FOSTERING STUDENT REFLECTION THROUGH SUSTAINABILITY DIARIES

Erica LÖFSTRÖM[1,2], Marikken HØISETH[2] and Trude J. ARNTSEN[2]
[1]NTNU Department of Psychology, Norway
[2]NTNU Department of Design, Norway

ABSTRACT

With growing access to tools like ChatGPT, fostering flexibility and reflection in education is becoming increasingly critical. In the face of global challenges such as war and the climate crisis, universities must shift from knowledge delivery to becoming incubators for creativity and innovation. This paper presents experiences from integrating Sustainability Diaries into two design courses, *Service Design (D5)* and *System (D7)*, at the Norwegian University of Science and Technology. In fall 2024, 85 students submitted Sustainability Diaries – open-ended reflections on course content and group projects, viewed through a sustainability lens and delivered in text, audio, visual formats, or a combination thereof. Drawing on both educator and student perspectives, we present preliminary findings on the perceived value of the diaries and on how the students responded to the open-ended format and thematic framing.

Keywords: Sustainability diaries, creativity in education, design education, flexibility and reflection, innovative teaching methods

1   INTRODUCTION

With the increased access to information and knowledge via tools such as ChatGPT, flexibility and reflection become key traits to hone. Moreover, with our world facing imminent threats of war in addition to the escalating climate crisis, contributing to finding solutions is – and should be – high up on university agendas. Our university, the Norwegian University of Science and Technology (NTNU), is no exception. NTNU as an organisation has an increased emphasis on *sustainability* [1]. From our perspective, this means that university education needs to move further away from simply delivering knowledge and instead focus on how we can successfully use it. Of course, this is not entirely new. Universities have always contributed to knowledge and research that drive advances in technology and innovation. However, due to the technological and digital advances with AI-solutions and other technologies, learning becomes more a matter of handling, sorting, gathering, analysing, and critically reviewing information. Learning to successfully use these new tools and manage the increased access to knowledge "at the tip of our fingertips" calls for flexibility and reflection. In essence, we argue that universities need to become *incubators for innovation and creativity* rather than simply centres for knowledge (re-) production. Thus, new teaching methods and tools are needed. As part of this, we need to put increased focus on how to use knowledge in creating something unique.

Ideally, universities as learning arenas may offer a clear link between research and teaching and are thus ideal for training students to contribute to solving so called "wicked" problems [2] both as part of their student life and in their future roles as professionals. In essence, we need to teach students to become what is referred to as "self-regulated-" or "lifelong learners". According to Butler and Winne [3] lifelong learners will be able to take control of their own learning and acquire new knowledge and skills on their own. Problem-based teaching can help students to gain control of their own learning processes. In our courses we often cooperate with external partners who provide context and a real-life problem that needs solving which allows the students to work problem- or case based. In the two courses, Service Design (D5) and System (D7), which are given in tandem, we have cooperated with Trondheim Municipality and let the students work in groups to design solutions for a planned neighbourhood, Nyhavna [4]. In our two courses, we wanted to explore how to address sustainability, and how to involve and motivate students in addressing this issue in a meaningful way. In accordance with the report Technology Education 4.0, which offers guidance on realising future-oriented technology education at NTNU [5], we believe a new approach is needed – one that emphasises reflection, project- and problem-based

learning, and, not least, the teaching of creativity. For this purpose, we have developed innovative methods to foster student creativity and reflection in design education at NTNU. In this paper we present experiences with integrating Sustainability Diaries into the two courses.

2   RESEARCH QUESTIONS

Our research questions are: 1) What is the value of using Sustainability Diaries to foster reflection and a long-term sustainability mindset? and 2) How does the open format and the relatively open thematic framing influence the students' perception and performance of the task?

3   THEORY AND METHOD

For many, the term diary is associated with childhood or teenage years, and many have previous experience from writing a handwritten (non-digital) diary, and during more recent years in digital more or less public "blogs". This means that the choice to call it a diary rather than a journal or log is likely to steer the mind of many students toward the typically hand-written personal diary. The Sustainable Diary is supported by NTNU Teaching Excellence [6] and aims to explore how key sustainability competencies can be developed through our study programs in design. We develop the format as an educational prototype and experiment with how it may be a tool for dwelling on, reflecting on, and articulating sustainability competencies. When we chose to develop our own version of diaries as an innovative method to foster student creativity and reflection on sustainability in design education, and test in two courses given in tandem, Service Design (D5) and System (D7), we made the aware choice to call it a diary. D5 is a third-year course and D7 a fourth-year course within NTNU's five-year integrated master's programme in Industrial Design. D5 had 59 enrolled students, consisting mainly of third-year students, but also including some from the second year. D7 had 26 enrolled students, drawn from both the five-year integrated master's programme and the two-year international master's programme in design. All students who had entered also finished the courses. As part of our two design courses, Sustainability Diaries were designed as three interconnected course assignments. For the first delivery, all students submitted individually (85), while for the second and third, some chose to submit as groups. Both courses were given over a period of one semester (7,5 ECTS) with the three deliveries evenly distributed.

Reflective Diaries have previously been developed for, and used as, a method in different educational and non-educational contexts. For instance, Wallin and Adawi have used reflective diaries in engineering education [7] while Moon [8, 9] has used reflective diaries in the health sector. However, these studies used the reflective diaries with the main intent of students to reflect more on their own learning process, and/or as a way for the reader (educators) to understand and assess the students' learning processes. In design, diaries are an established method to get user insights. For instance, Martin and Hanington refer to diary studies in the widely used educational book *Universal Methods of Design* as "useful tools in exploratory research" [10, p. 88]. Our version of diaries differs from these studies in that we have chosen to frame the diaries *thematically* to Sustainability. The students of both courses were asked to write diary entries in three set deliveries with strict deadlines for delivery via "Blackboard[1]" during the courses which lasted for one semester in total. While the diaries were thematically framed to Sustainability, we were aware that this is still a wide topic. However, what we did not limit, or frame was the format. We left it up to the students to choose whether to use the traditional "Dear Diary" narrative and format or to experiment with different formats. Audio, video, text or a mix, all were allowed. We also did not grade the diaries but used a passed/not passed evaluation format. These two choices, the thematic framing and the open diary format will, of course, have consequences as the students need to interpret and manoeuvre these conditions. Before the first delivery, we included a specific lecture where we presented some of the many *Sustainability Competences* [11, 12]. Apart from this specific lecture we did not alter the course material to our use of diaries as an "innovative method to foster student creativity and reflection on sustainability in design education". Feedback was given to the students after each delivery on a group basis. This was a choice we made after realising that we simply did not have the capacity to give each student individualised feedback. We did a general sum-up of our impressions from each delivery to the class and encouraged the students to experiment with different formats for the diaries. After the second delivery we also asked the students to reflect upon their experiences from writing a sustainability diary as part of the course. The diaries per

---

[1] Blackboard is the learning management system used by NTNU

se, and particularly the specific student reflections on writing a sustainability diary forms the data that is analysed in this paper. To our perception the feedback given by us to the students after each delivery is a relevant part of the method itself, we will therefore include some of these in the analysis. We also arranged two focus groups to collect feedback from the students on their experiences after the last delivery was made. The feedback collected in the focus groups is not included in this paper, but we are planning to include these in a future journal paper.

This paper presents an initial analysis of around half of the final deliveries of the sustainability diaries submitted in D5, based on a random selection. To evaluate and further develop the method, we analyse data from the Sustainability Diaries from two different perspectives, namely 1) the content[2] *per se*, and 2) the students own reflections on "writing" the diaries.

4 PRELIMINARY FINDINGS

4.1 Perceived value

When analysing the diary entries, we attempt to sum up the students' experiences of what – if any – value they refer to as a coming from using Sustainability Diaries. Does the experience contribute to fostering reflection and a sustainability mindset in relation to design?

Students expressed that the Sustainability Diary had helped them delve deeper into topics, increased their awareness, fostered critical thinking, and provided a useful exercise for reflecting on both theory and practice from a new perspective. Some noted that they would not have made these reflections otherwise and found the experience instructive. The Sustainability Diary could also serve as an outlet for "ranting a little." Many students conveyed that they gained a better understanding of what sustainability comprises and how it relates to the field of design. Several students stated that they valued reflecting on different aspects of sustainability and appreciated the course's emphasis on it:

> *It has given me time to reflect on various aspects of service design. Sustainability is very important to me, and it is very positive that it is so thoroughly included in the course.*

> *[It] has been very positive to have a focus on sustainability throughout the entire process [...] made me think more critically [...] I will take everything I've learned with me as I continue my design education.*

The students directly linked their reflections to specific parts of the course and the solutions they worked on throughout their projects. Several highlighted discussions about everyday experiences from a user perspective and changes they made or considered making in their personal habits. Some described an anticipated value for their future design practice.

> *I have become more aware of how designers can influence sustainability through service solutions, and I often find myself noticing things [...] These are insights I will carry with me, both in my studies and in future projects.*

Many students also expressed mixed opinions about the value of the Sustainability Diary, noting that its impact varied. Some thought the diary worked best at the course's beginning, while others found the development throughout the semester particularly valuable. Several mentioned that the task was difficult to understand, too expensive and time-consuming, and, at least partly, lacked a clear connection to the rest of the course. These are some illustrative statements:

> *Writing the sustainability diary has been an interesting exercise, but it seems more like a separate part of the course.*

> *Some see the value in it, while others struggle to understand the purpose.*

> *The project of writing a sustainability diary strikes me as very odd.*

---

[2] The content analysis is preliminary, and the diary entries will be further analysed in future studies/publications

It can sometimes feel a bit forced, especially when it is not always obvious how everything connects to sustainability [...] Still, I see the value in it because it pushes me to think more deeply about things I might not have reflected on otherwise.

I think the sustainability diary has made me more aware of how we can contribute to something greater than just creating a solution – we can also ensure that it truly has a positive impact on both people and the environment. This makes sustainability feel more like a natural part of the process rather than just an abstract concept.

I'm very glad that not all courses are like this, it's nice to have process and routine; but I believe the value of unprovoked curiosity is great.

Some students were predominantly negative and dared to be honest about both their own and others' experiences:

I've noticed a rather critical attitude toward the sustainability diary throughout the whole project, really. Not just in my own writing but also among others in the class. [...] I'd like to point out that some have struggled a bit to understand the assignment [...] I wonder if you've also learned a lot about ChatGPT's reflections on sustainability.

4.2 Perceptions of format and framing

Many highlighted that working on the Sustainability Diary had been challenging. Various reasons were given for this, primarily a perceived lack of clarity regarding tasks, expectations, and assessment criteria from the educators, as well as difficulties in reserving time:

I find it difficult to set aside time to work on it until the deadline is approaching. It doesn't feel urgent [...] What's needed is a little nudge, some external motivation. Perhaps it would help if there were bullet points for each session outlining what you'd like us to reflect on.

It ends up being something done at the last minute [...] when I'm sitting down to write, I really appreciate it – it's very enjoyable [...] We are trained to be critical, to find the right answers, to follow processes, and to brainstorm ideas. There are few assignments designed to inspire curiosity and push us to articulate it.

Time has really been insufficient. I haven't had the opportunity to explore a more creative and playful way of making it [...] It's been a bit demotivating that it isn't assessed based on any criteria.

The openness in the instructions regarding content – i.e. the limited framing of the task per se – was challenging for some students:

Sustainability is such a broad and open topic that it can be tied to absolutely anything! Where do you even begin? [...] You don't really talk about sustainability on its own, but rather sustainability in relation to something, right?

Other students, however, described the Sustainability Diary as a suitable challenge that was rewarding partly *because* of its openness in the instructions:

The most important thing is not necessarily always to arrive at a clear conclusion, but to explore thoughts related to what the subject presents to me.

I appreciate this kind of teaching and find it more rewarding than having to figure everything out on your own from the beginning.

Some students shared reservations about the project title. While a few made changes on their own, others suggested alternative terms to replace "diary":

I prefer "Sustainability Agenda," as 'agenda' implies a process, something forward-looking, planning for the future in relation to where you stand today. After changing the name, I like the concept better.

Some suggestions that try to pinpoint what I'm struggling with regarding this project: "Diary." Consider a different name [...] it becomes very broad, somewhat undefined, difficult to grasp.

I dislike the term 'diary,' as it feels forcedly personal and very childish.

When it comes to the format of the Sustainability Diary, descriptions such as 'medium,' 'opportunity,' 'timeline,' 'log,' 'development of thoughts and experiences,' 'safe space for my thoughts,' and 'a sort of experiment' were used to make sense of what the diary was or could be:

For each time, I've become more comfortable with the format [...] the diary has become a kind of safe space for my thoughts.

The sustainability diary as an update, a development, of my thoughts and experiences related to sustainability throughout the course.

A place where I can note reflections and thoughts I have about the topics we cover in the course, with a focus on sustainability [...] kind of a timeline where I document my course progression.

Many students were open to changing the format along the way, something we as instructors actively encouraged. Overall, we received everything from comics to podcasts, in addition to the more classic "Dear Diary" format – some with short, concise paragraphs, others with longer, more in-depth reflections. While the first round of submission mainly consisted of written content (primarily digital but also scanned handwritten pages) with individual reflections, the last two submissions included quite a few audio files as well as more combinations of written entries with images, drawings, visual mind maps, and group reflections:

Switching between different formats has contributed to a more flexible reflection process. Each format provides a unique entry point to my thoughts.

Alliances between two students or within the group that carried out the project together were formed on their own initiative:

This time, we have decided to write a joint sustainability diary, as the group collaboration has really gained momentum over the past few weeks.

5 CONCLUDING REMARKS

Our research questions are: 1) What is the value of using Sustainability Diaries to foster reflection and a long-term sustainability mindset? and 2) How does the open format and the relatively open thematic framing influence the students' perception and performance of the task?

In our quest to contribute to the evolvement of university education to lifelong learning arenas rather than simply delivering knowledge, we have developed and tested Sustainability Diaries as part of project-based design courses with external partners. Our overall aim was to provide a space that equips students to tackle complex, real-world challenges. Drawing on initial experiences, we see clear potential in using Sustainability Diaries to foster reflection and a long-term sustainability mindset among students. One key question we sought to explore was whether this mindset could mark the beginning of a lasting shift in perspective, or if it would remain a one-off experience. While it is too early to determine the long-term impact, diary entries suggest that many students were actively engaging with these questions and reflecting on how their values and behaviours might evolve over time.

Already the first round of Sustainability Diaries provided us with a feeling of intimacy and the students impressed us with their openness and their reflections. However, even though the first round of entries was impressive, it was in the development over time between the three entries we, and the students

themselves, could notice real progress. Even though the openness of the format was, at least initially, perceived as a hindrance, many students started to experiment with the format over time. The first entries were almost exclusively in the form of classic texts – most digitally produced, but some were hand-written and scanned – but over time students started to experiment more with the format. Of course, our feedback and encouragement to try new formats after the first entry not only confirmed to the students that they had all passed the assignment but also made it clear that this was a safe place to experiment. However, we believe that the open format *per se* also contributed to them becoming increasingly experimental. Perhaps the most exciting experience from testing the method was that so many students initiated cooperations with other students after the first diary entry. Not only did they experiment with the format, but they also seemed to widen their scope and mature together, potentially forming a long-term sustainability mindset that may become an integrated part of the future professional lives. Clearly the Sustainability Diaries have the potential to open for new cooperations and alliances between different students. Overall, we felt that we were taking part in something very precious, and we are now considering whether using the more neutral term "Journal" instead of "Diary" may be advantageous, or whether the personal approach is crucial for realising the method's usefulness. We are also discussing the pros and cons of framing the instruction of writing Sustainability Diaries more specifically.

ACKNOWLEDGEMENTS

REFERENCES

[1] Knowledge for a better world. *Norwegian University of Science and Technology*. (2018). NTNU strategy 2018–2025: Approved by the Board of NTNU. Communication Division, NTNU. Retrieved from https://www.ntnu.edu/strategy-2018-2025.

[2] Lönngren, J. and van Poeck K. (2020). Wicked problems: A mapping review of the literature. *Environmental Education Research*, 26(4), 481–502. https://doi.org/10.1080/13504509.2020.1859415

[3] Butler D. L. and Winne P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245-281.

[4] Trondheim kommune. (2022). Kvalitetsprogram for Nyhavna: Ti strategiske virkemidler for utviklingen av en sentrumsbydel på Nyhavna. Trondheim kommune.

[5] Øien G. E. D. and Bodsberg N. R. (2022). Teknologiutdanning 4.0: Anbefalinger for utvikling av NTNUs teknologistudier 2022–2030 (Sluttrapport). Norges teknisk-naturvitenskapelige universitet (NTNU). Retrieved from https://www.ntnu.no/fremtidensteknologistudier/sluttrapport

[6] Norwegian University of Science and Technology. (2025). Teaching excellence. Retrieved from https://www.ntnu.no/toppundervisning/utviklingsprosjekter

[7] Wallin P. and Adawi T. (2017). The reflective diary as a method for the formative assessment of self-regulated learning. *European Journal of Engineering Education*, 37, 97. https://doi.org/10.1080/03043797.2017.1290585.

[8] Moon J. A. (2006). Learning journals: A handbook for reflective practice and professional development. Abingdon, Oxon: Routledge.

[9] Moon J. (2010). Learning journals and logs. In *UCD Teaching and Learning Resources*. Retrieved from http://www.ucd.ie/t4cms/ucdtla0035.pdf

[10] Hanington B. and Martin B. (2019). Universal methods of design expanded and revised: *125 ways to research complex problems, develop innovative ideas, and design effective solutions*. Rockport Publishers Inc.

[11] Rieckmann M. (2018). Learning to transform the world: Key competencies in education for sustainable development. In A. Leicht, J. Heiss, & W. J. Byun (Eds*.), Issues and trends in education for sustainable development* (pp. 39–59). UNESCO Publishing.

[12] Norwegian University of Science and Technology. (2020). Bærekraftig kompetanse: Delrapport 1: Fremtidens teknologistudier. Trondheim: NTNU.