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Collaborating online with strangers

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“The truth is, when you are collaborating with strangers – whom you cannot always see – it brings up its own unique challenges, so conflicts in opinions are bound to happen, but I am very proud of how it was managed and of my group” – *design student reflection*.

Abstract

This paper reports on a qualitative case study exploring design student reflections about their experiences of a transdisciplinary online collaboration in a real-world learning project implemented in October 2020. The spread of a global pandemic that caused a primary and rapid shift from a contact-based learning model to fully fledged online teaching marked the year and learning for student participants. Applying an interpretivist paradigm, the researchers thematically analysed reflection essays from a sample of thirty-two design students to expose dominant perceptions.

Using social constructivism and online collaborative learning theory (OCL) as a conceptual framework, the authors highlight the authentic learning experienced by design students and the newfound insights of these students about sharing ideas in an online collaborative model. OCL builds upon three phases of knowledge construction, namely idea generation, idea organisation, and intellectual convergence to facilitate authentic learning. In this scenario, teams composed of final-year students (of which most were previously unknown) from the design, copywriting, and strategy disciplines met online daily for four weeks to develop and design original and meaningful strategic and creative solutions for challenges in South African business and society. The brief stipulated students should author reflective essays about their collaborative learning experiences on completion of the project.

Using innovative technologies combined with the present challenging socio-economic conditions suggests that online collaboration will become more prevalent in the learning and working world of design students and graduates. The authors posit that as design student learning grows beyond the initial novel sense of participating in transdisciplinary online collaboration on real-world challenges, they will find increasingly meaningful connections with their own personal lived experiences. Insights in these connections may assist researchers and educators towards a better understanding of how to design projects and facilitate authentic social interactions and learning in transdisciplinary student collaborations.

Keywords: Authentic learning, creative collaboration, real-world learning, transdisciplinary online collaboration

Introduction

Problem based learning (PBL) projects designed for student learning in transdisciplinary collaboration are not a new phenomenon. However, never has it been so necessary to create such projects for the online collaborative learning space. The necessary social isolation because of a global pandemic outbreak urgently prompted education into the digital space. This paper reports on explorative research that looked at third-year design students' experience in such a transdisciplinary project. The researchers used Linda Harasim's online collaborative learning (OCL) principles (1990) as described by Johnson and Johnson (1999) within the constructivist learning philosophy (Reeves, Herrington & Oliver 2002) to inductively arrive at repeating themes that crystallised from respondents' project reflection essays.

Theoretical framework

The constructivist learning philosophy in the online environment

The researchers ground the study in the constructivist philosophy, with which Reeves, et al. (2002, p. 562) state:

[P]roblem-based and case-based learning, and the use of immersive scenarios and role-play have placed the activity students' complete as they study firmly at the heart of the curriculum.

Such activities can be any activity beyond reading or listening, such as to 'practice, apply, evaluate, or in any other way respond to curricular content' (Brophy & Alleman 1991: 9).

If we describe the design of this project against the constructivist learning's ten authentic activities as described by Reeves, et al., the following is true:

Teams collaborated on real life briefs with **real-world relevance** (1), for actual clients. These real-life briefs purposefully focused on social and/or business challenges unique to South Africa or Africa. Tasks were situational and **ill-defined** (2). Every team worked with a different brief that required a different output. The **complex tasks** (3) ran over four weeks and required research, strategic direction, creative outputs, and presentations. Teams contained students schooled in various disciplines, with **inherently different perspectives** (4), resources and skill sets. Individual team members **collaborated** (5) to complete the complex task, since the challenge required various backgrounds and expertise to make sense of conditions to develop and execute a meaningful solution. Teams created **daily reflection opportunities** (6), and weekly presentations to a panel of educator experts. It integrated activities into one overall goal, with various stages and aspects that drew on all team members' individual expertise. However, the overall outcome is a **non-specific goal** (7) that they could only achieve with transdisciplinary collaboration. The entire project was **assessed for the overall outcome** (8), with no focus on individual aspects. The final project solution required a comprehensive skill set of all **role players** (9) to produce a meaningful creative solution and presentation to the client. Each team's **solution was unique** (10) with diverse outcomes, since the brief's complexity opens the process up for an endless variety of options.

Online collaborative learning

Taking the project online, the researchers describe it in terms of OCL (Johnson & Johnson 1999), with its five descriptors:

- **Positive mutual dependency:** Members have and lean on each other's unique competencies such as strategy, copywriting, graphic design, and digital design. Although they are all trained in research, their capabilities in the latter focus mostly on their own disciplines and competencies;
- **Personal accountability:** Consequently, team members are constantly reliant on the rest of the team's input to progress in their own direction. A collective team ethic encourages personal engagement and commitment to team expectations;
- **Promoting interaction:** By online communication and collaboration tools in the Blackboard LMS (the platform in this case), and any additional online tools that a team might want to add to their tool kit;
- **Social Skills:** The project requires advanced social skills in online communication and collaboration. Important levels of empathy are required to engage a multiple of conditions and perspectives to develop an original and meaningful solution; and
- **Group process:** The project is a group process and requires transdisciplinary problem solving.

Figure 1 captures the five requirements and context that explored design students' reflections. The final insights gleaned from the research, connect particularly with the aspects below:

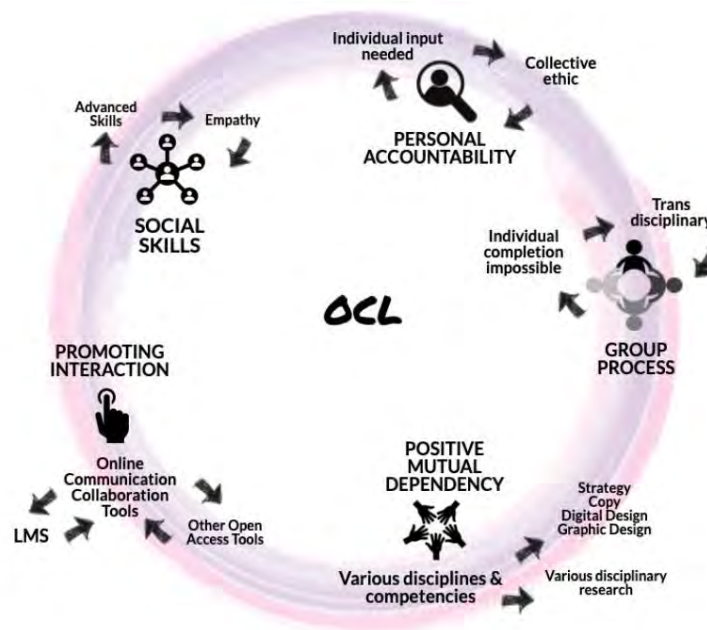


Figure 1: Five aspects of online collaboration and how they connect in this research

The importance of a transdisciplinary online collaborative process

Padurean and Cheveresan usefully define transdisciplinarity in education (2010: 127):

[The] principle of scientific research and interdisciplinary behaviour and practice that presupposes the application of scientific approaches to matters that lie between, across and beyond the boundaries of traditional, conventional academic disciplines. Its aim is the holistic understanding of this world and the unity of knowledge needed for this.

Nordahl and Serafin (2008: 2) explain that transdisciplinary studies typically proceed from a problem to engage disciplines in solving it while interdisciplinary studies develop a relevant problem, as illustrated:

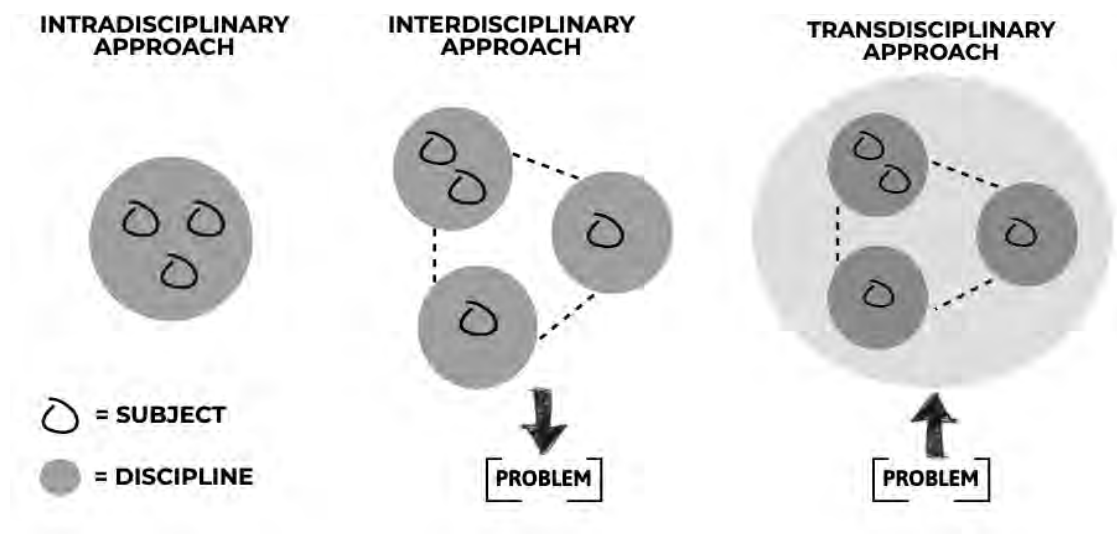


Figure 2: Disciplinary systems (Nordahl & Serafin 2008: 2)

OCL and problem-based learning (PBL) in the case of this study is viewed through a transdisciplinary lens of student reflections on collaborative idea generation, organisation, and intellectual convergence as phases of knowledge construction (Han & Resta, 2020). Jacoby-Volk and Bar-Eli (2021: 221) claim that this is the only way to use design projects for problem solving:

Only by introducing risk-taking PBL methodologies, generating organic leadership and promoting short- and long-term learning using the components of transdisciplinary performance can real-life design projects be initiated to solve problems and empower all involved stakeholders.

When OCL and PBL is situated in transdisciplinary performance, top sought-after skills such as those flagged by the World Economic Forum in the Future of Jobs Report (2020), are developed – analytical thinking and innovation; active learning; complex problem-solving; critical thinking and analysis; resilience, stress tolerance, and flexibility. With a research focus on online collaboration in professional transdisciplinary teams, Dale, Newman, and Ling (2010) stress the need to develop professionals’ soft skills and online dialogic techniques in effectively building a common language and mutual trust. In an increasingly interconnected and immersive world the need for graduate talent with well-rounded soft skills and the confidence and competence to participate and perform in transdisciplinary online collaboratives motivates contemporary design education to embed collaborative co-design approaches into curricula (Moreira, 2018; Lee, Ahn, Kim & Kho, 2019; McAra & Ross, 2020; Rowe, 2020). However, researchers still accept that it is difficult to facilitate these skills in a traditional higher education institutional context (Fisher & Newton, 2014) because many institutions still design their learning spaces to fit the accepted conventions of the last two centuries, with a pervasive industrial-age “egg-crate classroom” model of teaching and learning (2014: 903). Kauppi, Muukkonen, Suorsa and Takala (2020) furthermore posit that well evidenced insight into the pedagogical design principles that should guide the design or construction of collaborative projects remain scant.

Thematic analysis of design students' reflections

The confluence of relevant literature, the conceptual framework for social constructivism and OCL, directed an interpretivist and inductive approach for the research. It proposed this paradigm, as the researchers aspired to explore student experiences towards a better understanding of how to design for and facilitate authentic learning in a transdisciplinary online student collaboration (Flick, 2018; Rahi, 2017; Thanh & Thanh, 2015).

Upon completion of the problem-based online project under study, students submitted individual reflective essays in which they critically reviewed their learning experience and how it evolved over the four dedicated weeks of continuous online collaboration. They also reflected on three presentation- and feedback cycles with internal panels of educator experts, and finally a presentation to the originators of the brief (real-world clients). They reported on the social learning experience that required critical contemplation about the dedicated process and period of online collaboration with colleagues from various disciplines. As Papert in Picciano (2017) explains it, the learning process involved a continuous, deepening experience – students self-organised and progressed under complex conditions. The student essays presented a meaningful culmination- and rich reflection upon an authentic experience and it is these reflections, by graphic and digital design students, which served as the units of analysis for this exploratory study.

75 transdisciplinary online teams
25 real-world briefs/clients
4 dedicated and continuous weeks of online collaboration (Blackboard as primary platform – project resources, group rooms, file exchange, messaging, and access to panel feedback to all teams)
6 expert educator panels
Population: 33 Copywriting students 162 Design students (spanning graphic and digital disciplines) 297 Strategy students (spanning brand communication, brand-business, and digital marketing disciplines)
Sample and units of analysis: 32 reflection essays authored by design students

Figure 3: Project scope and units of analysis

The population of reflective essayists existed as known learning communities, organised in clear sets of classes and class lists. Therefore, the study employed systematic probability sampling to limit bias, respect the units of analysis (the reflections of design students about the transdisciplinary online collaboration experience), and to create a frame of thirty-two reflective essays to facilitate data saturation (Du Plooy-Cilliers, Davis & Bezuidenhout, 2014). Importantly, the individual social artefacts or reflective essays was not the focus of the explorative study, but collective insights gleaned from thematic analyses of all design students' reflections. The researchers applied inductive reasoning to the theoretical foundation of OCL and PBL theory, and analysed students' reflections on their learning experience to generate themes and underlying subthemes (Vaismoradi, Jones, Turunen & Snelgrove, 2016). With no preconceptions or hypotheses in place, reflections could speak for themselves. Through categorising or grouping reflections, themes or patterns emerged. To ensure a prominent level of trustworthiness in the inductive thematic analysis, the researchers employed Taguette (Rampin, Rampin & DeMott, 2021) as an open-access qualitative research tool, facilitating a step-by-step thematic data analysis process, with documented support (Nowell, Norris, White & Moules, 2017). The process developed from familiarisation with essays and reflections to a first set of open codes, categorised, and finally, the emergence of themes with subthemes.

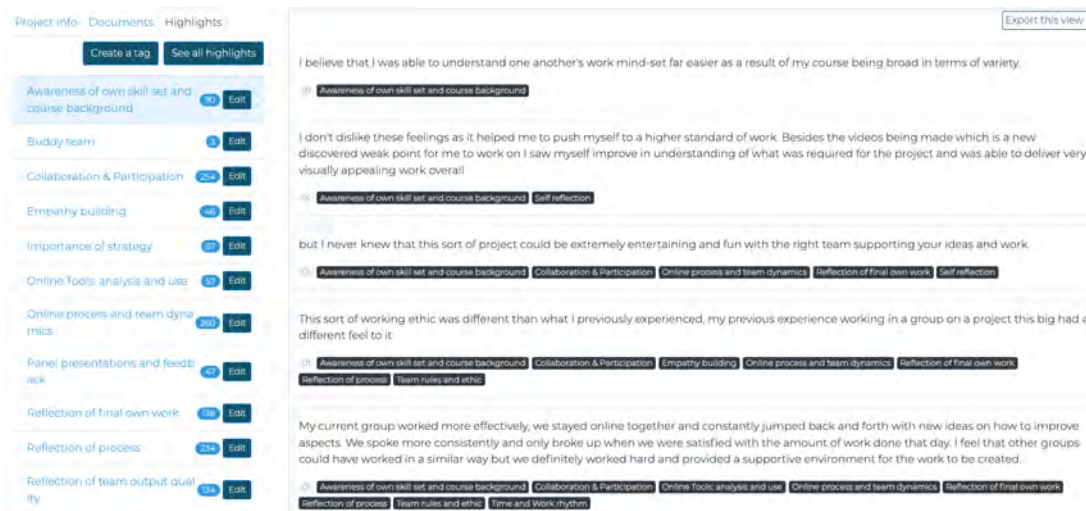


Figure 4: Screenshot of Taguette as part of thematic analysis

When working with student reflections, ethical considerations about confidentiality are crucial. The researchers obtained institutional ethical clearance and present thematic analyses using anonymous verbatim quotes only to reinforce and illustrate the discussion (Jowett, 2020).

Themes and Subthemes

Figure 5 illustrates emergent themes and subthemes from the inductive thematic analysis. Four main themes crystallised and are presented and discussed in terms of how they relate to one another in context of students' reflections on the transdisciplinary online collaboration.

Online Collaboration (with subthemes such as professional preparation, and practical online solutions and tools); Time Management and related issues (describing specifics such as the value of methods and conduct consensus, working method diversity and collaborator recognition); Personal issues, interests, skills and development (such as personal interest and skills, professional growth through collaboration, organising personal work and content, and interdisciplinary interests), and the Sum of the Parts (with mentions regarding creative project outcomes, the value of online collaborative learning, and transdisciplinary insights). The researchers emphasise that students do not mention these themes by scholarly terms but describe events and personal reflections. As researchers, we could classify descriptions into categories.

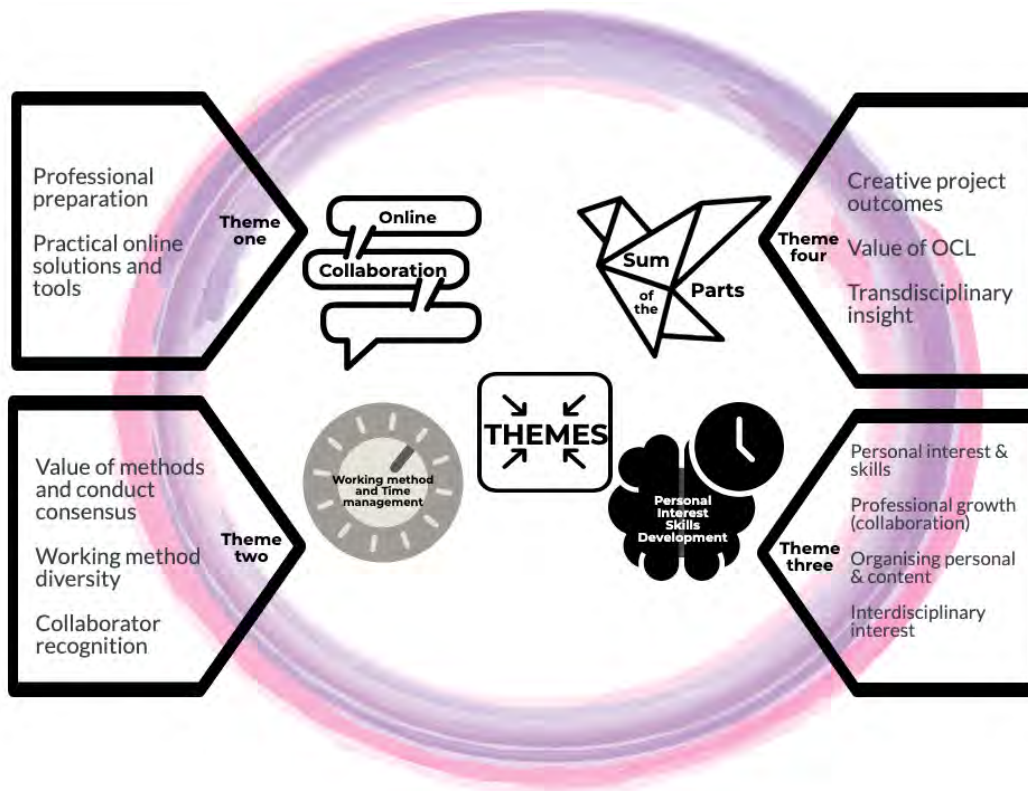


Figure 5: OCL Themes and subthemes from the data

Theme 1: Online collaboration

All design students in the sample group have experienced transdisciplinary real-world projects. However, these projects were localised, in face-to-face contact teams. The online collaboration involving transdisciplinary student teams based in disparate localities nationally was, therefore, novel for the student community. The researchers expected a preponderance of reflections primarily focused on the 2020 pandemic and the requirements for collaborating in a large-scale project online. Contrastingly, reflections of the design students about subjects were secondary, and mostly mindful, sober, and practical.

For many, the value of gaining experience in an online collaboration was clear and manifested as being better prepared for the working world:

*A tester into how our interviews for jobs potentially could be conducted, as well as presented to clients in future; and
Out of all the group projects and activations, [this project] held the most valuable lessons, it was great meeting new people and learning how they did things.*

The thematic analysis furthermore revealed that many teams effectively sourced practical online solutions and tools to enhance team dynamics or working methods:

Due to the constant updating that is required to co-work on X we discovered Y.

Students mentioned various methods and tools, and typically described them:

*Useful for real-time collaboration;
Very efficient tool - access it from any device with my sign in information; and
Very useful and time saving.*

Student reflections concluded:

*I will be using it in the future; and
I was able to do what was required from me in my own space concisely as well as with strangers thanks to all the
technology we have today.*

Some design student reflections mentioned team frustrations with unstable internet connectivity or limited data plans. However, a solution-focused approach or sense of resilience accompanies most reflections:

*But for the days that connectivity was an issue we switched to Y;
(we had) the odd technical difficulties at the most crucial times like presenting to the panel, which was frustrating
but luckily we could take it in our stride and carry on;
and
Determine who has good presentation skills and a stable internet connection.*

In few cases student reflections expressed a preference for face-to-face collaboration while recognising that they need to collaborate effectively online:

*Although working virtually is a whole different ball game that I had to accept and make the most of, I think I would
have obviously preferred to have worked in person, but it all worked out well in the end.*

In isolated instances, reflections expressed deep frustration with online collaboration:

The experience was incredibly isolating.

While some reflections also showed deep-seated regard for collaborative online team support:

*I am extremely grateful for being able to have bonded with someone from another city that I met online and how
she helped me through an emotional turmoil, like a true teammate.*

Theme 2: Working method and time management

Three subthemes emerged from design students' reflections on working methods and time management in an online collaborative. These include the introduction and value of agreed upon working methods and codes of conduct, differences, and adjustments in working methods and recognition of valuable new working methods.

It seems that several teams anticipated online collaboration might present new or additional challenges regarding team dynamics and thus introduced **agreed-upon working methods and codes of conduct** from the outset:

*It encouraged all of us to participate and feel empowered to work for the eventual success of the group;
Doing so allowed everyone to honestly and openly express their thoughts and opinions, creating a safe space for
any discussions; and
Members conducted themselves according to the agreed conflict resolution guidelines and the problems were
addressed effectively.*

Some student reflections referenced steps taken by the team to realign and reinforce codes of conduct throughout the online collaboration:

*Certain group members felt less obligated to participate within the group behind their screens; and
This proved to be challenging as users in the team were not as open to turning on their webcams or even
microphones on some days.*

And some reflections of design students highlight team performance specifically because of effective governance.

The final product was developed according to strict deadlines, day-to-day meetings, and consultations; Due to our healthy and clear ground rules that had been set in place from the beginning, we were able to work through this (challenge) and still work together as a team; and I learned that a group functions better when each member is empathetic and considerate of the next person, this calls for open communication and a conflict resolution plan that is actually followed by the members.

Several design students' reflections reveal self-recognition of how **personal working methods differed** from that of colleagues, which for most motivated **an adjustment to align** with the dominant and preferred online working method. The dominant topics in this regard seem to align time schedules and creative outcomes:

It just took some rearranging in our personal timeframe schedules that we had set out for ourselves; and I did work differently, then whatever their feedback or suggestions were, I would make some changes to make sure it is good enough for the work or presentation.

Many design students furthermore reflected on *valuable working methods* in online collaboration.

We stayed online together and constantly jumped back and forth with new ideas on how to improve aspects; and Constant check-ins and clear communication amongst all team members helped.

Student reflections also reference working methods of colleagues that were impressive or effective and that they would like to incorporate into their own skill sets.

I would like to improve on my techniques and versatility (such as having to work with other tools and resources to enhance my skill set); and It was really satisfying to work with other designers, and it inspired me to try out work that I never attempted before.

Whether from the outset or in realigning the team to resolve a particular challenge at hand, many essays in the research sample shared positive reflections about the online working methods and time management of the teams. Reflections on negative experiences were noticeably less, and mostly reflected imbalances in work schedules or work ethic.

Some group members did not take accountability and responsibility for their own work. This was incredibly hard to navigate.

Still, many reflections also contained some recognition where personal working methods could be improved.

One thing I would like to improve upon is my time-management skills, this really did catch me off-guard.

Theme 3: Self-reflection: Personal interests, skills, and development

A dominant theme emerging from design students' self-reflections is the **discovery or affirmation of personal interests and embedded skills:**

There were moments in this experience that made me realise that I am smarter and more creative than I realised; I discovered that I really handled stress much better than I initially gave myself credit for. I also learnt that I adapt very fast to changes; I can produce more than I thought I could, which was a good self-esteem booster; and I found a renewed passion for my education, and this experience motivated me to work harder than ever.

As a counterpoint, some design students found the discovery equally valuable that a particular design practice may after all have not turned out as their primary personal interest.

This (project) made me question where I want to work and how I want to showcase myself as a designer; and My strengths and my passions lie somewhere else... - that's a tremendously valuable thing to uncover in one's own identity.

Design students' self-reflections mostly revealed four specific areas where students wanted to **develop and grow as young design professionals** – foremost, the desire to master **newfound design skills or design tools** were inspired by observing and reflecting upon the unique styles, and capabilities of colleagues or by discovering a new online solution to a specific design challenge.

*It was very interesting to observe how my fellow crew members would develop ideas and how they would expand on those ideas in ways that would never occur to me;
When one of us did not know how to do something, the others would stop to teach or to listen as well. So, the process was very satisfying; and
The other creative gave me tips and tricks and different ways to accomplish things I till then thought could only be done the hard way.*

Reflections on opportunities to further develop own skill sets were followed by desires to develop soft skills, specifically in **sharing views in a collaboration and doing so truthfully and empathetically**:

*I will change the fact that I do not give my honest opinion in group situations and instead of worrying about how others may take it, I will tell the truth in a polite manner; and
Criticism is part of our work and we need to learn to be open to it.*

Other design students reasoned:

To provide constructive criticism to the work presented but also suggest solutions to improve it.

Designers furthermore reflected on becoming better disciplined in **organising both themselves and the produced content**:

*Folders to contain work became difficult to manage and navigate as there was an abundance of folders to sort through; and
I have since renamed folders, created folders and organised my workspace.*

Lastly, some students' self-reflections on developing and growing as design professionals reveal a **genuine interest in other disciplines** practiced in the team.

*This project has revealed that I am definitely a lot more into X side of things than I thought I was;
I found myself getting really involved in X and wanting to contribute and learn more; and
I really enjoy X, and I would like to pursue further education in X.*

Theme 4: The sum of the parts

Most of the design students' reflections reveal an important level of satisfaction with the final **overall creative outcome of the online project**, coupled with a specific aspect of the work that could, in their opinions, have been done better.

*I feel like some of the executions could have been more polished... but ultimately, I am impressed and happy with what we were able to do;
This is a project that I am super proud of and will definitely put into my portfolio to show off. I do think it could be developed further; and
I really believe that my group produced an incredible X that was of industry standard.*

Reflections that revealed a level of dissatisfaction with or disconnect from the final and overall creative product were in the minority and again seem to contain valuable learnings, for example:

It cemented my understanding of myself that I prefer to work more idealistically which is both good and bad because I do find myself having unrealistic expectations of the industry.

Most significant, is the design students' reflections on the overall value of the online collaborative learning experience. For many students, the ultimate value was in the learning journey or in the entire transdisciplinary synthesis.

*Our final execution as a whole had to be the most satisfying part;
Seeing all of the insights and research pull into the final ideas;
This experience made me realise how integrated all my past modules really were and how each one had a role in a large-scale project; and
It was a true culmination of everything that I have learnt. It showed me how much I have learnt.. as well as how much more I can learn.*

Several students then also reflected on the success achieved, given the complexity embedded in an online transdisciplinary real-world project.

*We had an enormous amount of in-depth information on X, to support our idea was a long process, the most satisfying part was both the finished product and the process;
Creating a successful campaign for a client is a large task, that needs to be executed correctly and effectively in all areas; and
Looking back on the experience there is a firm sense of accomplishment and pride considering the complexity of the challenge itself, and experiencing a live brief with a group from around the country.*

The expression most design students used in describing the workings of transdisciplinarity was the continuous need of a **golden thread**:

Tying each element together and finding a golden thread.

Some teams had to revisit team structures and communication platforms to enable the development and execution of a cohesive creative outcome.

This was because we weren't working together as the team was split into two, the creatives and the strategists.

However, most of these reflections show teams recognised and resolved such counter collaborative working methods effectively. Some student reflections also comment on the value of the review sessions with the transdisciplinary panels of expert educators, who kept teams on their "toes and grounded" or "when we did go off track slightly", working toward a cohesive creative outcome.

Closely related to the learning journey or entire project synthesis is a pattern of **transdisciplinary insight**, or perceived lack thereof. Although most of the design students saw their training in disciplines that inform design, for example research and strategy, come to life with appreciation and interest, many expressed frustrations with the lack of insight that colleagues from other disciplines had into the practice of design. This, for most, entailed:

*A lack of understanding and appreciation;
As to how long it takes to come up with and execute a creative idea; and related to this an overall lack of understanding of what an insight is and how this leads to a big idea; or
How to roll out a strategy into a creative idea.*

Despite the hurdles encountered in this real-life transdisciplinary online project, many reflections are focused on the satisfaction of having succeeded as a team.

*A life changing experience filled with different viewpoints, different backgrounds and different cities;
Both the process with the team and the final product was equally satisfying, as the team consistently pulled through the most negative times and came together to solve problems; and
Looking back, I am very proud of the work that we produced. I am especially proud of it considering the journey that it took to get to our final product.*

Discussion

The design student reflections revealed an important level of regard for the learning journey and the transdisciplinary synthesis achieved with the final overall creative outcome of the online project under study. A prominent level of critical self-reflection is noted as students came to better understand themselves as designers and as young professionals in a transdisciplinary team working on a complex challenge online. Reflections are rich in considering the hard and soft skills embedded and those already developed or are yet to be. It is important to note that in this regard most students seem to have been inspired by observing and reflecting upon the unique styles, capabilities, or inputs of colleagues or by discovering a new online solution to a specific design challenge. Authentic learning took place as students moved beyond the novelty of collaborating with members from other disciplines and campuses online and made meaningful connections with their own lived experience (Han & Resta, 2020).

Of the five required components described by Johnson and Johnson (1999) regarding successful OCL design, elements of **positive mutual dependency** among team members emerged as the most essential element for research into this one project. Although personal accountability, promoting interaction, building social skills and an effective group process are inherently important and interrelated, reflections regarding the above, dominated. Four insights evidenced this:

Despite the spread of a global pandemic that caused a primary and rapid shift from a contact-based learning model to fully fledged online teaching, the thematic analysis did not produce a preponderance of reflections focused on the requirements for collaborating in a large-scale project online.

When you are collaborating with strangers - whom you cannot always see - it brings up its own unique challenges; and There was no set expectation, no one knew what was coming and how to mentally prepare. It was somehow reassuring that we were all in the same boat.

Research conducted by Magen-Nagar and Shonfeld (2017), indicates that team members' feelings of intrinsic motivation and investment in the collaborative team and product extend to their confidence in and liking of collaborating online. Vladova, Ullrich, Bender and Gronau (2021) also caution that students in disciplines where they do not collaborate online regularly, seem to accept digital platforms slower. Our research focused on the reflections of design students who are, by their nature, described as enthusiastic digital participants (Zaphiris & Ioannou, 2018). The dominant reflective focus fell on the overall experience and value of collaborating in a transdisciplinary team online and producing a meaningful and well-integrated solution to a complex challenge. A transdisciplinary OCL and PBL project design should be cognizant of students' **comfort with online collaboration and capitalise on it**.

Related to the above insight, the thematic analysis revealed that a transdisciplinary online project design should facilitate positive mutual dependency and interaction at the onset and thus enable and support authentic collaboration.

It was incredibly difficult to work with individuals I have not met before, this proved problematic during the first week as I was too afraid to speak my mind; and This subsided fast as we got to know each other.

This insight underscores the importance of factoring in more time for team members to get to know each other and to gain insight into discipline specific strengths and working methods. Although a fast start might feel comfortable for students with extroverted personalities, it also means that a team might not fire on all cylinders initially. An online transdisciplinary project design should empower students to first get to know one another, to share personal goals,

professional strengths, and toolkits. Based on the reflections of students in this study, a norming phase should then also enable the team to co-create and implement an agreed upon code of conduct, mindful of supportive team structures, working methods, communication channels and styles.

An OCL project toolkit could therefore include team-building exercises to **stimulate and support positive transdisciplinary mutual dependency and interaction at the onset**. The researchers Ergulec and Zydney (2019), for example introduce the application of a *Fears, Hopes and Norms Protocol* before an online transdisciplinary project commences with prompts that enable the team to reflect, to share and to shape the code of behaviours that they wish to uphold – *if this team turns out to be one of the worst ever, what will its characteristics be?* Ergulec and Zydney (2019) then also encourage teams to scrutinise team norms and how they could work better in a next project phase, as much as they would reflect upon the progress of the project itself.

A third insight gained from the thematic analysis of design students reflections suggests that the design of an online collaborative learning project should consider how to **streamline workflow and enhance their time management**. This seems amplified when collaborating in a transdisciplinary team because individual ways of working and time demands are not necessarily common knowledge or practice. In supporting positive mutual dependency and interaction at the onset, project designers should therefore also concentrate on resources and toolkits that would simplify and streamline collaboration in such a project. Project resources should incorporate online kits composed of team collaboration, as well as time, and content management tools, and online presentation guidelines and checklists. Students might be prepared by exploring such tools earlier in their programmes and then be encouraged to share preferred methods with team members in norming the transdisciplinary online team. Kauppi, Muukkonen, Suorsa and Takala's (2020) research also suggests that student teams benefit from guidelines and support in preparation of social interaction and collaboration online, which Han and Resta (2020), also reinforce as the most crucial facet of collaborative learning.

Lastly, team leadership did not emerge as a dominant theme in design students' reflections. Sometimes, reflections celebrated the approach of a single leader.

He was a true leader, humble, kind and compassionate and was always willing to go the extra mile to make sure we were all on the right track.

In most instances **leadership emerged distributed** across disciplines, phases and or specific tasks such as taking the lead in workflows. This organic result aligns with Ergulec and Zydney's (2019) suggestion of rotating leadership in assisting online collaborative teams to learn to work together and to avoid one person from dominating the team. Before students attempt to start solving complex problems as a transdisciplinary team with an online project of this scale and complexity, they may benefit from a well-rounded conversation to help them properly grasp the interrelationships between diversity, distributed leadership, and creativity. Research indicates that inclusive acceptance of differing perspectives enables team members to better bridge socio-cultural variations through mutual recognition, thus enabling and stimulating collaborative idea generation (Hawlina, Gillespie & Zittoun, 2019). Pedagogical principles should guide and facilitate diverse student teams towards productive collaboration inasmuch as they provide for the development of skillsets for original, meaningful strategic and creative solutions to those diverse and complex challenges posed by South African and African business and societies.

Conclusion

Contemporary design education should embed collaborative co-design approaches into curricula to develop well-rounded hard and soft skill sets and thus the confidence and competence to participate and perform in transdisciplinary online collaboratives. It struck the researchers how student focus on social and interpersonal dynamics emerged from the reflections. Personal dynamics, and the importance of social connection, dominated many reflections and apart from a few outliers, design students built an understanding of and meaningful relationships with remote team members from other disciplines. These themes resonate with the OCL theory's first descriptor, namely that of positive mutual dependency as foundation to idea generation, organisation, and intellectual convergence and the construction of new knowledge through authentic learning.

The themes and insights also emphasise the critical role that educators play as project designers. A transdisciplinary collaborative can stimulate and facilitate in-depth authentic learning, but it requires careful designing. It is also clear that project designers need to allow time for and optimise connecting and norming, since teammates stem from various disciplines and do not necessarily know each other. A transdisciplinary OCL project toolkit can play a critical role at the onset in facilitating positive mutual dependency and social interaction in transdisciplinary student teams. All students should have time beforehand to familiarise themselves with such a starter kit. They might be comfortable with design-related software and tools that they use regularly, but in the transdisciplinary environment, an online project kit composed of methods and tools that facilitate online norming and collaboration, professional project management and the delivery of compelling presentations to internal and external parties, could support the collective to collaborate and function optimally. Additionally, to expand the study, the researchers aim to conduct thematic analysis of copywriting and strategy students' reflections on the same collaborative project, which may contribute further insights on how to design projects and facilitate authentic social interactions and learning in transdisciplinary student collaborations online.

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