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Creativity in Higher Education: Teaching Activities during Student Groups' Idea Evaluation Process

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Abstract

Creativity should be cultivated in higher education to tackle the increasingly complex healthcare problems; however, despite this need for novelty, students collaborating in groups to solve a complex problem often seek consensus around low-novelty ideas. This study aims to explore the challenges higher education student groups face while evaluating and improving creative ideas, and to identify teaching activities that overcome these challenges. A qualitative study was conducted using semi-structured interviews with 14 teachers from the "innovation project" at Radboud university medical center in Netherlands. The results show that student groups face challenges in balancing the goals of novelty and usefulness in their search for creative ideas, often selecting either novel ideas that are infeasible or ineffective, or useful ideas that already exist. Furthermore, teachers also identified problematic group dynamics as a challenge in the idea evaluation process. To overcome these challenges, teachers reported using cognitive, affective, metacognitive, and socio-communicative teaching activities. In conclusion, higher education students may not develop their most creative ideas even when creative solutions are required. This study highlights the importance of teaching higher education students to skilfully manage the twin goals of novelty and usefulness in their search for creative solutions, while also dealing with group dynamics.

Keywords

Creativity, Teacher Professional Development, Idea Evaluation, Problem Solving, Medical Higher Education

1. Introduction

The recent COVID-19 pandemic emphasizes the demand for skilled medical professionals capable of solving complex societal problems and generating innovative solutions. Higher education plays a fundamental role in meeting this demand by equipping medical students with the competencies necessary to tackle increasingly complex problems in healthcare that cannot be addressed by individuals alone, such as ageing and the speed with which patient needs and disease patterns are changing (Lechler, 2017; WEF, 2020; Ten Haven et al., 2022). Higher education provides opportunities for lifelong learning and skills development, essential for staying competitive and adapting to new challenges in the rapid changing modern economy (Bain & Cummings, 2021).

To foster creativity, medical education has implemented student-centered approaches, such as project-, design- and challenge-based learning (Badwan et al., 2018). While these didactic approaches are frequently implemented to provide medical students with the opportunity to develop creative ideas (i.e., novel and useful), medical students often experience these creative solutions as risky and the projects as very difficult to navigate through. According to the novelty-usefulness tension, students perceive their novel ideas to be infeasible or ineffective because they are, by definition, untested (Frederiksen & Knudsen, 2017). Subsequently, while medical student groups are able to generate creative ideas, the evaluation and improvement of creative ideas is not likely to happen without guidance of teachers, and, therefore, teachers need to help student groups to navigate the challenges triggered by the risky nature of creative ideas (Fredagsvik, 2023; Keith et al., 2023; Van Broekhoven, 2023). This study aims to explore challenges faced by medical student groups during the process evaluating and improving their creative ideas, and to identify the teaching activities that help them to overcome these challenges.

While the concept of creativity is debated (Liu et al., 2023), a recently developed definition postulates that creativity is the competence to engage productively in the generation, evaluation and improvement of ideas that can result in novel and useful solutions, advances in knowledge, or impactful expressions of imagination (OECD, 2021). This definition underlines the iterative nature of generating, evaluating and improving ideas that are both novel and useful. Novelty can be understood as being uncommon in terms of a task or social context, while usefulness can be seen as feasibility and effectiveness (Litchfield et al., 2015; Runco & Jaeger, 2012). To develop novel and useful solutions, students often evaluate ideas through a process that includes idea appraisal, forecasting and refinement (Mumford et al., 2002). During the idea appraisal, relevant standards such as novelty and feasibility are used to judge the viability of an idea (Medeiros et al., 2017). Forecasting involves simulating the consequences of implementing an idea, and refinement involves discarding or changing elements of an idea, elaborating on key details, or combining new elements to improve it (Byrne et al., 2010).

Several studies have identified teaching activities that foster creativity in terms of generating ideas, such as encouraging students to ask questions and think in different ways, or inviting them to provide multiple solutions (Belio & Urtuzuastegul, 2013; Liu & Wang, 2019). For the cultivation of creativity, however, there is a need to focus on the idea evaluation process as well. Students have different needs in this process due to the inherent tension between novelty and usefulness (Mueller et al., 2012). Teachers may need to promote self-evaluation, delay judgment, and teach students how to cope with frustration and failure, so that they have the courage to try new approaches and use flexible thinking to evaluate and improve their ideas (Cropley, 2018).

The socio-cultural theory of creativity suggests that students' idea evaluation is influenced by their interactions with their environment and culture (Csikszentmihalyi, 1999). Groups vary in their response to ideas based on their beliefs, attitudes, and experiences. Students' assessments are also shaped by their material and social environments, which may either limit or foster idea development (Glaveanu et al., 2021). For example, a lack of financial resources can prevent the pursuit of a new idea. The social environment refers to the discipline that acts as a gatekeeper, deciding which ideas or products endure (Kupers & van Dijk, 2020). The acceptance of novel ideas by the community is uncertain, and the classroom (or course) culture also affects idea evaluation and enhancement.

In light of the above, the present study seeks to address the following two research questions:

1) What challenges do student groups in medical undergraduate education face in evaluating and improving upon creative ideas, according to teachers?

2) What kind of teaching activities do teachers report using when student groups experience the above challenges?

2. Methods

2.1. Setting

We conducted this study in the context of a project-based learning environment at Radboud university medical centre in the Netherlands. During the eight-month "innovation project", first-year medical and biomedical sciences students work in groups to define a health(care) problem and develop an innovative solution to it (i.e., a novel and useful solution). During this project, students participate in workshops—like *problem validation*, *project management*, and *prototyping*- and collaborate with industries leading to the development of new products, services, and processes that potentially drive economic growth (Vaaland & Ishengoma, 2016). Guidance is available from teachers with some expertise on the students' topic. The teacher also grades the final project report.

2.2. Design

Consistent with the exploratory nature of our research, we held semi-structured interviews. Such interviews are particularly instrumental in facilitating detailed

descriptions of the understanding and experience around an unclear topic (Britten, 1995; Horton et al., 2004). Following the socio-cultural theory of creativity, the teachers reconstructed descriptions of the student groups' idea evaluation process that were grounded in a particular time and place (Bearman, 2019). We developed an interview guide based on the consistent literature finding that students tend to avoid original and risky ideas (Johnson & D'Lauro, 2018; van Broekhoven et al., 2022). This interview guide was tested in several pilot interviews, and unclear questions that caused confusion were reworded. The final interview guide consisted of an introduction, five open-ended questions with follow-up probing questions to elaborate on some responses, and the closure of the interview (see Supplementary **Appendix 1**).

2.3. Sampling and Participants

In the period spanning October to November 2021, we conducted semi-structured interviews with 14 teachers involved in the "innovation project". Each interview lasted approximately one hour. Based on purposive sampling, teachers were selected using the following criteria: 1) at least two years of teaching experience in the innovation project, 2) guided at least two groups of students each year, and 3) willing to participate in the research project[1]. The fifth author was part of the organisation of the "innovation project" and recommended teachers who would fulfil our sampling criteria. Participants were invited to take part in the study through an email outlining the purpose of the research. The participants' teaching experience in the "innovation project" ranged from two to seven years, with an average of five years. They each guided two or three student groups each year. The participants consisted of six male and seven female teachers.

2.4. Procedure

The interviews were held by the first author. With participants' written informed consent, all the semi-structured interviews were audio-recorded and transcribed verbatim. In the interview, each teacher was asked to provide multiple concrete examples of the student group's process of evaluating and improving ideas.

2.5. Analysis

The concrete example descriptions, provided by interviewees, are the unit of analysis, identified using the following criteria (Miles et al., 2020):

- The interviewee describes the students' identified health (care) problem in some level of detail.
- The interviewee describes the students' idea or solution in some level of detail.
- The interviewee explicitly describes the students' challenges that led to the teaching activities.
- The interviewee explicitly describes the teaching activities related to the students' process of evaluating and improving ideas.

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[1]This sample was part of a total of 88 teachers in the innovation project.

Together, the teachers reported 38 examples, with an average of three per teacher. The researchers used ATLAS.ti (version 9.0; Scientific Software Development, Berlin, Germany) to conduct a qualitative analysis of the interviews using primary, secondary and tertiary coding and constant comparison (Watling & Lingard, 2012). They first read through the interviews several times, then coded the individual lines or sentences descriptively. During this primary coding, the authors remained open to many possible conceptual and theoretical directions (Charmaz, 2006). This initial detailed mining of data led to a secondary coding, where broader categories were developed that encompassed a number of conceptually related ideas by going back and forth between coding and the literature. This meant that codes were grouped into categories, which, in turn, were systematically checked against new data and arranged into broader overarching themes (Boeije, 2010). The first author analysed all the transcripts, and the second author cross-checked the codes. Both researchers compared and discussed the codes until they reached consensus.

To answer the first research question, we created an analysis framework based on the novelty-usefulness tension (Mueller et al., 2012)[2]:

- Student groups evaluating ideas low in novelty and usefulness (NovLo_UseLo)
- Student groups evaluating ideas low in novelty and high in usefulness (NovHi_UseLo)
- Student groups evaluating ideas high in novelty and low in usefulness (NovLo_UseHi)

We identified an additional challenge, problematic group dynamics, which was included as a separate code.

To answer the second research question, we created an analysis framework based on Vermunt and Verloop's (Vermunt & Verloop, 1999) classification of teaching activities to support students' learning:

- Cognitive: Presenting and clarifying the subject matter for students
- Affective: Creating and maintaining a positive motivational and emotional climate for students
- Metacognitive: Regulating the problem-solving process of students

We identified an additional teaching activity, which seemed to refer to socio-communicative teaching activities (Vermunt et al., 2018). This was included as a separate code.

3. Results

1) *Research question* 1: What challenges do student groups in medical undergraduate education face in evaluating and improving upon creative ideas according to teachers?

We found that the teachers reported that medical students face two main challenges in the context of creativity in higher education:

- **Novelty-Usefulness Tension**: Students often struggled to balance the goals

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[2]We identified four cases in which a student group evaluated an idea high in novelty and usefulness, but these cases are beyond the scope of this paper.

of novelty and usefulness when generating creative ideas. They tend to select either novel ideas that are infeasible or ineffective, or useful ideas that are unoriginal and already exist.

- **Problematic Group Dynamics**: This study also highlighted issues with group dynamics during the idea evaluation process. Some students may dominate the discussion and push through their ideas, while others may withdraw if their contributions are ignored or ridiculed.

a) *Novelty-Usefulness Tension*

The majority of the example descriptions (29 of 38) could be characterised by student groups trying to find a way to manage the twin goals of novelty and usefulness. We discuss three example descriptions representative for each of the three categories: NovLo_UseLo, NovHi_UseLo and NovLo_UseHi (Table 1). The teachers reported 10 cases where student groups evaluated novel but ineffective or infeasible ideas to implement in practice (NovHi_UseLo). The socio-cultural theory of creativity argues that the evaluation of ideas takes place in the collaboration between students, the material and social environment, and is intertwined with culture. In line with this theory, we found that teachers reported several reasons for the impracticality of ideas (idea is not feasible or effective):

- The student group has insufficient knowledge and expertise to further develop an idea (i.e., collaboration between students).

Table 1. Overview of each of three main novelty-usefulness tensions reported by teachers, and the frequencies of each.

	Low usefulness	High usefulness
Low novelty	(iii) NovLo_UseLo: 7	(ii) NovLo_UseHi: 12
	"Elderly people who drink too little water are easily dehydrated and this is bad for their health. […] The students' lifestyle approach was that we need to make elderly people more aware that they are at risk of dehydration. […] The students came up with the idea of a smart drinking cup. They wanted to integrate the cup with e-technology and e-health, so that the smart drinking cup would tell elderly to drink more. […] However, the students abandoned the idea, because it has already been thought of several times and it does not work; it is expensive, and it is typical tech-optimism that does not fit well with the elderly population. So, then the students abandoned that path" [T14 dehydration in elderly people].	"I think those were all girls. […] One of those girls had asthma herself and they wanted to develop something with an app for asthmatics. Well, within the hospital, we have two very big examples of that, *Air Bridge* and *Asthma Buddy*, so those ideas have already been developed. [….] Within their ideas, there was just nothing innovative" [T5 asthma].
High novelty	(i) NovHi_UseLo: 10	NovHi_UseHi*
	"There was a group who were working on the problem of misophonia [a condition where normal sounds cause a psychological reaction]. The students generated a very interesting idea for that problem. […] A headphone-like device that would filter specific sounds out, so [the wearer] could still follow the conversation. The students had all kinds of contacts with technical companies; however, the students got stuck because their idea was not feasible without any funding" [T1 misophonia].	

Note: See Supplementary Material (**Appendix 2** for all quotes). *Example descriptions of student groups who evaluated highly novel and useful ideas are beyond the scope of this article.

- The task or project has insufficient budget (i.e., material environment) to further develop an idea.
- There is a lack of collaboration from the social environment, such as pharmaceutical companies or research groups (i.e., social environment).
- The existing legal law inhibits the further development of an idea (i.e., culture).

An example is a student group who worked on reducing the reactions to misophonia (a disorder in which emotional or physiological reactions occur to a sound with a specific pattern) but found their solution of noise-cancelling headphones for these specific sounds unworkable without financial resources. Secondly, the teachers reported 12 cases where student groups evaluated feasible or effective ideas that lacked novelty (NovLo_UseHi). In these cases, the groups often sought consensus around a digital solution for their healthcare problem, with over half focusing on apps or websites. Finally, the teachers also reported seven cases in which the student groups evaluated ideas that were low in both novelty and usefulness (NovLo_UseLo). An example is a student group who worked on preventing dehydration in the elderly but found their solution of an "E-teach" smart bottle unworkable due to its high cost and prior existence.

b) *Problematic Groups Dynamics*

Furthermore, teachers reported challenges with group dynamics during the idea evaluation (6 of 38), often with some (dominant) students suggesting ideas and other group members tending to accept them without question (4 of 6). In the other two examples with group challenges, a student proposed an idea but was abruptly ignored or ridiculed by the others. For example, a student group worked on the problem of tinnitus (a hearing disorder), but one student who suggested some ideas withdrew from the group after being ignored by the others.

"Once, I had a student group that worked on preventing noise-induced hearing loss during festivals, and these students were stuck at one point, but they had come up with a nice questionnaire to measure noise-induced hearing loss. [...] This was a student group with one man and four women. The man was completely overshadowed by the women. He did not get a single chance to advocate ideas with these women, although I noticed that he had very good ideas. He also became very frustrated in the process because his ideas were not heard" [T13 tinnitus].

2) *Research question* 2: What kind of teaching activities do teachers report using when student groups experience the above challenges?

We found that the teacher responses were contingent on the student groups' reactions triggered by the novelty-usefulness tension. Some student groups reacted *positively* and were still motivated to continue with their idea, while other groups reacted with *negative* emotions, such as anxiety, frustration and fear. These groups often had trouble letting go of their idea and embracing alternative ideas. Finally, teachers also reported several teaching activities to address *prob-*

lematic group dynamics.

a) *Teaching activities related to positive student emotions*

Teachers responded both with cognitive and metacognitive teaching activities to student groups that were motivated to continue with their idea (see Table 2). The teachers asked detailed questions about the problem or the students' proposed idea (cognitive level) and helped groups take the next step, such as seeking feedback from stakeholders. They also encouraged students to explore alternative ideas with stakeholders (metacognitive level). In this way, teachers tried to let student groups revisit or improve their proposed idea without directly instructing them to do so. Once teachers noticed that student groups were highly motivated to continue with their proposed idea, the teachers reported that they supported the student groups with their chosen idea.

b) *Teaching activities related to negative student emotions*

Teachers responded to negative reactions by using affective teaching activities to create a positive motivational climate, acknowledging and normalising failure (see Table 2). This was done by asking student groups about their motivation after rejection from stakeholders in the field, acknowledging declining motivation, and reducing fear and anxiety among students through reassurance. The teachers then also used metacognitive teaching activities to guide the students in finding alternative ideas or modifying their existing ideas with stakeholders.

c) *Teaching activities related to problematic group dynamics*

Finally, teachers reported using several activities to address problematic group dynamics, such as informing students of the importance of diversity in perspectives and encouraging students to contribute ideas. They focused on improving communication skills, including informing students of group dynamics, encouraging idea sharing and building, complimenting students, and encouraging individuals to speak up (see Table 2).

4. Discussion

This study explored the challenges faced by medical student groups when evaluating and improving their creative ideas and identified teaching activities to address these issues. Two major challenges were identified in student groups' idea evaluation process: the tension between the novelty and usefulness of creative ideas and problematic group dynamics.

First, the tension between the novelty and usefulness of creative ideas stems from the fact that highly novel ideas are more likely to be judged as less feasible because, by definition, they involve a step into the unknown. Yet, both are important in defining a creative solution for medical problems. A novel but useless idea cannot be implemented in healthcare, while a useful but not novel idea already exists and, therefore, does not solve the medical problem. We also found that student groups feel unable to select novel ideas because of a lack of financial resources, knowledge, expertise and/or collaboration with stakeholders in the field. These findings are in line with the socio-cultural theory of creativity, which

Table 2. Representative quotes illustrating teaching activities contingent on student groups' reactions.

Teaching activities	Contingent on:	Quotes from participants
Cognitive Metacognitive	Positive emotions	"The father of one of the students had ended up in the hospital and had experienced delirium. A delirium is a dysregulation of your thinking and the brain caused by a serious illness. […] The student had dived into the problem and learned that delirium occurs with serious illness and procedures. […] Then the student thought, could we come up with something to prevent that? For example, could we measure certain values, put them in an app, and have the app calculate the likelihood of delirium. […] The students spent quite some time on that idea; they wanted to make that idea into a prototype. However, something that impaired their process was that the students immediately worked on the five or ten most important parameters, and not so much on what a delirium is. […] I asked the students whether they felt that they knew enough about the whole clinical picture of delirium […] And how it would be to talk to a geriatric nurse, for example, or people who work in the recovery room. […] I tried to give the students some knowledge" [T6 delirium].
Affective	Negative emotions	"The students wanted to come up with something so that children who are in the hospital for long periods of time could still have contact with their pets. The students came up with all kinds of ideas, and the bottom line was that none of their ideas were possible. […] The students were very disappointed. [...] That did something to them, especially because these students felt that they had found the egg of Columbus several times in six weeks. [...] At one point, I noticed that the students were a bit worn out. [...] I asked them how they were feeling. The students said, "yes, I hate to say it, but [this failure] does affect my motivation". I replied by telling the students that it was good of them to say this, because that is why I asked about it, and it is very normal that this happens. So that is a bit of normalising that I do. I also work with the students to see how they can take the next step" [T6 long-term hospital visit].
Socio-communicative	Group dynamics	"At one point, I did say something about it to the students: "You know, every time he comes up with something that might be weird or crazy, you guys should actually try to build on that instead of cutting him off or saying that his idea cannot be done". He actually had really funny ideas. [...] I mentioned that I did not think it was fair that every time he came up with a crazy idea, the other students laughed about it or ignored it. Indeed, sometimes the ideas he brought up were not entirely useful, but he did think beyond what was already there. He did dare; he did have guts. [...] In the end, I wrote this in my evaluation, and I also said to him that he should have more confidence in himself and that what he did was good. I said this because I noticed that [the rejection of his ideas] made him insecure and that at a certain point he gave up, which is a shame" [T5 genetic disorders].

Note: See Supplementary Material (**Appendix 2** for all quotes).

postulates that the evaluation of creative ideas is dependent on and embedded within the material and social environment.

Second, we identified two group dynamics that impaired student groups' attempts to evaluate and improve upon creative ideas. The teachers reported that student groups converged on or accepted ideas proposed by the more dominant students without further elaborating on it, and that sometimes a student suggesting an idea was ignored or even ridiculed by the others. The first problematic group dynamic can be explained by the social comparison theory (Festinger, 1954). According to this theory, group members are aware of the activity level of each other, and some members may be more active than others. The type or

category of ideas shared by active members is then used to determine the appropriate level of performance (Brown & Paulus, 2002). This, in turn, causes groups to accept ideas proposed by the more active group members without further elaborating on them (Ziegler et al., 2000). The second problematic group dynamic can be explained by the idea evaluation apprehension theory (Cottrell, 1972). This theory postulates that group members are apprehensive about others' reaction to their ideas because most people want to be seen in a positive light. This, in turn, causes individual group members avoiding advocating novel or "weird" ideas because these ideas deviate from the status-quo and are likely to trigger a response from others. Group members are likely to withdraw from the group process even further when they are ignored or ridiculed by others.

As a result of these two challenges in their idea evaluation process, the student groups tended to seek consensus around ideas which were low in novelty. This is in line with literature on bias against original ideas (Mueller et al., 2012). The most original ideas are often those that are radically different from existing solutions or practices, which often cause people to have ambivalent feelings towards both the ideas and the person suggesting them as people often prefer the status quo. This bias against original ideas highlights the importance of teaching activities to guide students in the idea evaluation process.

The teachers reported that several student groups reacted negatively to the discomforting nature of creative ideas and, subsequently, discarded their ideas, while other student groups reacted positively and were motivated to continue with their idea. The teachers addressed the *negative* reactions through affective teaching activities, accommodating emotional outbursts, and creating a psychologically safe environment by supporting and encouraging risk-taking. By contrast, student groups' *positive* reactions were addressed with both cognitive and metacognitive teaching activities. The teachers asked detailed questions about the problem or the students' proposed idea (cognitive activities), and helped the groups determine their next steps, such as seeking feedback from stakeholders in the field, including patients, the industry, or healthcare management (metacognitive activities). Finally, teachers also reported several teaching activities to address *problematic group dynamics.* They responded with socio-communicative teaching activities to help students resist peer pressure, informing them of the importance of diversity in perspectives and encouraging students to contribute ideas.

4.1. Practical Implications

The results presented here have implications for teachers in undergraduate medical education. Medical undergraduate students working in groups are likely to discard creative ideas and seek consensus around more conventional ideas due to the novelty-usefulness tension and may display group dynamics that inhibit the further development of creative ideas. This study highlights the need for teachers to support medical students in evaluating and developing their creative

ideas, as this feels like a risky undertaking for students. To help medical students overcome bias against original ideas, a multifaceted approach could be effective. One could introduce, for example, a workshop that focusses on the importance of original thinking and how bias can hinder innovation. The workshop could create a safe space for sharing unconventional ideas and simultaneously teach students to critically evaluate ideas based on merit rather than conformity and encourage self-reflection and the use of tools like the Attitude Towards Implicit Bias Instrument (ATIBI) to help students recognize their own biases and attitudes towards original ideas (Gonzalez et al., 2021).

Furthermore, the results of this study provide valuable information for professional development programmes for teachers in undergraduate medical education, as they shed light on the challenges students face in the idea evaluation process and offer practical teaching activities. Teachers should be aware of students' tendency to choose familiar ideas over creative ones and be able to discuss this with students to encourage the selection of creative solutions. It's crucial to create a supportive environment that acknowledges the emotional challenges students face when generating and evaluating creative ideas. Teachers should normalize the experience of failure and encourage resilience.

4.2. Limitations

This study had several limitations. First, it was conducted at a specific time and place and may not be generalisable to other contexts. In addition, using only semi-structured interviews with teachers may not fully capture their perceptions and activities in the idea evaluation process. Further research with a larger sample size and observations of teacher-student interactions is needed to deepen our understanding of these challenges. This study highlights the importance of affective teaching activities in addressing student insecurities triggered by the novelty-usefulness tension. We suggest researchers to carry out a more in-depth exploration of affective teaching activities.

5. Conclusion

In this study, we explored the challenges faced by medical student groups when evaluating and improving their creative ideas and identified teaching activities to address these issues. Medical students working in groups are likely to discard creative ideas and seek consensus around more conventional ideas. Yet, the healthcare system is changing rapidly, and students need to be prepared for increasingly complex problems that cannot be solved anymore by conventional solutions. To meet this challenge, medical students need to learn to overcome their bias against original ideas and skilfully manage the twin goals of novelty and usefulness in their search for creative solutions. Teachers are advised to provide a balance between safety, freedom and structure, giving opportunities for risk-taking and explorations while simultaneously providing student groups with necessary direction.

Acknowledgements

Ethics Approval and Consent to Participate

The study was conducted in accordance with the Declaration of Helsinki, and it was approved by the Ethics Committee of the Radboud Teachers Academy of Radboud University. The voluntary nature of participants' participation and informed consent statements were included in the protocol and informed consent statements were obtained from all participants.

Availability of Data and Materials

The dataset analyzed during the current study is available from the corresponding author on reasonable request.

Authors' Contributions

KB made substantial contributions to the study design, acquisition of data, analysis and interpretation of data. She conducted semi-structured interviews, analyzed the data and drafted the conclusions. She has also been involved in writing the manuscript and has also given final approval of the version to be published. PM contributed to the study design; MU participated in the qualitative data coding and analysis process; KB and MU carried out coding and analysis of the data independently, then discussed and agreed themes jointly; MU, PM and JH also have been involved in writing parts of the manuscript, revising it critically and giving the final approval of the version to be published. EK has been involved in revising the manuscript critically for important intellectual content and has also given final approval of the version to be published.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Supplementary Material

Appendix 1. Semi-Structured Interview Guide

Introduction

- A brief explanation of the research and why we are here.
- Explain the process of a semi-structured interview.

Key questions

- Can you tell me about your current role in the innovation project?
  - ✓ Role as teacher (the so-called innovation expert)
  - ✓ Teaching experience (number of years; average number of groups)
- I would like to zoom in on the process of when student groups start evaluating and improving upon their ideas. Do you have an example of a student group who found it difficult to evaluate and improve upon creative ideas?
  - ✓ What happened?
  - ✓ Why did that happen? What inhibited student groups?
  - ✓ What did you do as a teacher? And why?
  - ✓ How did student groups respond on your teaching activities?
- Do you have another example of a student group who found it difficult to evaluate and improve upon creative ideas?
- Do you have an example of a student group who evaluated and improved upon creative ideas?
  - ✓ What happened?
  - ✓ Why did that happen? What inhibited student groups?
  - ✓ What did you do as a teacher? And why?
  - ✓ How did student groups respond on your teaching activities?
- Do you have another example of a student group who evaluated and improved upon creative ideas?

Closure

- Ask participant whether there are any further topics that have not been discussed yet.
- Thank the participant for their willingness to contribute to the research.

Appendix 2. Overview of Quotes Illustrating Student Groups Challenges and Teaching Activities

High novelty-Low usefulness (NovHi_UseLo): total 10

Student groups' challenge

"The students had generated several plans to provide information to illiterate people in many innovative ways, such as VR environments and online technology. And this would then be arranged through the municipality. However, after a talk with the municipality, students discovered that their idea was a step too far for the municipality. […] And, in the end, students described in their report that a first step would be to simply write a manual for municipalities: how to set up something in a neighborhood to involve residents and help them with their health literacy. And students had described their vision as well, where this could grow to. In this way, students choose both for change, so that something happens, and students choose for an original idea" [T3 medical illiteracy].

Teaching activities

"*And in this case, how do you guide the students?* By simply asking them, 'what does your stakeholder think of this idea, what will they think of it?' If there is resistance that your idea is too big or too immersive, what does the stakeholder then need? If there is a need, students can respond to that need and simultaneously take a step towards your idea. *So how do you help students with that?* Especially by recommending students to keep it small. See your vision separate from your advice in the report. And think about it—this is the first step—and this is the ultimate step" [T3 medical low literacy].

Student group's challenge

"Students were working on the problem of needle phobia. For this, they visited a clinic and talked with rheumatologists. To discover where this needle phobia comes from, and if they could do something about it. And—simultaneously—students thought of VR glasses to reduce with needle phobia. Even though the VR glasses were innovative, it was too big for the students. So, a doctor eventually picked it up himself. […] *How would the VR glasses work?* The VR glasses would have a hypnotic effect when put on children, and that would reduce anxiety for needles among children. *What happened then?* A doctor came up with the idea for VR glasses, and students talked to this doctor and discover that the idea would be too big for them to take on. In the end, that process of developing VR glasses took two years, so it had not been feasible for students. […] The students let go of the needle phobia and they worked on classical conditioning and its effects on nausea" [T9 nausea].

Teaching activities

"I had very extensive talks with students, brainstormed a bit with students, and also talked with stakeholders. Together, we talked and brainstormed about ideas. While discussing ideas, students realized that the idea of VR glasses was too big for them. Like, this is beyond our capabilities. And then I said, 'I also think that'" [T9 nausea].

Student group's challenge

"Yes, that idea was the GanZOOM board (deducted from the Game of the Goose). Students worked on the problem that, especially, older people have less contact with their family during the lockdown period of Covid-19. Students argued that people generally easily communicate with each other via video call, such as ZOOM and Teams. However, this is a challenge for older people, because older people really do not understand ZOOM, and

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that it is really difficult for them (older people). The students discovered things by trying to video call with their grandparents. […] Based on this discovery, the students remodeled a board game with cards with tasks on them. Then, the students played this remodeled board game in an elderly center. It was announced to the elderly that by playing this game they would learn how to call their grandchildren with video call. I thought it was funny. Students took existing things and combined into a new idea that also fits with the experiences of elderly. Everyone is familiar with typical board games, and students created some simple but also very funny tasks. For example, 'you have contact with the teacher of the senior gym, and he invites you to do three squats. But then you are out of view in the video call. How to ensure you remain in view during the video call?' […] At one point, students wanted to turn the board game into programming a serious game where people can earn points with cards and so on. However, to design and program the principle of a game requires a lot of knowledge and experience. There is a whole body of literature on the principles of error-free learning, a game where things cannot go wrong so that there are not failure experiences. I recommended students to talk with a study association on technology and game design to discover that their idea was not feasible" [T3 loneliness elderly].

Teaching activities

"Then I looked at how students still design a game that is simple and fits with the experiences of elderly, because developing a game is an art in itself. But if students take an existing game their energy will be spend as much as possible as to help elderly people and as little as possible to developing the game. […] At one point, I helped the students to conclude that developing a game will be too challenging. […] The simplest game that there is, is the Game of the Goose, because—as a player—you have no influence on it. And that is what we are going to use. This is the game that students will develop into an innovation" [T3 loneliness elderly].

Student group's challenge

"Students worked on the problem of major bleedings, like helping victims of bleeding on the street. [..] The students had no idea yet about how they (students) wanted to do that. The students started by wanting to develop a new type of bandage that would then locally influence blood coagulation. However, the students concluded at some point, that you cannot develop such new type of bandage without the full knowledge of blood coagulation and its research, without any money or cooperation with a company or a research group that is further along with developing such a new type of bandage. So, students got stuck. […] Students ultimately came up with the idea of using existing things that are not available yet on the street, because an ambulance has it, but they are not directly at the place where it happened, like in the street. […] Later, students came up with creating a first aid kit specially focused on large bleedings in the street, from existing kits. The students had made an extremely simple manual with pictures and tested it on non-medicine students whether they understood the pictures and could apply them in case of a large bleeding in the street. Then students worked on making that kit available, and the students thought of just hanging their newly developed kit in a different color box next to the general AID first aid box. I personally thought that was a fantastic idea, it is practical. […] What I often notice in groups when it goes well, is that there are different people in the group. You need someone who oversees everything and makes sure that all tasks are done at the right times. You also need someone who can think creatively and who is not afraid to change direction and who can convince the others that it is fine if you must change halfway the project. You also need people that can search in the literature and can write a good report" [T2 major bleedings in the street].

Teaching activities

"What about your role as a teacher in this group? Yes, I do not have to do much here" [T2 bleeding].

High novelty-Low usefulness (NovHi_UseLo) including negative student emotions

<u>Student group's challenge</u>

"Children with a cleft lip, also known as a hare lip. These children undergo surgery and then have to rinse their mouth with chlorhexidine. Children experience this as very nasty, so the students wanted to work on completely adjusting the taste of chlorhexidine. For this, they talked to pharmacists and pharmaceutical companies. However, they were very few possibilities to alter the taste of chlorhexidine. All the possibilities that students came up with led to a dead end. Because of this, the students switched to the problem of providing information. *Can you give an example*? Well, the pharmacist just told them, 'that it is a nice idea, but they cannot do anything about the taste of chlorhexidine'. So, it then stopped, that line of thought just stopped. Then students can jump high or low, but if the pharmacy says that it is not allowed to rinse it with another liquid, then it quickly stops. At these moments, students have to shift gears very much from 'if this is not the solution, then how are we going to tackle this problem?' […] *How did the students react?* The students—of course—were very disappointed" […] The students felt bad [T9 cleft lip].

<u>Teaching activities</u>

"At these moments, I encourage students to talk to their stakeholders, think for themselves, ask people around them and brainstorm with others. There are several design thinking tools and I provide students with these design thinking tools. […] Then, I also discuss with the students what it does for them and look at them. I also help them on their way to other possibilities, instead of just referring to things. Often, I say, 'okay, now we are here and that is less pleasant. What could be another solution?' Then we will explore alternative solutions together and I provide students with the design thinking tools to continue exploring alternative solutions. So that students can take another, a better path" [T9 cleft lip].

<u>Student group's challenge</u>

"Students worked on the problem that the alarm button is poorly used by elderly. They (the elderly) leave the alarm buttons by their bedside table or in the shower. And then, students have to figure out why elderly poorly use the alarm button, whether it is a problem or not, and how the use of the alarm button can be improved among the elderly. […] Companies, producing alarm buttons, are also thinking about these kinds of issues. The student group generated several variations with functionality of alarm buttons retrieved from talking with elderly, for example, in a care center. So, the students were on track and the company was their stakeholder. However, at the end, the stakeholder just dropped out. So, in the end, there was no newly developed product. The students wanted to develop a final product, but then there was nothing, except for some well-thought-out ideas that could solve the problem. Student felt like they had no product. *How did the students react?* Yes, the students were—of course—disappointed. There are students who expect a lot from companies and there are students who expect nothing from companies and who get a little. However, in this case, the students expected a lot from the company. They (students) had the feeling that their idea could really be transformed into something, and that the manufacturer would listen to them. So, the students were—of course—disappointed" [T12 alarm button].

<u>Teaching activities</u>

"In my opinion, as a teacher, you have to make immediately clear that it is not about developing a new product and that it does make sense that such a company has something else on its mind. I tell the students that the company takes over your ideas very cheaply. That is fine, view that as a fantastic outcome of what you have done. Because you still produced several ideas and that is your contribution to the problem. […] I think students are fine

with this reassurance. I have the feeling that this helps. If you just relativize those things, but also say, 'look, everything you do has an impact, even if you do not think so. You have talked to a lot of people, you have brought ideas to the manufacturer and if your innovation is not transformed into a product, perhaps the idea will be picked up by someone else. So, it always has an impact what you do. Even if there is nothing at the end'. So, yes, I have the feeling that students find that helpful" [T12 alarm button].

High novelty-Low usefulness (NovHi_UseLo) including positive student emotions

<u>Student group's challenge</u>

"I had a group that went for a technological innovation which was not possible in terms of feasibility. But the students completely went for it and developed a prototype. The problem concerned intravenous infusion (IV). It was about how an IV is especially painful for patients who have to have an IV on their arm for a long time. […] Apparently, the biggest problem is that if something pulls on the IV, it really hurts patients. And then the risk of infection is also higher. So, the students wanted to do something about the problem of pulling on the IV. […] The students came up with a system of a sort of garden hose, a model for the arm. [….] They (students) developed a system with a sort of rolled-up garden hose inside the IV, and if something pulls on the IV […] there is room inside the IV so that patients do not feel it in their arm. […] I do not know whether that innovation is really feasible, I do not really think so, but the students went for it, and they also built a prototype for it" [T11 pulling on IV].

<u>Teaching activities</u>

"I sent the students to a physiologist, so that the students had to think for which types of liquids their solution works" [T11 pulling on IV].

<u>Student group's challenge</u>

"There was a group who were working on the problem of misophonia [a condition where normal sounds cause a psychological reaction]. The students generated a very interesting idea for that problem. […] A headphone-like device that would filter specific sounds out, so (the wearer) could still follow the conversation. The students had all kinds of contacts with technical companies; however, students got stuck because their idea was not feasible without any funding. […] This group really worked on their solution until the last minute, and they kept working on it. I personally think that is a good thing. However, it is also the reality if students work on an innovative idea and they (students) are dependent on third parties, that—sometimes—these third parties do not want to cooperate. The students really wanted to have some type of prototype" [T1 misophonia].

<u>Teaching activities</u>

"But, at a certain point, you also reach a limit. So, I told the students, 'well, you have a very nice idea. You can explain to me very well how it works, and what it should look like. You just do not have the technical expertise to transform your idea into a prototype. That is okay, and it is not surprising. Now, make sure you put your idea on paper as well as you can. Try to add pictures, if necessary, of how you envision it, and then that will be your innovation'" [T1 misophonia].

<u>Student group's challenge</u>

"The father of one of the students had ended up in the hospital and had experienced delirium. A delirium is a dysregulation of your thinking and the brain caused by a serious illness. […] The student had dived into the

problem and learned that delirium occurs with serious illness and procedures. […] And then the student thought, could we come up with something to prevent that? For example, could we measure certain values, put them in an app, and have the app calculate the likelihood of getting a delirium. […] The students spent quite some time on that idea, they wanted to make that idea into a prototype. However, something that impaired their process was that the students immediately worked on the five or ten most important parameters, and not so much on what a delirium is" [T6 delirium].

<u>Teaching activities</u>
"I talked with the students whether they felt that they knew enough about the whole clinical picture of delirium. […] And how would it be to talk to a geriatric nurse, for example, or people who work in the recovery room. […] I tried to give the students some knowledge" [T6 delirium].

<u>Student group's challenge</u>
"Students wanted to come up with something so that children who are in the hospital for long periods of time could still have contact with their pets. The students came up with all kinds of ideas, and the bottom line was that none of their ideas were possible. […] The students were very disappointed. [...] That did something to them, especially because these students felt that they found the egg of Columbus several times in six weeks" [T6 long-term hospital visit].

<u>Teaching activities</u>
"At one point, I noticed that the students were a bit worn out. [...] I asked them then how they (students) were feeling. The students said, 'yes, I hate to say it, but it does affect my motivation'. I replied by telling the students that it was good of them to say this, because that is why I asked about it, and it is very normal that this happens. So that is a bit of normalizing that I do. I also work with the students to see how they can take the next step" [T6 long-term hospital visit].

Low novelty-High usefulness (NovLo_UseHi): total 12

<u>Student group's challenge</u>
"I think those were all women. […] One of those women had asthma herself and they wanted to develop something with an app for your asthmatics. Well, within the hospital, we have two very big examples of that, *Air Bridge* and *Asthma Buddy*, so those ideas have already been developed. [….] Within their ideas, there was just nothing innovative" [T5 asthma].

<u>Teaching activities</u>
"So, I said, 'well, you know, it is great what you wanted to work on, but just be aware that there is already a lot in development for this problem'. I can see whether I can bring you into contact with my colleagues" [T5 asthma].

<u>Student group's challenge</u>
"Students worked on informing people about euthanasia. The students eventually made a poster. […]. The students were all men. That is always bad for the group dynamics, because the students were hesitant, and they (students) did not really have much interest in the problem. So that makes a difference, there is a kind of gender difference. I mentioned that in every group there are always those leaders who quickly take the lead, but those are always women. This group consisted of four men. […] The students had a general practitioner as a client who also

directed the students quite well. So that was also quite useful, content-wise. The students eventually made a poster for the waiting room, something like that. But yeah, now I think, those posters probably exist countless. So, it is not that original either" [T7 end-of-life education].

Teaching activities

"I was not very creative myself at that time, or that I—as a teacher—could push students in a certain direction. That skill only came the next year or in the following years. That you think, oh yes, this is roughly the standard or measure of how we as an innovation project can agree on. For me, that was probably the most difficult year, that you do not know what is expected of us as teachers. […] But it was also the first year of the innovation project, so the teachers did not know stories from previous years. As a teacher, you do not know it all that well yet, so that is difficult" [T7 end-of-life education].

Student group's challenge

"The problem was that a lot can be found on the internet about migraines but aimed at adults not for children. Students wanted to develop something that can provide children with more information about migraines, how it works, and what it does, and the limitations that it may have and how to deal with these limitations. *And then*, *students generate ideas*, *how did that go*? By talking to stakeholders, customers, and patients. In this way, students came up with a book or a puzzle, which eventually became e-learning. *How did that translation go from a book or puzzle to e-learning?* I think mainly because the customer wanted an e-learning. He thought that it was a slightly more practical tool. So, students went along with what the customer wanted. […] So, the students had other ideas, like making a book or puzzle, or something else practical, and they (students) eventually went completely towards the e-learning, also in consultation with their client. Because that was then just a bit easier to work out for them" [T9 children with migraines].

Teaching activities

"I said, 'it does not really matter, if your client wants e-learning, then you make e-learning'. […] I often help students finding a stakeholder. However, these students already had contact with a stakeholder, and that stakeholder provided more stakeholders. Generally, students have contact with the hospital here, but these students had contact with a nurse in another hospital. Normally, I sometimes see the stakeholders and I can briefly brainstorm with the stakeholder about how everything went or ask the stakeholder whether they want to be stakeholders. That was not necessary in this group, because the students did it all themselves. So, then I thought, it is running, and I help the students where I can" [T9 children with migraine].

Low novelty-High usefulness (NovLo_UseHi) including negative student emotions

Student group's challenge

"Another group wanted to do something with walking with crutches. A student had a broken leg or torn a band or whatever and had to walk with crutches for a long time. They said, 'you do not get so tired from walking with crutches, but at the moment you have to stand somewhere, and you cannot sit, you really get very tired'. So, could we design a crutch where you can sit on it right away? […] The students searched for solutions in different directions. Relatively late in the project, students found out that one or two of their solutions already existed. So those solutions were dropped. […] *You mentioned that students found out that their idea already existed. How did the students react to this?* Disappointed of course, but on the other hand also proud that they (students) had thought of something that someone else apparently also thought of as a solution. So, students had mixed feelings.

[…] Although, of course, if you are already at 5 to 12 and you find out that one of the main solutions that you have thought of already exists, then one is naturally disappointed. That disappointment dominates, but the students did not give up, no, not at all. […] The students made a crutch with a kind of tripod on the side of the crutch, so you can just walk with it and the tripod does not touch the ground when you just walk with it. […] I did not think it is the most innovative thing I have seen, but it was quite meaningful, I think. I can also imagine that it could be taken into production at some point. So, in that sense fine, it was not world-shattering" [T2 crutches].

Teaching activities

"I try to get the students excited about the fact that they came up with the solution. And that someone else also thought of it and brought it to the market. And I also tell the students that it is a shame that they did not see it beforehand, but this was also difficult because their solution was not easy to find in the literature and it was implemented somewhere in Japan, I believe. But for some reason, it was not implemented in Europe. So, students might not have been able to find it. Later, it turned out that their solution did exist and then—as a teacher—you try to get the students excited again about the fact that they (students) came up with the solution and that it was actually very successful. *How do you transfer that enthusiasm?* I just think by radiating enthusiasm, and by giving students compliments for having thought of it in that way. […] So, then—as a teacher—you look for other people to talk to your students and then you hope that those people will inspire the students to take the next step. So, by sending the students to a rehabilitation doctor, in this case an orthopedist, by sending them (students) to an occupational therapist. And then I try to talk to those people first, so that they (stakeholders) are prepared for those students. Just a short phone call to introduce the students, and I always feel that if I talk to the stakeholders first, they (stakeholders) are more motivated to take students seriously and make time for them. And I also hope that the stakeholder can sketch the breadth of the problem and inform students about the ins and outs of the problem and that they (stakeholders) can make the problem come alive for students" [T2 crutches].

Student group's challenge

"I supervised a group of women who wanted to do something about population screening for breast cancer. Students wanted to make a mammography less painful for women, because they (students) found out that a mammography is very painful for women with as result that women do not want to participate in such a population screening. […] The students eventually also went to the hospital, because there was a researcher who developed a new paddle which makes the mammography less painful for women. So, students discovered that there was already a solution that existed. They (students) included that in their final report that they (students) did not come up with it themselves, but it was a very good solution direction for their problem. […] Students then focused more on the problem of cultural change, because it can be less painful, but how do you convince women who talk to each other that it is still very painful, even though it will be less so in a few years? […] At first, students were very disappointed when they (students) found out that there was already a paddle developed. Then, the students thought 'can it be less painful in another way?'. Well, the hospital here was also already researching that. […] Every time the students took such a path for another solution direction, it would lead to a dead end. So, the students were a bit frustrated" [T5 population screening for breast cancer].

Teaching activities

"So, I recommended the students to participate in a hackathon where they (student) can spend a whole weekend working on their problem. I advised students to participate in it, because I noticed they (the students) were a bit stuck and then their enthusiasm was also gone. If you notice that everything that you come up with has already

been thought of, the question becomes what you can still add as a student. Student experience quite a pressure to come up with something innovative. It is not called an innovation project without reason, while it is actually a task to learn how to innovate. *What do you do as a teacher to help students with this pressure or expectation*? Yeah, I mostly explain it to students, but that does not always work. *Are there any ways to explain it*? I think I just mention it occasionally when I notice that the students are stuck" [T5 population screening for breast cancer].

Student group's challenge

"Students worked on the problem that patients who receive a stoma in the hospital go home and then have to deal with the new stoma. […] The nurse specialist in the hospital said that they give patients as much information as possible and that patients go home, but always come back. So, that the patients are not well taken care of at home. […] The problem was about dealing with a new stoma. So, it was a kind of transfer problem or information problem between the hospital and home. […] The students wanted to do something with an app to provide information to patients and talked with a home care about this. However, the home care did not recognize this problem at all, so the students felt that they could not continue. *How did the students react?* The students were completely stuck. It stopped completely. […] That was a dead end because that stoma care is completely developed in terms of materials. So, very skin-friendly, not leaking, stomas already exist. So, then the students thought that that was not interesting anymore, so much had already been done. […] Students thought that they (students) had a very relevant problem identified, until they (students) came into contact with home care that did not recognize the problem. Then, the students could not go any further because they (students) thought that home care would be a good stakeholder. […] In the end, students also changed stakeholders. They changed to a nurse from the stoma association, and this person recognized the problem. […] The new stakeholder told the students that their problem fitted perfectly with a development that they (stoma association) are working on at a national level. The stoma association was also working on something with an app for patients. However, their solution was much bigger than students' solution. So, this group continued to develop their solution within the framework of the stoma association. This gave students wings because it made the acceptance and impact much clearer. […] The students are very flexible. The students immediately divided up tasks in their groups and did a Belbin test. This test gives everyone information about their expertise and talent. […] I can remember from last year that students were immediately enthusiastic and started dividing tasks. […] The students had an idea and that was an app. However, an app is not very innovative, but, in this case, it is because it matches the information patients need" [T10 stoma].

Teaching activities

"I have sent the students to the stoma association. But in any case, I also said that there are more sources of information. I personally found it very interesting that home care did not recognize the problem, and of course there are also more home care organizations. […] The students felt like being stuck, and thought they had to find another healthcare problem. But then I said 'No because you have a nice problem. It does not mean that the problem suddenly no longer exists because it is not recognized somewhere else'. […] I tried to stimulate the students to stay with their problem, even if it is not easy or something like that. […] I very much encourage the students to have conversations and go out into the field. And further, there has to be a report, so I sometimes ask about the planning, like 'how are you in terms of planning and are you able to keep up?'. And if the students have some text for a paragraph or something like that, they can send it and I will give feedback on it" [T10 stoma].

Student group's challenge

"The students wanted to work on informing family members about genetic disorders. […] For this, the students

developed a sort of tool, like a triage tool. The students did this after having all sorts of conversations with stakeholders, and they (students) really enjoyed that. However, the triage tool was quite conservative. […] Despite the fact that we also gave workshops on creative thinking in which it has been stated that no idea is too crazy and that is important to generate as many crazy ideas as possible and try to build on that in the concept phase. Just for inspiration for yourself. But you noticed that these women were less open to that and that they thought something like 'yeah, but we already have a direction, and it is good enough. And why would we do more now?'" [T5 genetic disorders].

Teaching activities

"I brought these students in contact with one of our colleagues, a clinical geneticist from the genetics department. That clinical geneticist became the client of that group and told the students what they (genetics department) were running into. […] At a certain point in the concept phase, I said—the students were satisfied with what their idea of the triage tool—something like 'this is actually quite easy, this was actually a little bit known already and have you (students) explored other solution directions? Or can it not be better or more innovative?' I said that, because their idea of the triage tool was an improvement, but the students had made it too easy for themselves. […] In the end, I really pushed the students and brought in some ideas myself" [T5 genetic disorders].

Low novelty-High usefulness (NovLo_UseHi) including positive student emotions

Student group's challenge

"The students worked on differentiation in heart rehabilitation. So, people who had had a heart attack and then had to rehabilitate. With two of those students, the father had experienced something like this, and one of the things the students learned was that rehabilitation often takes place in groups. But within such a group, there is relatively little differentiation within treatment. One of the fathers was actually a very fit person, so he wanted to move faster than the rest of the group. So that father was held back in his rehabilitation. […] In the end, students developed a kind of prototype on paper of an app. The conversations that the students had with patients revealed that an app was the most convenient solution. That patients have something on their phone. […] Students were initially puzzling with whether they could bring differentiation with a card game or dice game. The students thought that was a fun idea but realized—after conversations with patients—that an app is more convenient and that it is a functionality that really adds something on existing solutions. Yes, it is a good idea. *With this group, the students were testing the game idea among patients, and they (students) realized that the app was more convenient. How did the students react to that?* Students then have to make a change, but the students mostly felt relieved because then they (students) have something" [T7 heart rehabilitation].

Teaching activities

"The students discovered that there was a big advantage with the app, and then I also tell them that it is a very good discovery. Because through such an app, patients can also communicate with their physiotherapist and other care takers. Students can build in a communication functionality, so that patients can consult care takers through a chat function or something. And that confirms that that was indeed a very good idea. […] My role as a teacher is to bring the students to those kinds of ideas. So, I encouraged students to go to patients to check and test their idea. That is how I remember it. There are different solutions, you can think about different ways of what can be added to the app. But let's present it to the patients for whom it is intended. I encouraged students to talk to the patients about it. Then, write down what the patients think, because then you have a basis for your solution in this innovation project. So that also means that I stimulate students in a substantive way in the process. […] That I say,

'this is how you could approach it', because sometimes students find it difficult to come up with the next thing themselves" [T7 heart rehabilitation].

Student group's challenge

"The students wanted to work on providing basic life support to high schools. […] Some studies show that people just do not know what to do in an emergency, especially younger people. So, you need to inform people about basic life support knowledge before they get their driver's license for example. So, the students generated the idea to involve high schools. […] The students were so convinced of their own idea that they made twenty very short videos. Like very easy first aid procedures for students. […] It was not super innovative because the sources that students used were from the Red Cross. So, in terms of innovation, it was not that high. But the students were super enthusiastic about their own idea, and they (students) shared all those videos" [T11 basic life support].

Teaching activities

"As a teacher, you also do not want to limit that (student groups' enthusiasm). So, I know that it will not be really innovative, and that the students will not make a big difference. But the students are so enthusiastic, and so into it. And my role as a teacher is then not to discard or reject the idea in some way, but simply to support the students in taking the enthusiasm of the project with them" [T11 basic life support].

Student group's challenge

"Last time I supervised a group working on the inventory management of nursing homes. […] The students quickly came up with a solution for an app that would scan and manage inventory. [..] The students already envisioned their idea and they (students) had already made a few screens. So, they were invested in the idea, and the app eventually became their proposal. By the way, it was well put together, they really worked it out well. However, I do think this is a very concrete example of where students did not really give a chance to alternative solutions and did not take advantage of what was possible in those alternative solutions, which could have improved their app. [..] This is partly caused by time pressure. Students have limited time, and if they (students) have a solution that seems to solve the problem, it is better than possible alternative solutions that the students are not sure of whether they will solve the problem. I think the main problem is that students do not take the time for it. Or students do not get the time for it. And I also think it is partly caused by uncertainty. Just as students know for sure that their idea of an app is something, all those alternative ideas—that still need to think off—are uncertain. You definitely see this with first-year students. The first-year students really want to do it by the book, and they just want to have something. Something good, something certain. And all those deviations from their idea, all those thinking steps outside of that feels like a distraction and uncertainty for the students" [T3 inventory management of nursing homes].

Teaching activities

"I asked the students if they had thought about alternative ideas, what else could you do? And if I recall correctly, the students did come up with something, but they did not really give it a serious chance" [T3 inventory management nursing homes].

Student group's challenge

"The students noticed that older people often experience loneliness with various effects on their health. […] The students wanted to do something about loneliness among elderly people and they (students) came up with the idea

of an app. Something like Tinder, but different, where the older person is one party and on the other side, a young person, student, or something like that, who wants to do something in the field of caregiving, play a game, do a task or something like that. And the students were really into that app, and it was very difficult for them (students) to get away from their idea of an app. […] Because the students were very focused on making this app. The students were already considering whether they knew someone to build their app. One of the students' classmates from high school is studying computer science and might want to program the app for us. And the students came to me in this state in November. *And it starts in November*? Yes, and this was basically the introduction. So, the students were already fully invested in their solution, without having the problem clarified. […] However, then the students realized that an app is difficult for older people, and that it is likely that someone else has already thought of this idea. And then the students started to question their own idea. […] What the students did next is that they (students) said, we see that older people are lonely, including during this lockdown, and that high schools are running out of internships, social internships and so forth. What if we (students) talk to a high school, or to students in social studies, and these students can do something with an older person. So that we (students) do not develop an app, but as an older person, you can contribute to a high school students' education, and a high school student can mean something for that older person. So, the app was never developed. […] I sometimes see this tendency among students—as is clearly evident here—to think they have an idea, the app, that is an idea. But there may be twenty more ideas to come up with. But students think that their first idea is good enough, so they will continue with it. While students could also say, it is an idea, it goes in the pool of ideas, and we add more alternative ideas to it. And then, we think and walk around this pool of ideas, and talk to each other about what we consider important criteria. And then you pick one idea out. And that is actually—what I think is—the best way. […] At the moments when the students started making contacts with stakeholders. […] That was during the lockdown period, so the students often did not get an answer. Or then the students were allowed to talk to someone once, and it was still canceled. […] And then I noticed that the students tended to go back to their first idea of an app. Because that idea was also in their innovation proposal, the students had already pre-sorted on the app" [T6 loneliness of the elderly].

Teaching activities

"Well, first I listen to the students, and then I told the students that the idea of the innovation project is not to come up with a solution and implement it, but mainly to go through the academic exercise. So, you move from practical to a theoretical framework of the problem. And then look for theoretical solutions. And then bring that back to reality. So, it is something to investigate, what lies behind the problem of loneliness? I then gave the students some literature suggestions, and also asked what they themselves could think of for ideas. The students came up with questions like, can we find statistics on loneliness, can we find stories about loneliness? Then I said, "I have an idea for a search term. Look for loneliness and health effects, there is a lot to be found about that". […] It was the next meeting when I told the students, "if you put your idea of an app in the fridge, and look at it, we have now found several effects from loneliness among elderly people. We have learned something about diabetes and cardiovascular diseases". The students then approached their problem like this. Sometimes they (students) came back because they were restless. They felt uncertain whether they would still have enough time for their app. […] In this way, I tried to give the students something to work with, some knowledge. There is—for example—a lot of literature about health effects. […] At some point, the question was raised, "could there be a barrier for older people to use technology (like an app)? And how can you make a solution from two problems? For example, that the flood simultaneously extinguishes the forest fire". And then, the students came up with the idea of linking high school students to lonely elderly people. So, I pointed them (students) in that direction, but I did not dictate or

think for them. I just guided students to look creatively and innovatively at what you can do. […] Letting go of what they (students) already think and looking again with a different lens to the problem. These conversations with students are always very interesting. Like, 'okay, you have generated a solution, and we will not evaluate whether it is good or not. But are there more alternative ideas?' So, first the focus on quantity and then quality. […] I also reward students for coming up with crazy ideas. *Can you give an example*? By acknowledging and telling students, like 'wow, that is a really creative idea'. Sometimes I even challenge the students to make their idea even crazier. For example, with the problem of loneliness among elderly people, students were discussing how people in nursing homes are lonely. I asked the students, 'who here lives in a student dorm, ad how is that?' Students hang out in common rooms or in the kitchen and make small talk. I asked the students, 'what if we turned nursing homes into student dorms? Because in that way, elderly people could live together'. I took students back to the innovation proposal in which they (students) had outlined the problem and explored possible solutions. I assured the students that if they went in a different direction, that this was fine too. That is part of the innovation process. I had to reassure the students a few times because they were getting worried that they were not getting any answers from stakeholders in the field" [T6 Elderly loneliness].

<u>Student group's challenge</u>

"I supervised a group of students that wanted to work on hand hygiene and immediately wanted to make an app. […] It is known that hand hygiene is not well practiced in hospitals. I have seen students working on this healthcare problem in the innovation project for a few years now and students immediately say. 'we are going to make an app', because then they know how to do it. But the question is whether that is the problem. […] *How do these students react?* These students were actually very good. I have also had groups that were a bit disappointed who thought they had already done a lot and were actually not that far. But these students responded like, 'oh yeah, we did not see it that way, that is actually a valid point, let's do it and it can still be an app'. […] And then the students indeed found out that there were already a lot of apps and tools for this problem. […] But then, the students always come to a point where they (students) are hugely disappointed, because they (students) found out that everything had already been done. […] So, they (students) did not do the app anymore. The students eventually made a game" [T13 hand hygiene].

<u>Teaching activities</u>

"I then told the students that it is definitely a problem, if it was already solved, it would not still be everywhere known as a problem. But also inform the students that a lot has already been done, so I encourage them to first find out and ask around what has already been done, then see if you can find the gap, bring the pieces together so you can come up with a solution that has not been done yet and adds to solving the puzzle. Then I usually ask the students with whom they (students) think they can talk to, and then I try to add on that or let the students think of who else they (students) could talk to. […] I tell the students that their solution could always be an app, but first make sure you thoroughly explore and discover the problem. And the students actually thought that was a good idea. […] However, I see that a lot too that students are disillusioned because they (students) discover that everything has been done. Then, I tell the students that their problem is a rightful problem. It is still a problem, you also found that out. So many people in the hospital still do not follow hand hygiene, so all those existing solutions are not the solution to this problem" [T13 hand hygiene].

Low novelty-Low usefulness (NovLo_UseLo): total 7

<u>Student group's challenge</u>

"Elderly people who drink too little water are easily dehydrated and this is bad for their health. […] The students' lifestyle approach was that we need to make elderly people more aware that they are at risk of dehydration. […] The students, for example, came up with the idea of a smart drinking cup. And the students wanted to integrate the cup with e-technology and e-health, so that the smart drinking cup would tell elderly to drink more. […] However, the students abandoned the idea, because it has already been thought of several times and it does not work, it is expensive, and it is typical tech-optimism that does not fit well with the elderly population. So, then the students abandoned that path" [T14 dehydration elderly people].

Teaching activities

"And then I also said to the students, 'have you already checked whether that idea does not already exist?'" [T14 dehydration elderly].

Student group's challenge

"A student had a certain illness as a child and had to get injections very often and was extremely scared of those injections. And so, the students wanted to come up with an innovation that would make children not so scared of injections. […] You can for example distract children by playing a video or something or they watch Donald Duck, and at the same time they get injected. You can also distract them with a teddy bear or something like that. But the students evaluated those solutions and concluded that this is not an effective solution yet, because they (students) were working on the fear of needles in the acute phase that children have to be injected, like in the emergency room. And then, nurses do not have a cuddle or a video, because there is no time for that. The needle immediately goes in and that generates the fear among children. So, the students wanted something different as a solution. […] This group came up with another solution and then presented it—again—to the nurse in the emergency room. And the nurse told them, 'you have not thought about this and that, because your solution is not going to work. So, you will have to do it differently'. So, the students went back to the drawing board and tried to come up with a better solution. […] The students came up with the idea of letting the young children in control how they (children) would like to be injected. So, there is a choice process in which the injection needle was processed in a Disney doll where the needle itself is not visible. And the children could then choose between different dolls, giving them (children) more control over the injection process. […] *How did the students react to the feedback from the nurse?* Well, the students actually loved that. That they (students) have someone in practice who thinks along with their topic. Who can also just say something about it, who provides relevant information. Of course, sometimes it is indeed a bit of a disappointment, if a stakeholder says what you came up with, that is not going to work in practice for this and that reason. But students generally find it great when they (students) can talk to people in practice or on the work floor. And refine their idea with the stakeholder or maybe even completely change their idea. That is a bit sad, but most of the time the students still experience it as positive" [T2 fear of needles].

Teaching activities

"When the students started to work on this problem, they wanted to develop a solution for young children. But then I think, you have not thought at all about the precise age of the child. […] So, if you—as a teacher—ask students such critical questions, the students will think themselves, oh, what we thought may not be entirely correct, we have to do something else. […] So, yes, I always try to think logically. I feel a little bit like a multifunctional stakeholder. […] Yes, then I encourage the students to first talk to a nurse at the emergency room. So, then the role of the teacher is to make that possible. So, I will make contact with someone from the emergency

room and ask if the students can come. In this case, I introduced the students to a pediatrician from the children's center here, because he knows a lot more about what and why of the problem. So, the role of the teacher is important in the mediation or facilitation field. […] *And after the feedback from the nurse. Was there a role for you as a teacher?* No, not really. I did not really have an active role anymore, but students kept me informed. The students started communicating more with the nurse and the pediatrician and did not really need me anymore" [T2 fear of needles].

Low novelty-Low usefulness (NovLo_UseLo) including negative student emotions

Student group's challenge

"A group that comes to mind is a student group that worked on nutrition. They asked themselves how it could be that people with diabetes eat so unhealthy, so the problem is that people with diabetes cause part of the condition and the misery themselves by eating unhealthy. That is especially a problem among lower educated people and people with a migration background. So, the students felt that they (students) have to make a change here. And then, the students came up with the idea of cooking with those people in the neighborhood. I then thought whether the students could think of something else. Because it is a nice idea, but how is this idea innovative? Of course, it has already been done that people cook with these people in the neighborhood, what is new about that? Nothing came out of the students. […] It was a bit of a hassle to get something more out of the students. […] In the end, the students did a number of fun things with my suggestion to do some things online. The students made short videos with very simple advice. The students were then faced with the question what the most prominent problem is with nutrition, what foods are we talking about, maybe you just have to be concrete—besides cooking something healthy—be clear about what is allowed and what is not. So, the students then recorded short videos in which they all played a role promoting specific foods. The funny thing is that they had the most fun if they did come up with something. […] I noticed that if the students came up with something they had not thought of initially—which they thought they would never get done—that gives the students the wow feeling. Then they (students) feel that they have achieved something" [T12 unhealthy eating patterns].

Teaching activities

"I recall that together with the students, we thought of several suggestions which were scalable. The initial idea was that students would go cook for people in the neighborhood, which is fun, but then in the long term, how sustainable is that innovation? And how innovative is it really? So, then the students have to think about how to go a step further, how to make it work in the Netherlands? How to ensure it can be shared in another way besides students traveling through the whole of the Netherlands. […] So, I just asked the students, 'so, you have to come up with an idea. What exactly is the innovation here?' I usually just ask it like that. And then I say, for example, 'you want your idea to be applicable in the long term. So, if you look at everyone involved in this problem, have you analyzed the stakeholders and students whether your innovation will succeed? Is it feasible to expect that all students will do this?' […] However, not much response came out of my questions, so eventually I made a few suggestions of what the students could do. For example, 'can you think of anything that can be done online—that a few people can do online—which can be used very often?'. […] And in this way, you can make the message available in different but very easily way to people with a lower education or migration background. […] Well, I try to encourage the students to look further and to ask people again and again. And to dare to. […] I also tell the students that 90% of all your innovations ultimately will fail, that is not a problem, but you just have to dare. And you have to do something that you actually think of that it will succeed. Otherwise, it is not an innovation. So, you really have to dare to think creatively and sometimes go outside your comfort zone. *How do students respond on*

this? Some groups do it very naturally and with other groups it is just a little more difficult, like with this group. But eventually students do it and then they also say afterwards, yes it was actually very fun to be involved with this innovation process. […] I also encourage the students to think of ways how they (students) can get their initial idea, which requires a lot of effort towards less effort. So, their idea for cooking clubs for all people with a low SES and diabetes. This is not feasible for all medical students in the Netherlands. So, if you think medical students are going to help people with diabetes cook in the evening. […] That could be something that you might say has a medium impact, but the efforts are gigantic. So maybe this is a good innovation, but then you have to think about how you can move it so that it has the same effect with much less effort. So, the suggestion of, can you come up with an idea where you do not have to send students to the neighborhood a thousand times, but change something where you do something once and then students virtually go to the neighborhood, do a cooking program on TV or something else. Then students have much less effort with their solution with equal impact" [T12 unhealthy eating patterns].

Student group's challenge

"There was a group of students who wanted to do something about the recycling of medication. They (students) wanted to do this, because a lot of medication is thrown away and not used. However, the law inhibits the reuse of medications as there is a danger to it. This group of students wanted to do something about it, but they did not know what and how it should be done, as the law was an obstacle. Furthermore, if you want to recycle medication, it often costs more than just throwing it away. We are not talking about immunotherapy that costs 100,000 euros per year, but about normal medications that cost a few euros. You often need staff to manage and run such a recycling process, and the cost of the medication does not outweigh the cost of such a person. […] Students did find out that there were certain groups of medication that could be reused if certain conditions were met, such as the box not being opened and so forth. It was a difficult subject and students did not really come up with a great innovation, but for a very small part of the medication, recycling was possible. […] The students really struggled with this healthcare problem. The problem is really relevant, but the students talked to people in the field and then they (students) became a little disillusioned because the stakeholders said that the recycling of medication is not allowed by law. Then, the students dived into the law, and read the law again and looked for any openings in the law. Every time, they went back to the stakeholders, but stakeholders repeatedly told them that it will not happen in practice. So, the students got more frustrated every time" [T2 recycling medication].

Teaching activities

"I then brought the students in contact with various people from different pharmacies, to talk to these people to see if there is still an opening somewhere that could be used for the recycling of medication. […] *What is your role as a teacher?* My role is to try to keep students' enthusiasm up and to inform students that working on complex healthcare problem is not simple. If it was simple, then someone else would have thought of a solution already. […] So, per definition, it is difficult, and it is challenging. So yes, I try to keep the students enthusiastic. So that is probably the most important thing and that the students still see it as a challenge to come up with a solution anyway" [T2 recycling medication].

Low novelty-Low usefulness (NovLo_UseLo) including positive student emotions

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Student group's challenge

"In the first meeting, the students came up with sort of a solution for their healthcare problem. I noticed that the students thought more from a solution perspective than from a problem perspective. The students thought that

their solution did not exist, so it should be created. Students often come up with an app as solution. The most thought-of innovation is an app, and that was the case with this group as well. They came up with the idea of a website with Wikipedia information, like a Wiki-like website with information. According to students, there was a lack of information. But which problem is that website solving? Is there a problem? The students wanted to set up an information website for children with tracheostomies. However, that group is very small, and it is very rare. So, the students talked with medical specialist, and the specialists told the group that it was a very small group of patients, and that they already provide very good information to the patients. So, the specialists thought that the students would make a lot of effort for little return. Then, the students dived much deeper into what actually the problem is of tracheostomas, and why, for example, tracheostomas leak and get infected, and patients need to stick it with plasters. Then, the plasters irritate or do not work well. The students talked to a medical expert, and the expert confirmed that there are many problems with tracheostomas for patients. Then, the students concluded that the biggest problem is that a tracheostoma does not stay in place well and irritates. They decided to come up a solution to keep a tracheostoma better in place" [T4 tracheostoma].

Teaching activities

"Then, I will initiate the conversation with students to ask them what the problem is that they (students) are trying to solve. That is also how I look at it, how it should be. Students must first analyze very well what the problem is, and only then look for solutions to that problem. But also, students should have a certain level of support for their solution among their stakeholders. […]. I think my role was especially present in the conversations with students. To let students much more think about what the real problem is. And to ask students questions, like 'what do you already know about it?' […] This group with the tracheostoma, they had been switching back and forth between different problems. On the one hand, patients experience speaking problems with a tracheostoma. On the other hand, there was a problem with the plasters to keep a tracheostoma better in place, but also the leaking and infections of tracheostomas. So, there were multiple problems, and therefore also multiple solutions. And the students then had to choose. I mostly directed the students to tackle the problem that is most urgent or largest. So more to make a choice based on the problem. […] With the idea that with that solution you can have more impact" [T4 tracheostoma].

Student group's challenge

"Initially, that student group wanted to make an app. As I understood from somewhere, about 80% of all students want to make an app. The students came up with the problem of medication non-adherence in patients with kidney failure, and they (students) specifically wanted to target teenagers, the toughest category. For these teenagers, the students wanted to develop a new app that would give some sort of loud alarm if patients did not take their medication. However, there are already a lot of apps like this. […] And then the students switched to informational videos instead for teenagers. This was done because the students found out—during their conversations with a psychologist and all their gathered information—that an app did not add much value. The problem was not there, but there was a gap in the information patients received about the importance of therapy adherence. So, the students took that into account and eventually worked it out into an informational video. So, the students started with an app, but ultimately did something else based on input from stakeholders and patients" [T9 medication non-compliance].

Teaching activities

"The students wanted to develop an App. I told them (students) that they can, that they are allowed to do that, but

that they have to think about what value the app will have compared to all other existing apps. I also encouraged them to talk to these teenagers themselves, because they (teenagers) can easily ignore the app. […] At first, the students thought their idea would be very different, and that it would really be better than other existing apps. Then I supported the students and told them to go ahead and keep researching your app. So, then I support the students, so to speak, but I still want to say to them, 'test it with the patient for whom you are actually doing it. Because if your product is ready, and it does not match the wishes of your customer or the wishes of the patient, then you can innovate as much as you want, but then the goal is more the innovation itself than the product'. […] I support students because I still want to try to keep them (students) motivated. So that they do not immediately think, well, this app is nice but everyone is doing that and it is not going to work. The students have to discover this for themselves, like maybe this is not the ideal solution. I can tell the students that, but if they (students) experience it themselves through conversations with stakeholders, it also comes from them. And then it is better, so to speak, for the student's process. […] Yes, with that app. So students need to be able to let go of their idea, they have to be able to let go of their solution, because the solution may be different from the app that you initially wanted to develop. First, really go deep into the problem analysis, and then keep all options for possible solutions open. *Does that work?* I think so. Otherwise, I would not advise it to students" [T9 medication non-compliance].

Student group's challenge

"I also once had a student group who wanted to make people in wheelchairs, with a disability, more socially skilled. People in wheelchairs are often lonely, and the students wanted to do something about the loneliness of those people. […] The students immediately had a solution of making a social platform, like a café, and then all those people in wheelchairs will come together in that café. […] In the end, students went back to their idea of a party, but the party consisted then of people with and without disability. Everyone at the party had to be seated, so that no one talked over the heads of people in a wheelchair. So, the party was mixed, but in a fun way" [T13 loneliness among people in wheelchairs].

Teaching activities

"Coincidentally, I supervised a PhD student in a wheelchair, so I asked the students whether the social platform is really what people in wheelchairs want. Because your healthcare problem relates to people in wheelchairs, but I do not think that the people in wheelchairs want that (social platform) at all. […] So, I asked the students whether they (students) have asked the people in wheelchairs about that. The students admitted that they had not spoken to people in wheelchairs about their idea. Later, it turned out that this was not really their (from people in wheelchairs) problem. […] The students eventually spent a day in a wheelchair to see what people in wheelchairs were facing in daily life. The students went by public transportation. And then the students came back with a list of a hundred points. And the students said that they did not know anymore what to solve. *How did that go?* Then I told the students that they (students) can choose one of those points, it does not matter that much which of the points you choose. […] I tried to make the problem smaller for students, because it is impossible to develop a solution for all disabled people around the world. [...] I told the students that they do not have to solve the problem for the whole world but think about how you solve a piece of the puzzle. […] The students were maybe a bit less confident themselves, so they listened more to my advice and then went ahead and did it" [T13 loneliness among people in wheelchairs].

Group dynamics: total 6

Student group's challenge

"The students wanted to work on informing family members about genetic disorders. […] And they (students) developed a sort of tool for this, a triage tool. […] However, there was one man in the group who always had great ideas, but he was actually ignored by the women every time he spoke up" [T5 genetic disorders].

Teaching activities

"At some point, I did say something about it, like 'you know, every time he comes up with something that is maybe strange or weird, you should actually try to build on it instead of cutting him off or saying that it cannot be done, because he really had some pretty funny idea directions'. […] So, at some point, I actually mention it specifically. I said that I did not think it was fair that every time he came up with a crazy idea, the students would make fun of it or ignore it. Because the ideas he came up with were sometimes not entirely usable, but at least he was thinking further than what was already there. He had the courage, he took risks. […] In the end, I also included this remark in my evaluation towards the students. I also told him (the man)—in the end—that he should have more confidence in himself and that what he was doing was good, because I noticed that he became insecure about it and at some point, gave up, which is actually a shame if that happens in groups" [T5 genetic disorders].

Student group's challenge

"Once, I had a student group that worked on preventing noise-induced hearing loss during festivals, these students were stuck at one point, but they had come up with a nice questionnaire to measure noice-induced hearing loss. […] The students discovered that many things had already been done; there has already been a lot of research into noise-induced hearing loss. I thought they could get an earplug manufacturer involved to make these earplugs available to them (students), but this turned out to be more difficult. […] 'How did the students react to this?' Within the group, it was quite varied. Some students could deal with it, while others became a bit angry and recalcitrant. […] This was a student group with one man and four women. The man was completely overshadowed by the women. He did not get a single chance to advocate ideas with these women, although I noticed that he had very good ideas. He also became very frustrated in the process because his ideas were not heard" [T13 tinnitus].

Teaching activities

"So, I asked the students what happened, and then the man also said, 'I am not allowed to say anything in this group'. Ah, yeah, and then the women immediately were on top of him and said that he could say anything in the group. Then I said, 'look what is happening now'. Then I tried to describe to the students what is happening in their group. And I told the students that he now gets to say something in the next ten minutes and you all have to be quiet. […] So, I try when I see this problematic group dynamic then to discuss this in the group, yeah, I try to break it down" [T13 tinnitus].

Student group's challenge

"Eventually, students moved their problem to working with postpartum depression among women giving birth. The problem was that women are often diagnosed too late with postpartum depression, and they (women) should be diagnosed earlier when they experience depression symptoms. […] Then you always have one or two students who suggest an idea direction. So, you always have students who are more proactive and come up with an idea. The rest of the group then thinks about that suggested idea, and when a student has suggested a nice idea, and the rest sees the benefits of it, then the students dive deeper into the idea. So, at the moment that the suggested idea seems like a good fit, then the students—as a group—put their shoulders to the wheel. The students unanimously express themselves in favor of the new idea. […] It is often that an idea comes from one student. So, perhaps, it is

better to state that students ultimately come up with the idea. And these students are often the more articulate types, the ones who are more dominant in the discussion. And the quieter ones, they can critically investigate the idea. They (quieter students) can also come up with good input, but my impression is that they (quieter types) come up with an idea less quickly. *Do the quieter students take over those ideas?* Yes, the quieter types will probably do further research on the proposed idea and often conclude that it is a good idea. At the moment that quieter types do not agree with the proposed idea, they (quieter types) will also say something about it. […] Eventually, one student brings up the idea that students continue with. In the beginning, multiple students can propose ideas, but you often see that there is one or two students who propose ideas. Eventually, the group chooses for one of those proposed ideas. And the quieter students, who do potentially just as useful work in a team setting, are then a bit less present. […] For the problem of diagnosing postpartum depression earlier among women, an app has been proposed as a solution. In this app, women would receive a questionnaire every few weeks to examine if there are symptoms of postpartum depression. […] *What do you think of the idea of an app?* There is often room for innovation through an app, but its attractiveness depends very much on the target group. For example, if you work with weakened cachexia patients, you should not come up with an app. In contrast, another target group, is a generation that often has their phone in their hands, like young women who just had children. For this target group, an application is an easier route than e-mail. So, attractiveness of an app as solution depends very much on your target group" [T8 diagnosis postpartum depression].

Teaching activities

"I mainly ask a lot of questions of course. I also let students explain to me the need for an app and how it is linked to innovation. I keep asking the students how stakeholders elsewhere try to solve this problem. For example, how is it done in other countries? Is it worse regulated in the Netherlands than in other countries or is it everywhere the same? Do you think that women will fill in the questionnaire, or how often do you think women will fill in the questionnaire? […] I noticed that I take a more critical stance towards wild ideas that students came up with and from which I think that it is not going to happen. […] I think students can better work out a smaller innovation really well and implement it in practice, instead of having grand plans that are not realistic at all. So, I noticed that I often steer students towards smaller innovations that are feasible and applicable. An example of this is this group that eventually came up with a small innovation. […] It was actually an existing questionnaire that the students copied, and the students wanted to conduct this questionnaire more often among women. [..] The students even wanted to implement the questionnaire after the innovation project. But then—as a student—you do not want to keep making improvements to the questionnaire. Therefore, I was very critical towards students and ultimately encouraged students to take an existing and validated questionnaire that they would repeat over time, because that is more feasible. This was also done in agreement with the stakeholders. […] The students also received feedback during a workshop in the innovation project. […] The supervisor of that workshop did not think that their innovation (repeating questionnaire) was very sexy. And, of course, I agree with that, and that is of course a consequence of the process. So, I look very critically at what is really feasible, and what can be carried out by students" [T8 diagnosing postpartum depression].

Student group's challenge

"So, the intravenous infusion (IV) shifts sometimes, and the students wanted to ensure that the IV would not easily shift anymore, so that nurses can secure the lines. The students had come up with a kind of 3D fixation construction on the arm. That idea was proposed by the woman who had done HBO-V (prior education) and who was quite dominant in the process. *Was this their first idea or were there other ideas?* Uh, no, so this idea was quite

dominantly carried out in this group. […] In this case with the group working on shifting IV, one student had already done HBO-V (prior education). And, indeed, that person will also handle the contact with the stakeholder. […] Because she (dominant student) has already worked in a hospital, so all contacts go through her. However, the problem and solution are then written up by that person, and the other students in group just hang around and do not get the feeling that they can and are allowed to do a lot. […] It is an example of—which I think—one student that is quite dominant in the group and she pulled that group across the finish line by herself" [T13 shifting of IV].

Teaching activities

"I encouraged the students to openly discuss this idea, and to discuss the problem and whether this problem is different at the Intensive Care Unit (ICU) than at the geriatrics for example. […] This group, I think, consisted of only women, and these women went really along with her (the more dominant student). So, I tried to discuss their group dynamic and I also tried to give room for those students who possibly have trouble with this dynamic. However, that never came forward in these talks. […] So, I tried to encourage the students to talk with stakeholders and figure out whether their problem is the same in the ICU as in geriatrics. […] I tried to encourage the students to think a bit further and also to identify the weaknesses of their idea. I also ask questions, but that does not always work. […] And this pattern is very difficult to break, even if you—as a teacher—make it discussable. Because the dominant student also has most of the knowledge and the contacts in the field" [T13 shifting of IV].

Student group's challenge

"The question was how the environment at the pediatrician in youth care could be built as patient centered as possible. […] The students have chosen a quite conservative approach. I encouraged students to talk to several people who also have experience with healing environment, so who can really provide a substantive background as well. But what came out was quite conservative according to me. […] As a solution, the students chose pictures and furniture that they (students) will use in the healing environment. […] This complemented with wallpaper that looks like a forest or something like that. The students also wanted to use a big screen where a few things would be shown to the patients, and music. […] So, this solution was really limited in terms of innovation, I would say. [..] My feeling is that students had imposed restrictions on themselves, of what is feasible and what is not. I do not know exactly what the dynamics were in the group, but from what I saw, I think the students were a little more reserved than other groups. Let's say that this group was less active than other groups. So, I often felt that I had to encourage and confirm the students in their own skills. […] Students need to trust in their own crazy ideas, and this trust was missing in this group. […] I think, as teachers, we can support and encourage their trust, but it also depends on the personality of those students, to what extent do the students trust their own ideas? Students need to trust their own ideas, but they (students) also need to trust in themselves and that they (students) can share their ideas within the group. And that they (students) can also make other students enthusiastic about your idea because I think it is enough if there are one or two students who look at it from the sideline. And if students do not have much confidence in their own ideas, it is also difficult to defend your ideas for such a group. […] So, I encouraged students—in that group—to give feedback to each other. In every group, there may be one or two students who are quieter, and some students who speak more loudly. […] Of course, in every group, you have different personalities and different egos" [T11 healing environment].

Teaching activities

"I told the students, 'if there are already pictures, then it is already made. So how can you go a step further in your

idea development?' […] The students really wanted to do it well. […] And I told the students that perfectionism is their enemy if they are developing ideas. That is really not what you want at this moment, because if you want to do it perfectly, it does not work with your prototype, it also does not work in the idea generation process. So, you have to break away from perfectionism, and to what extent are you open? […] I tried to really emphasize in students' idea development that it is not about perfect ideas. Students need to generate a lot of ideas first, and there is no wrong way to do that. So, it is just about putting things together, and then you can also use those crazy ideas—that you might never be able to do—to adjust your ideas. So mainly an encouragement process. […] So, one thing is that you try—as a teacher—is to encourage students so that everyone can bring in their own ideas. So, if it happens that students are sitting together, you—as teacher—try to bring the students in the conversation from time to time who do not say anything. As a teacher, you do not want to do that too much, but you also want to feel that everyone can contribute something. The second thing is that as a teacher, you really say to students that they (students) have done a great job and that the students are in the creative process. So really just encourage how their process is going. So, I think that is what students also like to hear from me for confirmation. Because the students put time into it, they (students) do not know exactly what they are going to do. And I think it is very important that students hear that they (students) are actually doing it well, and that you—as a teacher—also appreciate their effort. […] I think what is important, and what I always give back to students when we do these feedback rounds, is that not everyone in the group should behave the same way. It is actually very important to have different perspectives and different people with different skills. So, it is about taking as many perspectives as possible. So, I also tell the students who are a bit quieter that what they are doing is fine. You do not always have to be on stage, but just make sure your ideas are also heard. So, if you feel like you can also contribute to this group, then it is fine. You do not always have to do it as the first person, but you just need to make sure you are heard. So that is important. I tell this to the students in one-on-one conversations, so they have the chance to say what they feel. […] My feeling was that students really thought that their idea was innovative. And this is what I mean, it also depends on your own experience. I said at a certain point to the students that they (students) will find a lot of images, so there are already examples of this, but maybe you can look further. And then I had the feeling that the students could not find any other more innovative solutions. And then I stop, because my role as a teacher is not to say that it is not innovative. Like 'that is really boring, do something else'. No, my role is to try to stimulate the students, and if they (students) get really excited about developing new things that is fine. But if you see that it is really difficult for the students, and if they feel that it is innovative, even though you think otherwise, then it is a choice that students make. I am not a member of the group, so I only try to support the students" [T11 healing environment].

Student group's challenge

"The students came up with something of an interactive information platform. However, I think that their idea was also driven by their stakeholder. One of the women in the group worked at a call center. It was a sort of bureau that provide advice to people with rheumatism. This was an easy link for the students, and she asked this bureau to be their stakeholder of the problem. This bureau was very focused on providing information to people with rheumatism with a digital platform. So, for the students, there was not much choice in the idea, because the stakeholder already had a preference. […] Because the student worked there, she (student) became dominant in the process. It was an easy link to a stakeholder. However, that dominant student immediately took the lead from there and she (student) also felt a sort of responsibility. Personally, I do not think that is a healthy relationship. A student who has a part-time job, but her employer is also going to guide and evaluate the innovation project. Of course, that dominant student wanted to deliver a good product to her employer. The dominant student definitely

took the lead there. In this case, it went well, but it does not have to go well. The other students did not dare to say, 'hey, why, or should we do this now'? […] For the stakeholder, it was very clear, he had an interest in the solution students would be proposing. Because of that, he was steering the solution. *What do you mean by steering the solution?* The stakeholder owned a company that delivered telephone advice to people with rheumatism, and he wanted to make a digital platform for this, and this was actually the product that was supposed to be developed" [T4 rheumatology].

<u>Teaching activities</u>

"I think I mainly encouraged students to find out more about the actual need for information. Where is the lack of information, and what should the information look alike? […] If a stakeholder has a very clear idea about the problem and possible solutions, they (stakeholder) can be very directive towards students. And I expect that students will be very sensitive to that. Because then someone is the client, and you have to be accountable to them. And if the stakeholder wants A or B to happen, then you do A or B. But actually, the students should then say 'why? Is there even a problem?' The students should ask the same questions that I ask them" [T4 rheumatology].