LESSONS LEARNED: FURTHER STRATEGIES FOR THE IMPLEMENTATION OF E-PORTFOLIOS IN ENGINEERING SCIENCES

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ABSTRACT

In spring 2022, we implemented e-portfolios at a product design course for engineers in the bachelor's programme on 'Sustainable Engineering' at the University of Applies Sciences, Ansbach. The use of e-portfolios was new to both students and lecturers. To evaluate the effect the e-portfolio had on students, we accompanied the implementation with surveys and interviews. This paper provides a comprehensive analysis of the evaluated results. Among other things, the following three main findings convinced us to continue with e-portfolio work. First, ~91% of the interviewed students felt that they were supported very well by our introduction. Second, ~93% got along well / very well with the functions of the e-portfolio software. Third, ~86% of those interviewed appreciated the freedom of design. Prior to the implementation of e-portfolios in our first test course, we identified the following factors as crucial for the successful implementation of e-portfolios: a comprehensive personal introduction, extensive information material, continuous guidance, clear work instructions, room for flexibility and creativity to foster learners' individual strengths, and exchange between learners and teachers. This paper reflects on these initial factors. The aspects identified for further improvement in the second round of e-portfolios, in the summer of 2023, are better technical preparation of the lecturers, the communication of technical borders in advance, timing of the accompanying e-portfolio workshops and a more comprehensive promotion of teamwork. The suggested modifications will be discussed in detail in this paper.

Keywords: E-Portfolio, design, student feedback, didactic strategies, teamwork

1 INTRODUCTION

E-portfolios are rarely found at German universities, although they offer a lot of benefits to lecturers and students [1]. We want to change this and share our didactic experiences in the field of engineering with other universities. So far, field research into didactic strategies of e-portfolio implementation in the German speaking area mainly comes from the fields of teacher training and foreign language teaching [2-4]. From the perspective of the discipline of engineering, we want to offer new contributions to this topic. In the spring of 2022, we implemented e-portfolios (using Mahara software) in a course on project-based product design from a bachelor's degree programme for 'Sustainable Engineering'. It is the only course focusing on product design in the curriculum of the bachelor programme. The students faced a challenge to *design* and *build a* wooden product for children [5]. At the beginning, one lecturer taught the theoretical aspects that provided the content for the relevant project management and product design (90 minutes per week over the first four weeks and three other lectures that the students had to carry out on their own via digital material). The practical part took place in a laboratory and was accompanied by the lecturer and a laboratory engineer (90 minutes per week, for 14 weeks). Previously, students had to demonstrate the skills that they gained through a seminar paper [6]. This form of examination did not really reflect the creativity and complexity of the project. Therefore, we decided to use e-portfolios as a more diverse tool. Students can document what they have learned more easily via pictures, videos, embedded links, and text (nice design). In March 2022, we implemented e-portfolios as a tool for the documentation, reflection, presentation, and proof of the acquired skills. The students learned to use the software in eight weekly workshops (for one hour a week, see Figure 1 below).

Before implementation, we identified the following four important aspects that should be considered in the development of didactic strategies (based on the literature and our own field research findings). First, a comprehensive introduction to e-portfolios because they are an unknown tool for most of the students; second, a clear, well-defined framework and guidelines; third, weekly tutorials as part of a compulsory course; and fourth, mutual exchange, feedback, and teamwork, as important parts of autonomous learning [5]. We want to show how the general acceptance of e-portfolios was achieved and how our students assessed the different aspects which we identified as being important. The aim was to also indicate which findings were expected, which surprised us and what changes can be planned for the next round of testing.
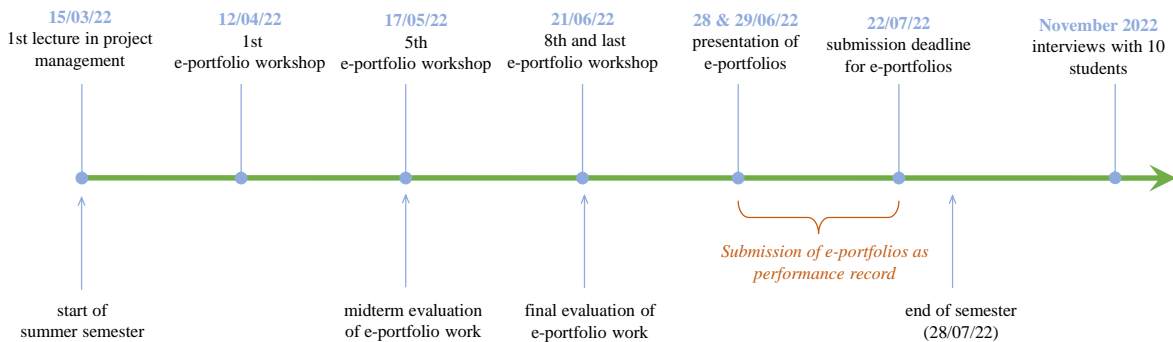

Figure 1. Time overview test course 1 (summer semester 2022)

2   IMPLEMENTATION RESULTS

We received a lot of e-portfolios that fully achieved the required tasks and were very well done. At the middle and the end of the course phase, the students answered online questionnaires (a mix of open and multiple-choice questions), in which they were asked about their perception of e-portfolio work. Evaluation topics were the general acceptance of e-portfolios, the added value that students see in portfolio work, the obstacles for e-portfolio work, and the assessment of our introductory workshops and information material. After the course, we also conducted expert interviews with 10 students from the test course (16 participants in total). The paper brings together the results of our different evaluations and shows how the factors that were identified for a successful implementation of e-portfolios were evaluated by the students and what changes we suggest for our second test course in the summer semester of 2023.

2.1 The general acceptance of e-portfolios

In the first online questionnaire, 14 students answered questions about their impressions so far. For 93% of them, e-portfolios had been an unknown tool before the start of the course. 67% of the students felt motivated to try e-portfolios, 33% were more sceptical about them and questioned the effort of learning a new tool, asking why they would ever need it again.

In the 8th workshop, 11 students filled out a longer digital survey. This time, 36% gave quite sceptical answers regarding their lasting impressions of Mahara, mainly criticising the usability of the software. 64% of the students described the use of the software as being positive and only 50% could imagine using Mahara e-portfolios again, in other courses. At this time, many students had not completed their final portfolio and the exam phase was imminent.

After the course, which was also after the exam phase, we conducted expert interviews with 10 students from the test course, using a semi-structured questionnaire. This time, the answers referring to the general acceptance of e-portfolios, were strongly divergent from the answers given in the questionnaires during the course phase. Nine of the ten interviewees said that e-portfolios would be their preferred examination form and all ten found that they had much more fun with this performance record than with term papers or exams: 'Yes, in any case, one has been able to realise oneself.' At the same time, they felt positively challenged: 'It went much better with me (...) but it was still demanding, you still had to do something for it.'

Furthermore, they felt less pressure because they could work continuously on their portfolio and did not need to know everything at a certain time: 'I think it's good to get away from the bulimic learning because we were able to finish our project step by step.'

In conclusion, it can be said that the students had a very high acceptance of e-portfolios as new performance records. This is especially true at the end, when the students reflected on their e-portfolio work, in direct comparison to the exams they had passed.

2.2 Barriers

Before the course started, our plan was to identify a top ten of barriers to e-portfolio work at the end of the test round. However, in the concluding interviews the students either named none or a maximum of three barriers: 'Actually nothing has inhibited me, to be honest.' This shows that, with the help of our didactic strategies, we can already prevent a lot of potential problems that can occur with the introduction of a new digital tool [7].

The only factors that some of the interviewees perceived as barriers were (i) the usability of the e-portfolio software (70%), (ii) the great deal of effort required to come to terms with a new tool (20%), (iii) the fear of the new (20%), and (iv) the fear of having to be creative (10%).

(i) The main criticism of the software was that some functions were not complex or intuitive enough, like a timetable on Mahara, where it was not possible to backdate past events. At the beginning, they also had problems with the uploading of data because the pre-set memory space was too small. It should not have been a problem to increase the storage space but we, the lecturers, were also newcomers to Mahara and had not recognised or solved these points before the students. With respect to other little challenges, where we had anticipated possible pitfalls, the students stayed quite relaxed. After having found alternatives for the first technical problems, the students were more positive about the software: 'Yes, in the beginning, it didn't go so smoothly. But then you managed it relatively quickly and well.'

This shows that it is very important for the lecturers to know the software very well and can point out the limits of Mahara in advance, to avoid expectations that cannot be fulfilled later.

(ii) The effort to get to know a new tool was only criticised by two students. In the end, both of them found it interesting to have worked with an e-portfolio: 'In conclusion, this is a cool gimmick that you have learned there, I've just never done such web pages, so it was great to do something like that.' One of the two would always prefer an exam to e-portfolio work as a performance record.

(iii) The scepticism towards the unknown, as a barrier, was also mentioned by two students. Both changed their mind later. One of them evaluated the portfolio work very positively in the end and noted that his attitude towards new things had changed: 'Yes, you just shouldn't jump to conclusions and take a look at it already.'

(iv) One of the students had also mentioned his fear of having to do something very creative or 'artistic'. This was his interpretation of our arguments for e-portfolio work when we introduced the portfolio as a more creative tool for documentation. To avoid this misunderstanding in the next test round we should, rather, use the phrase 'freedom of design' to explain what we want to offer with an e-portfolio. This should prevent students from thinking that they have to produce a piece of art.

2.3 Added values of e-portfolio work

What the students really appreciated about e-portfolio work was the clear structure of an e-portfolio collection and the fact that they received an overview of their project results. Page after page can be added and the collection can be flipped through digitally, just like a real book. In the survey, during the course phase, 50% of the interviewees named this point as positive. In the interviews after the course, 44% of those interviewed positively mentioned this aspect again: 'That you see your collection growing. I thought that was really cool to see. And that also motivates you to continue and finish your collection.'

Other added values of e-portfolio work which are very often named, are the variety and freedom of design (43% in the survey and 67% in the interview): 'I think it's cool that you can just bring in so many different things - videos, links, images, text. It's cool that it's all so jumbled up and you don't just rattle off text.'

Comparisons with a classic seminar paper were mentioned as being very motivating (14% in the survey, 33% in the interview). Some based their preference on a lower workload, whereas others found that the workload was roughly equal. They preferred the e-portfolio because it offered more variety and fun than the seminar paper: 'Otherwise, you always think, no, I don't want to study and it's easier to get distracted. But when I was in this e-portfolio, I just concentrated on that, and I thought that was good.'

In the interviews, 22% also referred to the flexibility of the application. First of all, you can work on the portfolio from anywhere, which is motivation to edit your portfolio more often and this led to people working continuously with it. Secondly, the e-portfolio can be more than one thing, meaning that it can

be used as a documentation book but, also, to present the project, when you fold in the text and just show the headlines and pictures.

2.4 Offer of support (comprehensive introduction and information material)

Since Mahara was completely new software for all students, we offered them a comprehensive introduction via eight accompanying workshops during the course phase, where they learned to use Mahara step-by-step and to continuously work with it during the semester. As shown in Figure 1 we only started with the workshops after the first four lectures. This was due to technical issues (we got the access to the software later than expected) and not part of our initial didactic strategies. We would recommend introducing Mahara before or in parallel to the first lectures.

The overall feedback to our introductory workshops and information material, anyway, was very positive. All students felt well or very well supported (according to the survey results). Also, in the interviews, the students evaluated the offer of support to be very positive: 'That we have gone through it all together with you, that was definitely very good.'

The success of our support was also decided by the e-portfolio template with work instructions, which was provided to the students: 'It helped a lot to get a rough overview. So, I think without the example presentation it would have been much more difficult.' All 10 of those interviewed found the template to be very important and supporting because it gave them a clearer idea of our expectations. They simultaneously felt that they had a lot of freedom of design, as our guidelines gave the students the freedom to decide how to document their results themselves: 'Because, nevertheless, it still became clear that everyone can live out as he wants, can design as he wants.' This matches our assumptions, based on the interviews with other lecturers and former students, as well as the findings from other researchers, who discovered the demand for a clear structure and the wish for liberty and creativity as being essential [3]. For this reason, we will definitely maintain our template and work instructions.

Only the volume and number of workshops could be reduced (from 8 to 6) for the majority of those interviewed. They would prefer a more condensed introduction, with fewer but longer workshops (90 minutes each). On average, the students think that a total of 6 hours seems appropriate. For some, it was more a question of time saving and their semester timetable (they had to come to university for only one hour, because they had no other courses that day). Others prefer a condensed introduction because they want to get to know all of the elementary functions from the beginning and then work with them independently. The students positively mentioned the fact that they were motivated to continuously work on their portfolio by the workshops (7 out of 10 interviewed). How can these two contrasting needs be combined? A solution for the next testing round could be to offer one first introductory 90-minute workshop where they learn to use all elementary functions, followed by four 45-minute workshops that take place directly after the project management lecture, to offer longer blocks to the students. In these short workshops, important functions will be deepened by solving little tasks on Mahara. At the end, we offer one concluding 90-minute workshop where students get feedback on their preliminary results and can ask final questions about the e-portfolio submission.

2.5 Mutual exchange and teamwork

Based on didactic research results [8], we identified mutual exchange and teamwork as very important aspects of our didactic concept. Therefore, every student obtained a tandem partner (by drawing lots) with whom they had to exchange communications with, at least three times, regarding the respective work progress. The result of the meetings had to be documented in the e-portfolio under the headline 'teamwork.' In addition, in the Mahara workshops, the students were asked to give other colleagues feedback on little tasks, or to discuss newly learned functions during the workshop.

But how did the students themselves assess this aspect? For the majority, teamwork associated with working with the tandem partner was the most important aspect (8 out of 10). One student talked about a colleague and friend, whom he worked together with on a product, and then about his tandem partner; whereas one student mainly associated the topic with the feedback he got from others in the workshop groups.

Some of the students also referred to the lecturing team, other colleagues that gave them feedback and the group exchange in the workshops, when we asked what else they connected the topic of teamwork with.

The tandem partnering system should definitely be maintained, as it was evaluated as doing 'very well' by the students. Eight of the ten interviewees found the feedback of their tandem partners helpful for

their projects: 'It gave me ideas like 'yes, I'll try to put plexiglass on it.' In any case, it helped me a lot in finding ideas.' In the beginning, four students had the sensation that the tandem system was a bit artificial and that they only met because they were asked to do so. However, afterwards, all of them discovered that the tandem partner could give them useful advice, new perspectives on their project or orientation and an idea of where they stood compared to others.

One student, who told us that his project work did not really improve through the tandem meetings, could see a network sense in it later. He then worked together with the former tandem partner on another course, because they had already known each other from the tandem partnering. Another student, who did not give positive feedback, could not really evaluate the tandem system because his tandem partner quit the course.

The reason that the students mainly referred to the tandem partner system in the context of teamwork was probably because this was the only aspect of teamwork that the students had to document in their portfolio, which was, therefore, assessed. All of the other aspects of teamwork are important as well. Later, four students explicitly mentioned that working in little groups and providing mutual feedback was very helpful. Two of them suggested that students should be encouraged to exchange even more and get feedback on their portfolio from many different students.

To more comprehensively convey what teamwork is all about, the didactic concept for the second test round (in summer semester 2023) will be adjusted. Together with the students, we want to define different important aspects of teamwork and give them a task for each part with documentation in the portfolio. It could be that students only give feedback to their tandem partner twice. They also have to discuss certain project relevant questions in a larger group, of three to four people and document the results. They have to leave feedback on two other students on the course via the commentary function in the e-portfolio. To avoid feedback not being exchanged because of organisational problems (three students told us they had problems finding a common time to exchange), there will be reserved time slots for teamwork in the Mahara workshops.
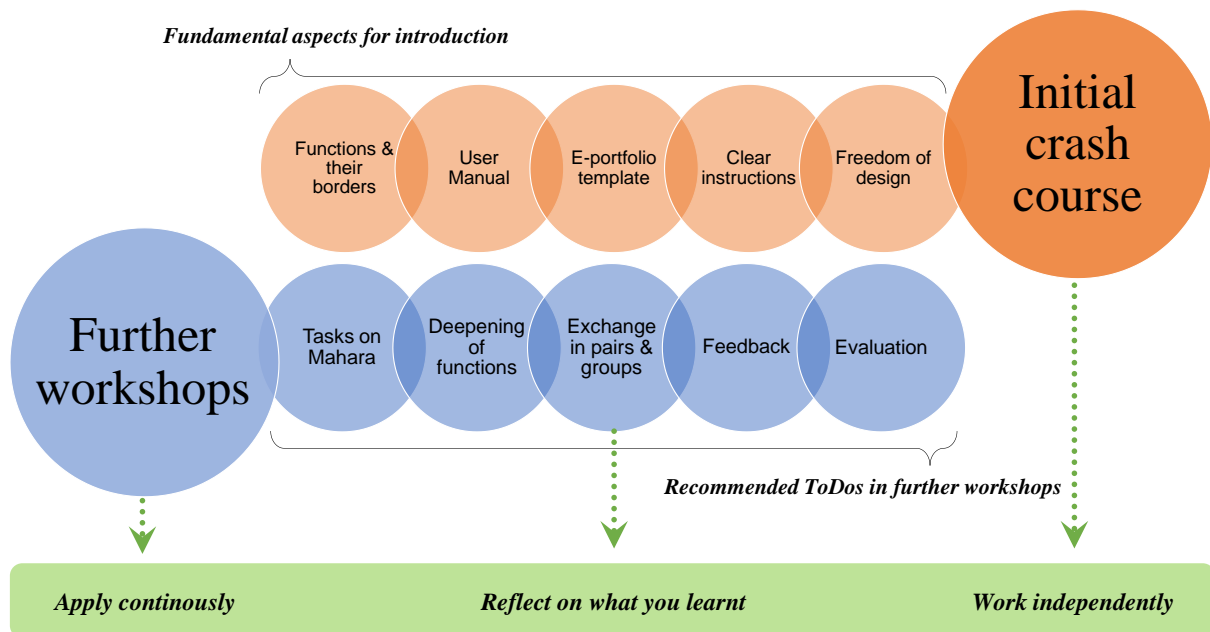

Figure 2. Didactic strategies for upcoming test course 2 (summer semester 2023)

3 CONCLUSIONS

In summary, our evaluation results lead us to the conviction that the use of e-portfolios should be continued. It offers a lot of benefits, such as a good structure and overview, freedom of design and variety, a low threshold, flexible application, more fun and less pressure.

It is important to anticipate all of the technical challenges, to enable a good acceptance of the software. Central to its introduction is to offer a comprehensive e-portfolio template that clearly explains what a portfolio can look like and what expectations the lecturers have. The accompanying e-portfolio workshops should start with a condensed crash course, to meet the needs of those who like to work quickly and independently with the software. Then, further workshop sessions should be used to deepen

knowledge and to encourage continuous application. Exchanges and teamwork should be supported by mutual feedback and various tasks, in the pairs and groups that are assessed.

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REFERENCES
[1] Schütz-Pitan J., Seidl T. and Hense J. Wirksamkeit eines fächer- und modulübergreifenden ePortfolio-Einsatzes in der Hochschullehre. Einflussfaktoren auf den Kompetenzerwerb. *Die Hochschullehre Interdisziplinäre Zeitschrift für Studium und Lehre,* 5, 2019, pp. 769–796.

[2] Rachbauer T. *E-Portfolios als Instrument für Selbstreflexionsprozesse in der Lehrerinnen- und Lehrerbildung. Eine empirische Untersuchung zur Implementierung von E-Portfolios in der universitären Lehrerinnen- und Lehrerbildung*, 2019 (Dissertation: LIT Verlag, Münster).

[3] Weber N. *Reflexionsmedium ePortfolio. Strukturierung von digitaler Portfolioarbeit im Lehramtsstudium*, 2021 (Dissertation: Verlag Julius Klinkhardt, Bad Heilbrunn). Available: https://elibrary.utb.de/doi/book/10.35468/9783781558854 [Accessed on 2023, 15 February].

[4] Gebhard C. Das Lernportfolio als Leistungsnachweis im Chinesischunterricht. *CHUN*, 35, 2020, pp. 86–102.

[5] Tyroller M., Walter M. S. J., Kaetzel C. and Riess C. A didactic look on the introduction of e-portfolios in a product design course, In *DS 117: Proceedings of the 24th International Conference on Engineering and Product Design Education (E&PDE 2022),* London, September 2022. Available: https://www.designsociety.org/publication/45829/A+DIDACTIC+LOOK+ON+THE+INTRODUCTION+OF+E+PORTFOLIOS+IN+A+PRODUCT+DESIGN+COURSE [Accessed on 2023, 28 February].

[6] Riess, C., Walter, M. S. J. and Tyroller, M. Digital documentation and planning of student projects in engineering and product design using e-portfolios. In *50th Annual Conference of The European Society for Engineering Education*. Barcelona, September 2022, pp. 2161-2165. Available: https://www.sefi.be/wp-content/uploads/2022/12/ebook-sefi-2022-1.pdf [Accessed on 2023, 28 February].

[7] Mulders M. and Krah S. Digitales Lernen während der Covid-19-Pandemie aus Sicht von Studierenden der Erziehungswissenschaften. Handlungsempfehlungen fuer die Digitalisierung von Hochschullehre. *MedienPädagogik. Zeitschrift für Theorie und Praxis der Medienbildung*, 40, 2021, pp. 25-44. Available: https://www.medienpaed.com/issue/view/91/56 [Accessed on 2023, 15 February].

[8] Arnold P., Kilian L., Thillosen A. M. and Zimmer G. M. *Handbuch E-Learning. Lehren und Lernen mit digitalen Medien*, 5, 2018 (W. Bertelsmann Verlag, Bielefeld).