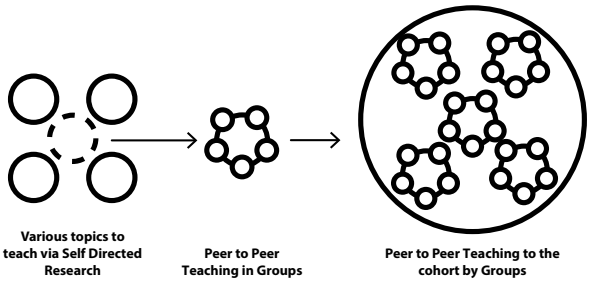


Figure 4: An overview of the "Peer Tutor Lecture Series." It is a combination of self and peer learning, with student groups teaching their peers as part of their assignment. *Source: author*

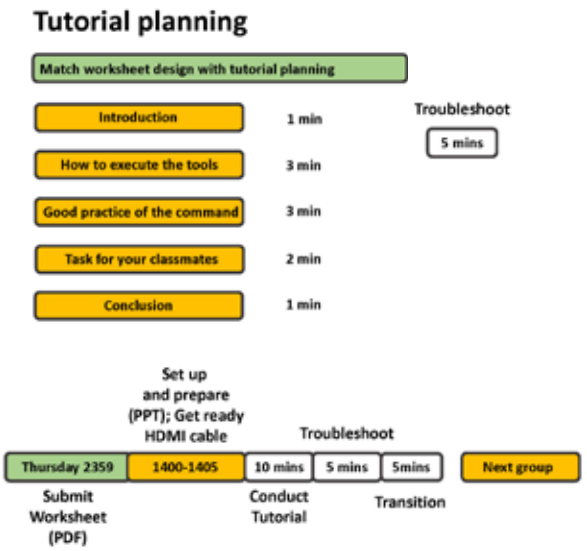


Figure 5: Tutor's touchpoints with students before the final presentation, the lecture delivery; tutorial planning guide for students during the consultation. *Source: author*

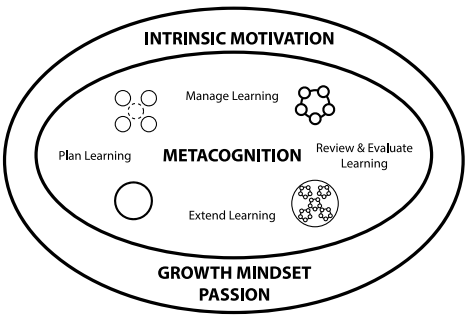
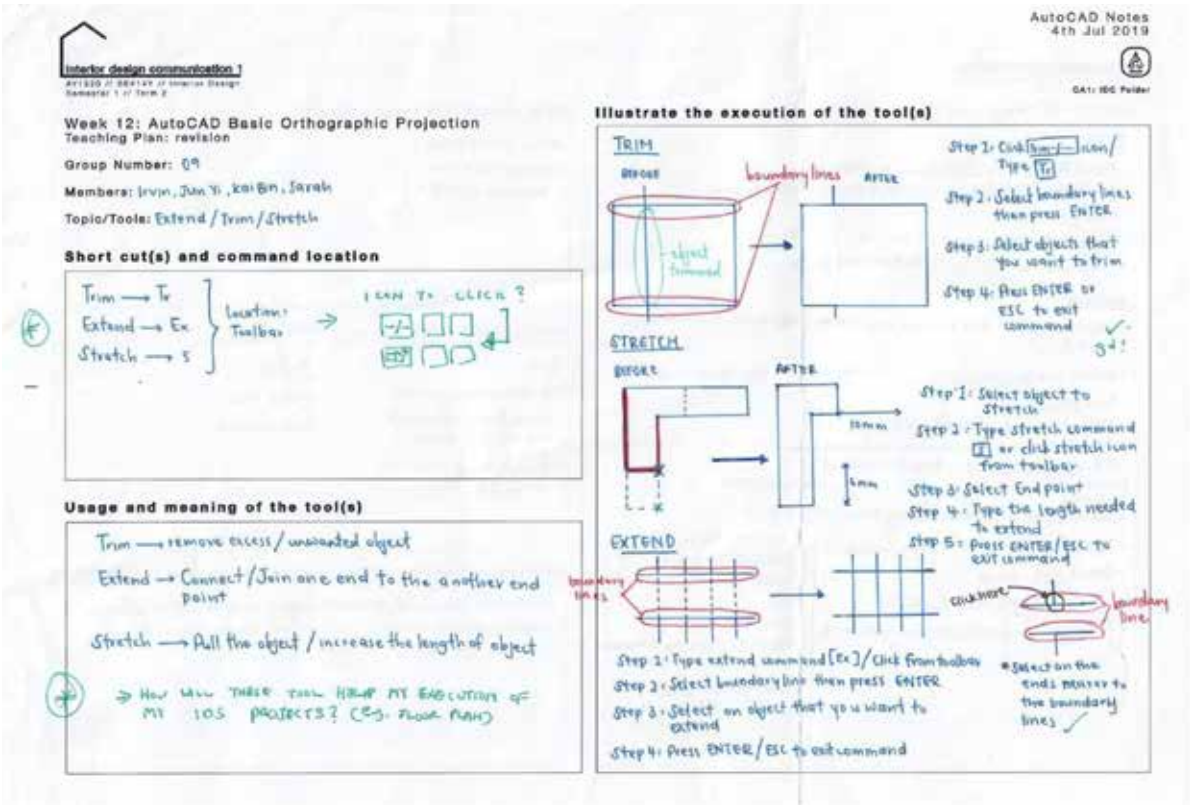


Figure 6: Application of peer to peer learning within the framework of self directed learning. *Source: author*



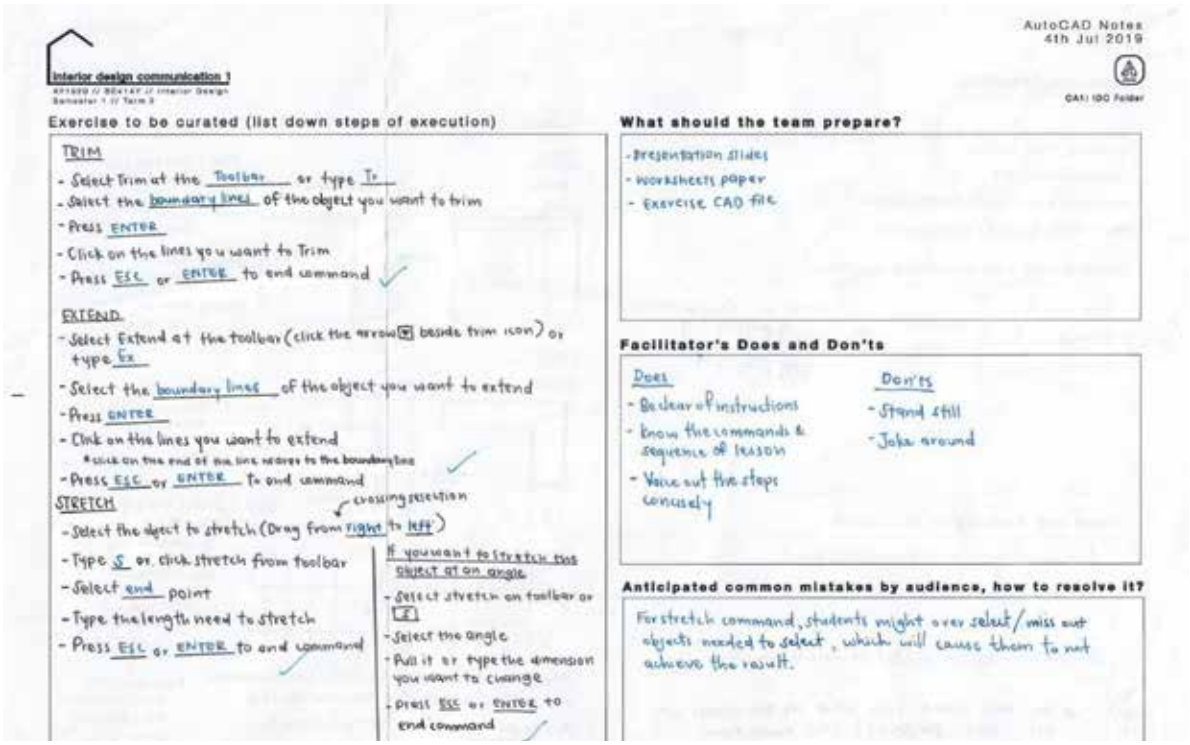


Figure 7: Sample team worksheets. *Source: author*

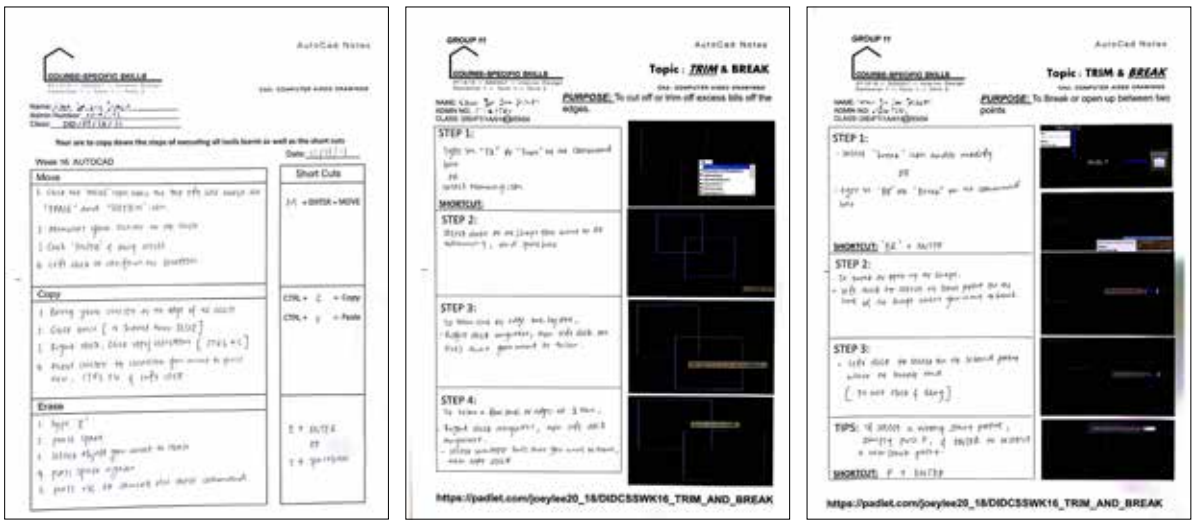


Figure 8: Sample tutorial slides. *Source: author*

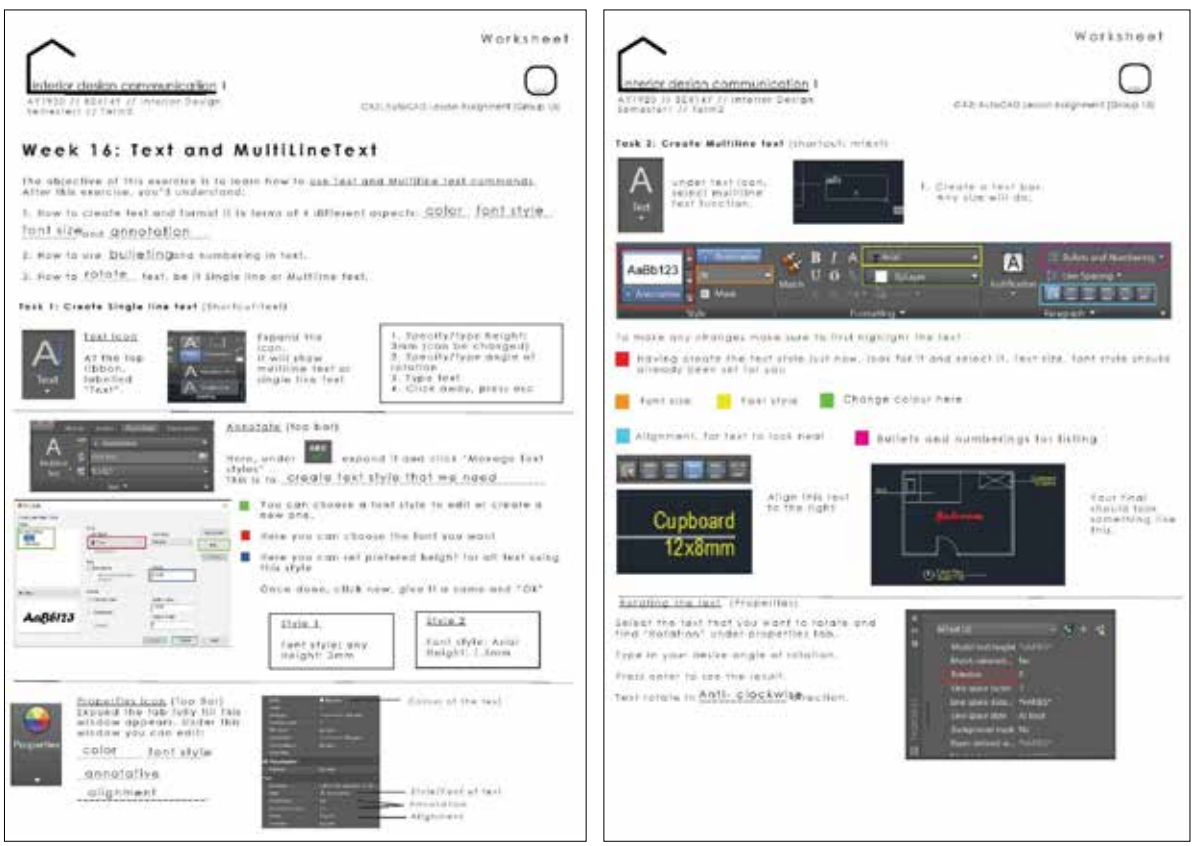
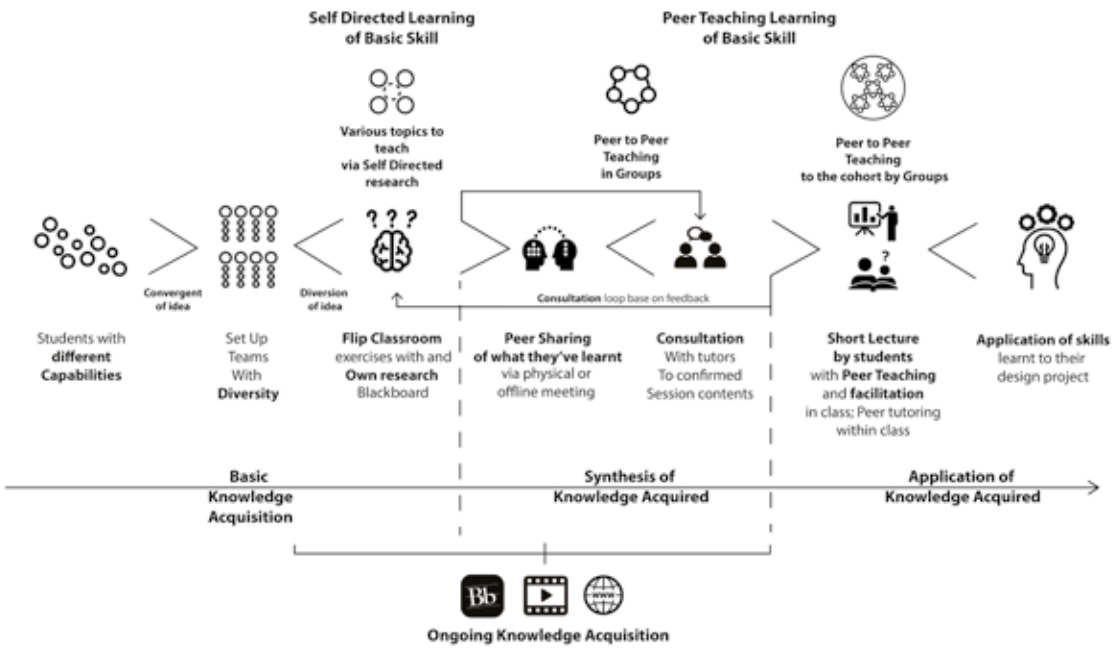


Figure 9: Sample completed participant worksheet. *Source: author*



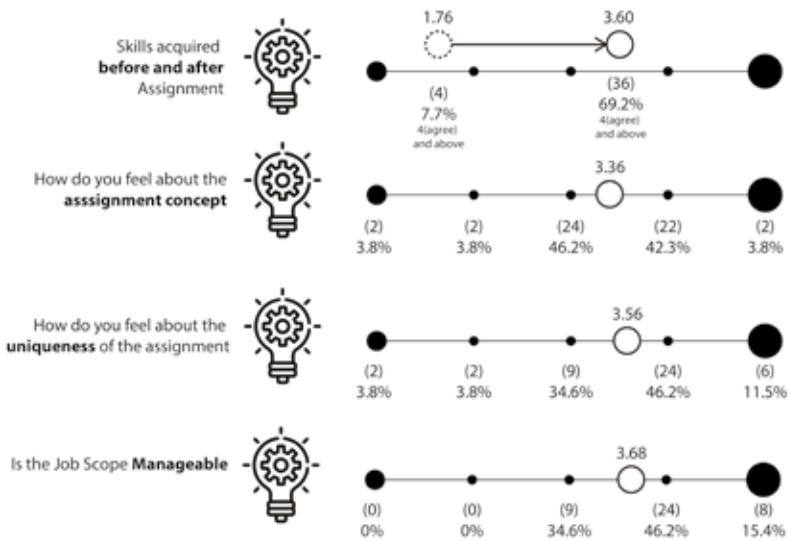


Figure 10 and 11 (top): Individual peer evaluation worksheet for team members (left); and feedback sheets to evaluate peer groups' performance (right). *Source: author*

Figure 12 (middle): A quick summary of the "Peer Lecture Series", in comparison with the framework of the self-directed learning. *Source: author*

Figure 13 (right): More than half of the cohort (65.4%) noticed that they learnt more about the subject after the assignment. *Source: author*

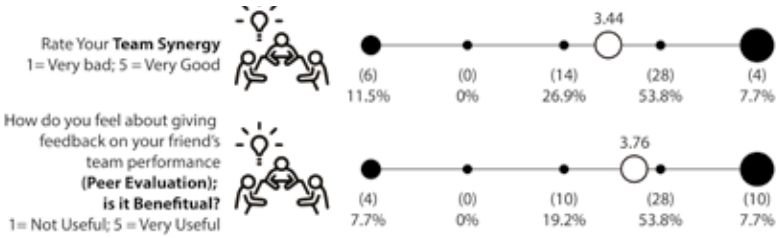


Figure 14: More than 60% of the students felt that they had good team synergy among their peers. *Source: author*

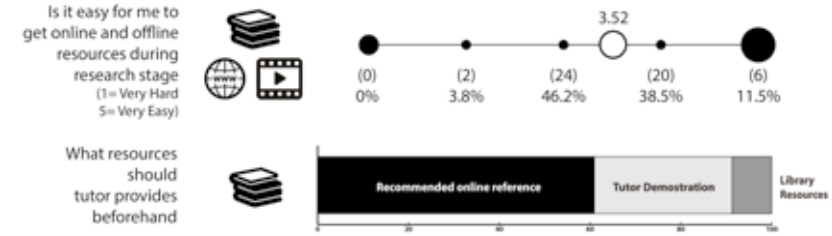


Figure 15: Student teams informed us that they utilised the recommended websites and resources as the main sources of reference. *Source: author*

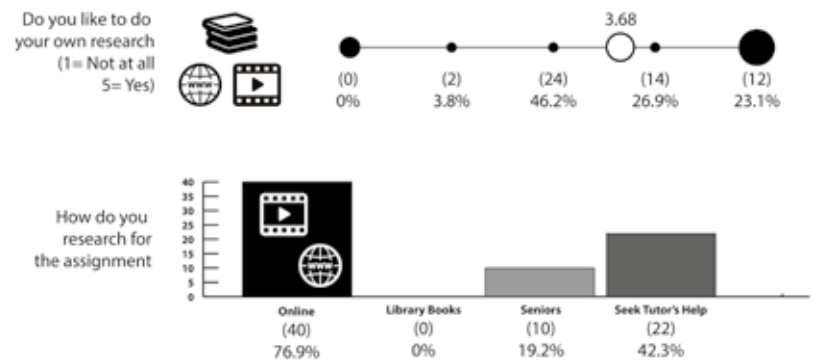


Figure 16: A majority of their research was done online, with the top three research channels being websites/ blogs, online social media and MOOC channels. *Source: author*

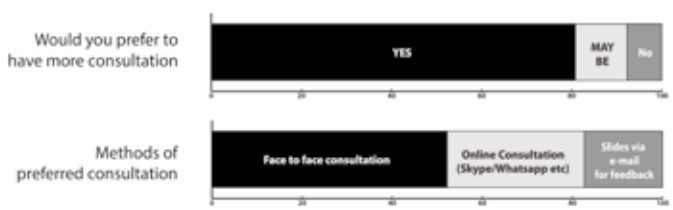


Figure 17: Students prefered to have a balance between tutors' lesson, self-study and research. A majority of the students would like to have more resources, guides and materials beforehand, be it online resources or live demonstrations. *Source: author*

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Bio

Iain Choi coordinates the above-mentioned module in this paper, while looking for better education strategies to benefit students' learning experience. A lecturer specialized in commercial, museum and communication design, he has a strong interest in user experience and empathetic studies. He has participated in design thinking and social innovation projects, both locally and internationally.

Fann Zhi Jie is an experienced lecturer with a demonstrated history of working in design education. He leads a dynamic team to inspire, nurture and grow future spatial designers. He is skilled in urban design, urban planning, architecture, visual merchandising, curriculum development and art. He is a strong education professional trained in Singapore and the U.K.

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