Tutor Perceptions of Learning Ecology in a Project-Based Unit

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ABSTRACT

CONTEXT

Student learning doesn't happen in a vacuum. What students learn depends on their personal experience and knowledge, the social context they learn in, the physical space they sit in, and much more. All of these things contribute to what is called the ecology of learning. Understanding the individual factors that contribute to this ecology of learning is important for an educator as it can help them to facilitate the learning of their students. In this paper, we investigate the factors that contribute to the ecology of learning through the perspectives of tutors who teach a large, project-based unit. These tutors are often the ones who are best placed to comment on some of the challenges that students experience due to their first-hand interaction with them.

PURPOSE OR GOAL

The purpose of this study was to investigate how students engage with learning in an interdisciplinary project-based unit. A focus was placed on activities that explicitly aim to teach students professional skills such as empathy. This research is part of a larger study which uses multiple data sources and methods to investigate the same topic.

APPROACH OR METHODOLOGY/METHODS

Semi-structured interviews were conducted with four tutors who all teach the same third year interdisciplinary engineering unit. These interviews were transcribed, member-checked and then thematically analysed to identify common trends and different experiences.

ACTUAL OR ANTICIPATED OUTCOMES

Tutors observed that many factors including time of day, room type, student characteristics, and instruction clarity all appeared to influence student engagement. Some of these factors, like room type, influenced student learning in ways that differed from the tutors' initial expectations whereas other factors, like student characteristics, had more predictable impacts. It was also observed that the relative magnitude of these effects differed, with student characteristics potentially having the strongest impact on the learning ecology.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

It can be concluded that tutors have noticed many factors contributing to the learning ecology of their students, agreeing with published literature on the topic. However, for this understanding to positively impact how tutors facilitate learning, unit coordinators need to design their courses to suit some of these factors and give tutors flexibility and a degree of autonomy to empower them to adapt the space and time they teach in. It should be noted that this study was limited to a single subject in a single institution, and so may not be generalisable on its own. However, the agreement with existing literature provides support for the conclusions of this paper.

KEYWORDS

Professional Skills, Student Engagement, Learning Ecology

Introduction & Background

Traditional teaching methods, where direct instruction is given to students, have typically focused on clarifying the content of a course in order to help student understanding. In this type of teaching, the clarity and sequencing of the content is crucial to help learners slowly develop and generalise their skills. While this type of teaching has been proven to be effective in cases where technical content needs to be taught (Liem & Martin, 2012), other teaching styles, like project-based learning (PBL), tend to be better at teaching students interpersonal and professional skills (Vogler et al., 2018). These professional skills are important for an Engineer's working life and as such should be taught at university (Elmasry et al., 2023; Johnston & McGregor, 2005; Ngang et al., 2015).

Both traditional and project-based teaching methods, however, are influenced by the social, spatial and personal environments in which the learning takes place (Elmasry, 2024). This consideration of the impact of a student's environment on their learning is the heart of learning ecology. Learning ecology views the process of learning as a complex system (Sochacka et al., 2020) and so is focused on all of the environmental factors that might interact with each other and impact a learner, similar to how ecology is the study of the complex interactions of organisms.

Understanding learning ecology, then, is important to help teachers facilitate the learning of their students and to not become a hindrance to them (Hill et al., 2004). In a university context, tutors are often the ones interacting with students and facilitating their learning, so it is important to understand their perspectives on learning ecology as this affects how they facilitate their classes (Richardson, 2002). This is in contrast to Unit Coordinators who may not directly interact with the students as much. The objective of this paper is to investigate some of the tutors' perceptions of learning ecology and compare them to the existing literature.

Methodology

This project investigates some of the factors that influence student learning in a large (300+ students) interdisciplinary project-based unit. We conducted a thematic analysis of eight semi-structured interviews with four tutors out of a team of seven who delivered the unit. This research is part of a larger study that also collects data from the students themselves, however only the tutor data will be considered in this paper. The research was approved by the University of Sydney Human Research Ethics Committee (HREC Approval No.: 2023/808).

Tutors were first informed of the interviews in their first tutor meeting of the semester. From then onwards, tutors were invited to participate in interviews multiple times throughout the semester, aligning with weeks where there was the explicit teaching of professional skills in a group-work setting. Tutors were welcome to accept any and all of the calls to be interviewed. Four tutors were interviewed in total with one of them being interviewed once, two of them being interviewed twice and one tutor being interviewed three times.

The tutor interviews were conducted in-person or online and were recorded using a laptop that was running Zoom. Audio files were automatically transcribed using a locally run large language model (OpenAI's Whisper automatic speech recognition running ggml-medium). Transcripts were checked and edited by the first researcher to ensure accuracy and sent to participants for member checking.

The final checked transcripts were then uploaded to NVivo and analysed using Inductive Thematic Analysis (Jason & Glenwick, 2016). The themes identified using this analysis are presented in the results section of this paper.

Results and Discussion

A thematic analysis of the tutor interviews revealed four main themes that tended to impact student engagement and learning: Tutorial Characteristics, Instruction Methods, Student

Characteristics, and Tutorial Equity. Each of these themes contained sub-themes shown in Table 1 below. A breakdown of each theme is also presented in the following section.

Table 1: Themes and Sub-Themes Identified in the Tutor Interviews

Theme	Sub-Themes	Characteristic Quote
Tutorial Characteristics	Room Size, Room Type, Class Size, Teaching Location, Teaching Time	*"I found that they were better than last year, because I feel like they got less lost in the room."*
Instruction Clarity	Assessment Clarity, Language Clarity, Individualised Attention	*"I kind of move the group on personally if I thought they had enough time to kind of chat and get to know each other."*
Student Characteristics	Pre-Existing Social Groups, Gender Ratio, Proportions of International Students, Student Motivation	*"I think there were less groups that had planned to be together if that makes sense. This year than last year."*
Tutorial Equity	Tutor Experience, Missed Activities	*"We are running the morning class incredibly differently to the afternoon class, though. It's kind of bonkers."*

Tutorial Characteristics

One theme that clearly emerged from the interviews was the impact that different tutorial characteristics had on a tutor's ability to teach. Several tutors ran multiple tutorials that took place in different rooms, locations and times of day. All of these differences were commented on in the interviews as either a help or a hindrance to teaching.

Room and Class Size

Unexpectedly, there was a general consensus that it was more difficult to teach in more spacious rooms, even when the class size and tutor-to-student ratio remained the same. The tutors put this down to the ability of students to 'hide' from the tutors and to disengage from the class without being noticed. Tutors also commented that students felt more awkward and were less likely to engage in much larger rooms:

> I feel like last year, it was a lot more awkward. And I think part of the nature of that was the fact that our rooms were so big.

However, tutors also found that a larger room with more empty seats was more conducive to students moving around prior to group formation and not being attached to the same people they sat next to in the first week:

> In the morning class, almost everyone let us arrange them because everyone sat in different places every week, because there's so many more spare chairs than there are people.

This may indicate that an interdisciplinary subject that encourages students to meet people from other degrees may benefit from larger spaces prior to group formation whilst a smaller, more densely packed room may be beneficial for cultivating student engagement with the tutor once teams are established. Alternatively, teachers in a large room could consider purposefully concentrating students into one part of the room after group formation to help increase engagement.

Room Type

In addition to the size of the room, tutors indicated that the type of tutorial room also made a difference to their ability to teach. One tutor taught in a class with moveable desks, moveable chairs, and whiteboards on all of the walls, and also taught in a room with a singular whiteboard at the front of the room with all of the tables and chairs facing forwards. This forced the tutor to run the two classes very differently:

> *We did a lot of whiteboard work in the morning session, but the afternoon sessions don't really lend itself, which is kind of annoying.*

This difference in room type (and subsequent teaching style) also lead to a difference in the efficiency and engagement of both classes, with the more flexible room style lending itself to deeper work but the more traditional classroom lending itself to faster progression through the learning activities:

> *What I've noticed is that we get through more of the tasks in the class that doesn't have the whiteboards and we're better with the time management. But in the room where we do have whiteboards and I think when we're doing the tasks we're more meaningfully getting people to engage with them - we never run to time.*

This indicates that the advantages of flexible classrooms may come at the cost of making it harder to get through the same amount of content. Both of these findings are consistent with literature that has found that some rooms are more conducive to active learning, helping students learn more (Brooks, 2011), but that while rooms with clusters of desks can be more approachable, they are also more prone to "disruptive and off-task behaviour" (Cheryan et al., 2014).

Teaching Location and Time

Several of the tutors interviewed had classes that took place at different times of day and at different locations around campus. One class activity gave students the option of leaving the classroom and bonding with their team outside of class before coming back. The tutors noticed that this activity was only taken up by students who were in a more centralised location and who had an earlier class time:

> *Interestingly, in the morning session, when we were in a very centralized location, super near a cafe, they all know where it is, almost everybody left and then came back with either a snack or a drink or a blah blah. And that class is 9 till 11am. In the afternoon one, because it's far away from everything, I still gave them the option to get up and walk around, but I found not a single person left the classroom.*

Additionally, one tutor noted that while they were expecting their Friday afternoon class to be the least engaged, they actually found that their engagement levels remained high over the semester:

> *Bearing in mind one of my tutorials, which is the afternoon on Friday, which you would expect to have shocking attendance, everyone comes to every class.*

> *…they're just more engaged. And it just makes the job more rewarding.*

This indicates that while centralised locations and early class times may be more conducive to outdoor activities, the negative effect of afternoon or late-week timeslots appears to be smaller than some of the other positive effects that can encourage learning. This is consistent with findings that place other factors, such as student self-efficacy, as more significant (Deakin Crick et al., 2007). Additionally, if tutors are given sufficient autonomy, they may be able to adapt to these constraints.

Overall, the findings that the physical space affects student engagement strongly match previous studies, including those covering student perceptions of learning ecology by Yang et al. (2013).

Instruction Clarity

All of the interviewed tutors made comments on times when they noticed that students were confused by the clarity of instructions that were given to them. Two main elements of this were

clarity in the assessment guidelines and clarity in the language used in the subject. Tutors also found that they often had to individually clarify concepts to groups before they understood a topic.

Assessment Clarity

Tutors commented that they believed that some students did not understand the assessment requirements and were submitting poor work due to their perception of the unit not giving enough guidance in its assessments:

> *But non-effort when we don't really explain what they are meant to be doing - it's not fair.*

A similar comment was made about the open-ended nature of some of the assessments:

> *I think sometimes the nature of tasks is, we assume that they'll interpret it the way that we intended. But sometimes that means that we fall down slightly because it actually is more vague than what students are used to.*

It is clear from this that tutors believe assessment clarity can impact student performance, however, it was also noted that part of the intention of the unit was to encourage students to deal with ambiguity:

> *Absolutely one of the skills we're trying to teach them is like, sometimes it is up to your interpretation and you need to demonstrate sophistication in the way that you handle ambiguity*

This indicates a tension between increasing the clarity of the assessment description for the sake of student performance and teaching students to deal with uncertainty as a professional engineer. An additional complication is the fact that LMS statistics show that many students do not access the assessment pages until shortly before the due date. This makes it less likely for students to be well-informed of the assessment descriptions that are written.

This tension is also born out in the student satisfaction scores for this course, with students rating the course more highly in 2022 when videos were made that explicitly broke down each assessment. These videos were not continued in later years due to a variety of reasons, but this ultimately resulted in lower student satisfaction scores.

Language Clarity

Tutors noticed that the inconsistent use of language in a subject can confuse students who are learning a topic for the first time. One example of this was in the problem definition stage of the project where students were attempting to learn the difference between the issue the client was reporting and the underlying problem behind it. A tutor noted that this confusion arose when they talked to students about what they called a 'problem brief' when it was actually termed a 'project brief':

> *We're not being consistent. So then we're trying to have a whole tutorial about issue versus problem: Why are they different? And then students see problem brief. And I'm like, but it's actually a description of issues - and you're meant to be defining the problem. And they're like, what?*

Student confusion about such terminology also led to the tutors developing their own analogies and explanations for the concept, but they identified that inconsistent language was the underlying cause of student confusion on the topic:

> *So [the] issue happens, information [is] collect[ed], now we can define the problem. Because I think we need to be careful of confusing students. I don't think it's very fair.*

However, it should be noted, that the unit never actually used the term "Problem Brief" in official materials, instead using the phrase "Project Brief" to avoid this sort of confusion. It seems that some students and tutors inadvertently used the wrong phrase which added to the confusion. This further stresses the importance of clearly defining key terms and phrases, and careful use of language when teaching.

Individualised Attention

Tutors commented that the nature of a project-based learning unit made it more difficult to give group instructions and to gauge when the class was ready to move on as a whole. This resulted

in them individually checking on groups and advising them on how to progress based on their actual progress:

> *I kind of move the group on personally if I thought they had enough time to kind of chat and get to know each other.*

While this personalisation of instruction helped the groups stay on track, it created the inherent inequity of some groups receiving assistance much earlier than other groups:

> *Meaningfully if you only get to someone in the last 15 minutes of that hour because you've only got so much time, they haven't been working on it for 45 minutes and the group you started with is really on track. And I don't know how you fix that.*

Tutors admitted to not knowing how to resolve this problem and expressed that the problem itself appears to be inherent to a project-based-learning context. However, it should be noted that all learning ecologies will have students who progress at different rates and this problem is not any easier to solve in large classes. This is because in large classes teachers must get around to a larger number of individual students. The difficulty of this task typically results in lecturers not being able to pay attention to students who are not progressing at an expected rate and instead assuming the rest of the class is keeping up.

Student Characteristics

Tutors commented that different student characteristics influenced student learning in their classes. It was noted that group formation was influenced by the tendency of students to have pre-existing social groups, and engagement with certain activities was influenced by the gender, race and identity of the participants.

Pre-Existing Social Groups

Tutors noticed that students who did not have pre-existing friendship groups in the room were much more engaged in group formation than students with pre-existing friends:

> *I would say that they were more chatty, more friendly with each other, more willing to break down those boundaries. I think there were less groups that had planned to be together if that makes sense. This year than last year.*

Tutors also found that a densely packed room led to students sitting next to the same people and forming friendships earlier in the semester, also impacting group formation:

> *In the afternoon class, I think maybe because they're all jam packed in a bit more, and because there are no spare seats, really, everyone sat next to the same people every week. So a bunch of them went, oh, I don't really care what project I did for stage one, we're just going to go as a five because we've sat together now for two weeks and I don't want to sit next to someone else.*

These comments suggest that it may be beneficial to purposefully move students around in more densely packed spaces to allow them to meet more people around the room in the leadup to the group formation process.

Gender Ratio and Proportion of International Students

Particularly when it came to activities that related to the professional skill of empathy, some tutors commented on the fact that classes with a higher proportion of female students had higher student engagement:

> *I actually made that observation to the fellow I was talking to, I said just look around, if you want to see how to do this affective responding, well, just look at what the women are doing because I think they're generally better at it than we are.*

Other tutors commented on the fact that a reduced number of international students also helped with student engagement:

> *I think we've also only got one group in this lot who are entirely made up of international students. Those guys tend to not come out of themselves as much.*

> *There were more of them [Engineering & Law Students] in the afternoon class, and less international students. And I think all of those things play a part in how engaged students become.*

It seems that for some international students, the difficulty of communicating in a foreign language results in them being less likely to engage in class. This lack of engagement tends to also influence the rest of the class as it makes other students less likely to engage. On the other side, a few hyper-engaged students can also set the tone for the class and increase engagement.

Student Identity

Tutors noted that some students' perceptions of themselves impacted their likelihood to engage with and learn from the course. This was especially true when it came to teaching students about reflective practice as many students felt like it was not "an engineering thing" to do:

> *There were a number of students who sort of jokingly were like, "Oh, should I take this document to my therapist to explain why I'm like, the way I am" or like, there was lots of students sort of using defensive humour for feeling awkward about writing about themselves and their contribution and things like that.*

> *I think engineers can be quite predisposed to thinking writing about themselves and their feelings is fluffy.*

In contrast to this, tutors felt like students who did combined degrees like Engineering and Arts or Engineering and Law were able to appreciate the significance of the work:

> *There's a few students in one of my classes who do a double with law, and I think they grasped why it was important and what they were doing much more quickly.*

> *Anyone that doubles with arts or anyone that does extracurricular debating or performance or something. I think that they find it a bit easier to grapple with this idea of like, how do I do better next time I need to like look inward?*

This finding shows the importance of students' perception of their identity and its relationship to the learning activity, and it agrees with existing research that shows that student mindsets are significantly linked to their achievement (Deakin Crick et al., 2007; Krishnan et al., 2011).

Tutorial Equity

The interviews highlighted some inequities between tutorials that tutors thought could be influencing student learning. One example of this was missed tutorial activities due to external factors. Another was the difference between the experience of the tutors that were teaching each class.

External Factors (Missed Classes)

2 Public holidays and 1 subject assessment fell in the tutorial times of this unit. While ordinarily the tutorials in these weeks would be re-scheduled, the large interdisciplinary nature of the unit made it difficult to re-schedule tutorial times to another day that all students could make. As such, a decision was made to simply allow each class time to miss one week, but on different weeks of the semester, with the expectation that students would catch-up in their own time. One tutor commented that they felt the effect that missing the week on "having difficult conversations" had on their students:

> *Groups seemed worse at working in teams than they were last semester… I think honestly, [the difficult conversations module] is one of the early ones that helps groups become friends. And I think that I had less groups that seem to have become friends than last year.*

> *The other bit that our students didn't do, which I actually think has made a massive impact also on them as a group understanding stakeholders, was the difficult conversation week.*

The tutor also commented that it was not possible for students to catch-up in their own time for some modules:

> *You can catch up on stakeholders. You can catch up on risk. Can you catch up on difficult conversations with your teammates? I don't know if you can.*

The finding, then, is that circumstances beyond the control of the teaching team are also part of the ecology and for a large unit of study that runs on multiple days, it doesn't impact all students consistently.

Varied Tutor Experience and Repeat Tutorials

A final factor that came up in the tutor interviews was the varied experience of the tutors. Some tutors had taught the course for multiple years whereas others were teaching it for the first time. This is often reflected in their confidence:

> *Maybe it's also that I feel more confident with the topic area. That could also definitely be a feature.*

> *Maybe I'm leading that piece better than I was last year.*

However, one element of experience that was even more noticeable was the effect of teaching multiple tutorials. Several tutors commented that they felt they delivered the second tutorial much better than the first:

> *Time management in your first session of the week is not quite as good as the second session. You send them home with a lot more homework after a first session.*

> *We saved more time for it in the afternoon than in the morning. I think that's purely because I watched the morning one and said "damn we should spend more time on that." And so I was a bit stricter with the timing of the earlier sections for the second session.*

This indicates that classes with more experienced tutors, or who are delivering a repeated tutorial can influence the learning experience for students. However, it is worth noting that other studies have found that both experienced and new teachers have their strengths and that both can still be effective (Berkel, 2010; Cromley, 2005).

Conclusion

In conclusion, it appears that tutors have noticed many factors contributing to the learning ecology of their students, and that many of these factors agree with the published literature. For this understanding to positively impact how tutors facilitate learning, lecturers need to give tutors flexibility and a degree of autonomy to empower them to adapt to their teaching contexts.

Additionally, it should also be noted that learning designs need to account for practical limitations (venues, timetabling, public holidays) as much as the underlying design of the learning process. Unit coordinators can also guide tutors on effective ways to use their teaching space (e.g. having a large class for group formation and then confining the students post-formation) but it is important to note that this learning plan must still allow for some degree of autonomy and adaptability to respond to the students in the room.

While these findings offer some insights on how to take learning ecology into account, it is important to note that this study is limited to tutor perceptions of how these learning ecology factors impact learning and the student experience. Broadening the research into different types of units and comparing tutor perceptions to student or instructor perceptions would deliver a more complete understanding of how to account for learning ecology in engineering education. Additionally, we acknowledge that we were only able to obtain the perceptions of four tutors. Interviewing more tutors could help establish the generalisability of the findings.

References

Berkel, H. J. M. van. (2010). *Lessons from Problem-based Learning*. Oxford University Press.

Brooks, D. C. (2011). Space matters: The impact of formal learning environments on student learning. *British Journal of Educational Technology*, *42*(5), 719–726. https://doi.org/10.1111/j.1467-8535.2010.01098.x

Cheryan, S., Ziegler, S. A., Plaut, V. C., & Meltzoff, A. N. (2014). Designing Classrooms to Maximize Student Achievement. *Policy Insights from the Behavioral and Brain Sciences*, *1*(1), 4–12. https://doi.org/10.1177/2372732214548677

Cromley, J. G. (2005). What Do Reading Tutors Do? A Naturalistic Study of More and Less Experienced Tutors in Reading. *Discourse Processes*, *40*(2), 83–113. https://doi.org/10.1207/s15326950dp4002_1

Deakin Crick, R., McCombs, B., Haddon, A., Broadfoot, P., & Tew, M. (2007). The ecology of learning: Factors contributing to learner-centred classroom cultures. *Research Papers in Education*, *22*(3), 267–307. https://doi.org/10.1080/02671520701497555

Elmasry, J. (2024). The Idea Acceptance Model. *Proceedings of the 2024 ASEE Annual Conference & Exposition*.

Elmasry, J., Goldfinch, T., Hadigheh, S. A., & Marks, B. (2023). What is Empathy—A Multi-Disciplinary Approach. *34th Annual Conference for the Australasian Association for Engineering Education (AAEE 2023)*.

Hill, S. B., Wilson, S., & Watson, K. (2004). Learning Ecology. A New Approach to Learning and Transforming Ecological Consciousness. In E. V. O'Sullivan & M. M. Taylor (Eds.), *Learning Toward an Ecological Consciousness: Selected Transformative Practices* (pp. 47–64). Palgrave Macmillan US. https://doi.org/10.1007/978-1-349-73178-7_4

Jason, L., & Glenwick, D. (2016). *Handbook of Methodological Approaches to Community-based Research: Qualitative, Quantitative, and Mixed Methods*. Oxford University Press.

Johnston, S., & McGregor, H. (2005). *Recognizing and supporting a scholarship of practice: Soft skills are hard!* https://wilresearch.uwaterloo.ca/Resource/View/34

Krishnan, S., Gabb, R., & Vale, C. (2011). Learning Cultures of Problem-Based Learning Teams. *Australasian Journal of Engineering Education*, *17*(2), 67–78. https://doi.org/10.1080/22054952.2011.11464057

Liem, G. A. D., & Martin, A. J. (2012). Direct Instruction. In *International Guide to Student Achievement*. Routledge.

Ngang, T. K., Yunus, H. M., & Hashim, N. H. (2015). Soft Skills Integration in Teaching Professional Training: Novice Teachers' Perspectives. *Procedia - Social and Behavioral Sciences*, *186*, 835–840. https://doi.org/10.1016/j.sbspro.2015.04.204

Richardson, A. (2002). *An Ecology of Learning and the Role of elearning in the learning environment*. https://www.semanticscholar.org/paper/AN-ECOLOGY-OF-LEARNING-AND-THE-ROLE-OF-eLEARNING-IN-Richardson/4614d56e37aec56570756e085ae43933f241f0e0

Sochacka, N. W., Walther, J., Morelock, J. R., Hunsu, N. J., & Carnell, P. H. (2020). Cultivating a culture of scholarly teaching and learning in a college of engineering: An ecological design approach. *Australasian Journal of Engineering Education*, *25*(2), 165–176. https://doi.org/10.1080/22054952.2020.1864087

Vogler, J. S., Thompson, P., Davis, D. W., Mayfield, B. E., Finley, P. M., & Yasseri, D. (2018). The hard work of soft skills: Augmenting the project-based learning experience with interdisciplinary teamwork. *Instructional Science*, *46*(3), 457–488. https://doi.org/10.1007/s11251-017-9438-9

Yang, Z., Becerik-Gerber, B., & Mino, L. (2013). A study on student perceptions of higher education classrooms: Impact of classroom attributes on student satisfaction and performance. *Building and Environment*, *70*, 171–188. https://doi.org/10.1016/j.buildenv.2013.08.030

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