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# Promoting institutional collaboration through a joint project-based learning course: a case study of upper secondary school and university students' experienced relevance

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There is a great need to develop research-based models for supporting collaboration between educational institutions. Collaboration models are needed, for example, to assist the transition from lower educational level to higher education or from higher education to working life. In this research, collaboration was conducted through a joint course between upper secondary school and university, which addressed global challenges by using a project-based learning approach. There is a shortage of research exploring students' perceptions of collaboration. Therefore, the main purpose of this qualitative case study is to explore the relevance of the joint course for upper secondary school students and university students. The research was guided by the following research question: What kind of relevance did the students experience in the joint project-based learning course? The data were gathered using questionnaires, interviews, and reflective study reports. The data were analyzed via theory-based content analysis, where research-oriented relevance model was used as the analysis framework. The analysis framework enabled categorizing experienced relevance on individual, vocational, and societal dimensions. Altogether, the analysis produced seven relevance categories for upper secondary students and nine for university students. According to the analysis, upper secondary school students felt that the course offered the most on an individual relevance dimension, whereas university students experienced the vocational relevance dimension as the most diverse. As the main conclusion, this research produced new insights on the experienced relevance of upper secondary level and higher education cooperation from the students' point of view. The acquired knowledge can be useful for everyone developing new cross-institutional collaboration models.

## KEYWORDS

upper-secondary school, higher education, collaboration, cooperation, project-based learning, students' perceptions, relevance

## Introduction

In the educational path, there are many challenging transition periods, such as transition to higher education institutions (HEI) or to working life (Lin et al., 2023). For example, university studies do not always match with expectations, or studies do not proceed as planned (Jansen and Suhre, 2010; Valto and Nuora, 2019). This increases dropout rates that is a major issue for HEIs (Hailikari and Nevgi, 2010). Therefore, it is important to ensure an effective transition both for promoting the wellbeing of young people and remain productive in the educational sector to match the massive, constantly growing need for education (Ikävalko et al., 2023; Lin et al., 2023). The education sector also important task to find solutions. We think that the collaboration between higher education institutes has a possibility to enhance relevance of education for upper secondary school students.

In recent years, there has been a growing interest in studying and developing models on how to support transition periods. In many cases, the initiatives to develop new models come from governments. For example, in Finland, which is the research context for this study, the government realized that transition to the next degree-oriented education at the upper secondary level is slower compared to the OECD average (Ministry of Education and Culture, 2017). The findings launched many development projects, the results of which were taken into account in the new national core curriculum for upper secondary education (Finnish National Agency for Education, 2019) and upper secondary school act. It states that schools should cooperate with higher education institutes and working life (Ministry of Education and Culture, 2019). Similar issues in student attraction, enrolling, and persistence in higher education, especially in STEM field, are present in other countries as well (e.g., Sithole et al., 2017). In Finland, the cooperation is part of the curriculum, ensuring that all upper secondary schools (USS) implement it in some way. However, according to the Ministry of Education and Culture (2017), the majority of cooperation is conducted through single study visits or visiting researchers. Therefore, there is a need for developing more engaging and versatile cooperation models between educational institutions. Focusing on the models that benefit all the stakeholders would make the cooperation more effective and attractive. Cooperation could also be beneficial for higher education institutions, for example, practice and research in pre-service teacher education. Some projects have been successful in combining support for the transition of upper secondary school students and in-service training for teachers (Hultberg et al., 2008).

To support the described need, we developed a joint course to promote the collaboration between USS and HEIs. It was developed via co-design approach (Aksela, 2019). The designed course was named Global challenges, and it focused on socio-scientific issues (SSI) and sustainable development challenges that are commonly known as wicked problems. Wicked problems are in nature complex, difficult to solve, linked to societal systems, and commonly related, for example, to sustainable development challenges (Rittel and Webber, 1973). The course addressed these global challenges through project-based learning (PBL). Wicked problems do not have a simple solution, and the formulation of the problem is one of the most important parts of addressing them (Rittel and Webber, 1973). Project-based learning was selected as the pedagogical framework because defining the problem is a very important part of project-based learning. PBL also enables working with interdisciplinary content knowledge and

supports the development of 21st-century skills (Han et al., 2015; Haatainen and Aksela, 2021).

The course was developed both for university students and upper secondary students. University students were involved as developers and instructors. USS students were the learners in the course. Many of the university participants were pre-service teachers. Therefore, one central aim was to support the vocational relevance of pre-service teacher education. For upper secondary students, one of the aims was to offer an overview of university. Reflecting the introduced research background, we aimed to support young people in career planning through the course and facilitate the transition from upper secondary to further education or from higher education to working life (Hailikari and Nevgi, 2010; Jansen and Suhre, 2010; Valto and Nuora, 2019; Ikävalko et al., 2023; Lin et al., 2023). Project-based learning was chosen because it suits the main features of the course. The more open model of the course allowed students to explore the possibilities of university and follow their interest. In addition, the first time the course was organized, the new national core curriculum was implemented in Finland. It enabled better collaborative teaching methods. Therefore, the experiences of the course help to implement project-based teaching as a collaboration between teachers and as a teacher team.

The designed research context enabled addressing a known research gap. According to the Ministry of Education and Culture (2017) and our previous research (Ikävalko et al., 2023); there is a need for more research exploring students' perceptions of institutional cooperation. Therefore, the aim of this qualitative research is to contribute to the topic by exploring USS and HEI students' perceptions of cooperation. To ensure the relevance of the designed collaboration, we apply a widely used relevance model published by Stuckey et al. (2013) in mapping and classifying the experienced relevance by students. In this regard, the research produces new insights into the experienced relevance of USS–HEI cooperation from the students' point of view. The acquired knowledge is useful for everyone developing new cross-institutional collaboration models. In this research, we use the term collaboration to describe the model. We had a shared goal with other stakeholders and had a close connection throughout the process. In general terms, higher education cooperation has a common goal, but it is not tailored for each participant. This research is conducted as a qualitative case study, where the case is theoretically grounded in the contexts of relevance in science education and project-based learning. Therefore, next in the Theoretical Framework section, we define and review research backgrounds for these concepts. Then, in the Methods section, we present a more detailed course description to provide a comprehensive understanding of the research context. The Results are in subsections in correspondence with the Research questions that are based on the relevance model. In the Discussion and Conclusion section, we reflect more about the results and discuss them with the previous research.

## Theoretical framework

In this section, we define the central concepts used in the research and introduce their research backgrounds. The theoretical background consists of two components. First, the relevance of science education is used in analyzing the data to produce insights into what kind of relevance students experience in the USS–HEI

collaboration. Second, PBL is included in the section because it is the central theme of the designed course used in gathering the data.

## Relevance of science education

The starting point of our research is in science education, but the applied teaching approach in the designed course is transdisciplinary (Ashby and Exter, 2019). There are most experiences in university–upper secondary school cooperation in the field of natural sciences. This is due to discrepancy of society's needs on STEM field experts and young peoples' interest. The low interest and attitudes of young people toward science have been a challenge for a long time in science education (Osborne et al., 2003; Osborne and Dillon, 2008; Krapp and Prenzel, 2011). According to many authors, the reason for this is the lack of experienced relevance (van Aalsvoort, 2004; Eilks and Hofstein, 2015). The working practices and contents of science education in schools do not reflect the needs of society or most students. The situation is especially challenging for those who are planning a career in science (Hofstein et al., 2011). This is a matter of concern because attitudes are persistent and significantly influence interest, learning motivation, and future career decisions (Osborne et al., 2003; Lavonen et al., 2008; Hidi and Renninger, 2019). This is also the case in Finland. Even though Finnish students have had a high science performance in PISA 2006 and 2015, they have scored low on attitudes toward science, especially chemistry-related issues (Lavonen et al., 2005; Sjøberg and Schreiner, 2010; OECD, 2019).

In this regard, relevance is an important concept to consider in science education. During the past decade, science education scholars have introduced multiple approaches to support the relevance of science studies. For example, researchers have developed interesting contexts such as industrial chemistry and chemistry of tattoos that young people might experience relevant (Hofstein and Kesner, 2006; Stuckey and Eilks, 2014; Eilks et al., 2018). Blonder and Mamlok-Naaman (2019) evaluated the possibilities and challenges of using historical and contemporary approaches in science education. According to Perna et al. (2023), the selected learning tools can affect the experienced relevance. They found out that computer-based molecular modeling is a highly relevant tool for chemistry education at the lower secondary level. Tolppanen et al. (2015) analyzed the relevance of non-formal learning environments such as science clubs, camps, and laboratories to support holistic science education. In addition, Halonen and Aksela (2018) and Nuora and Jouni (2018) have developed science camps to support the relevance. They seem to offer great possibilities to improve the experienced relevance.

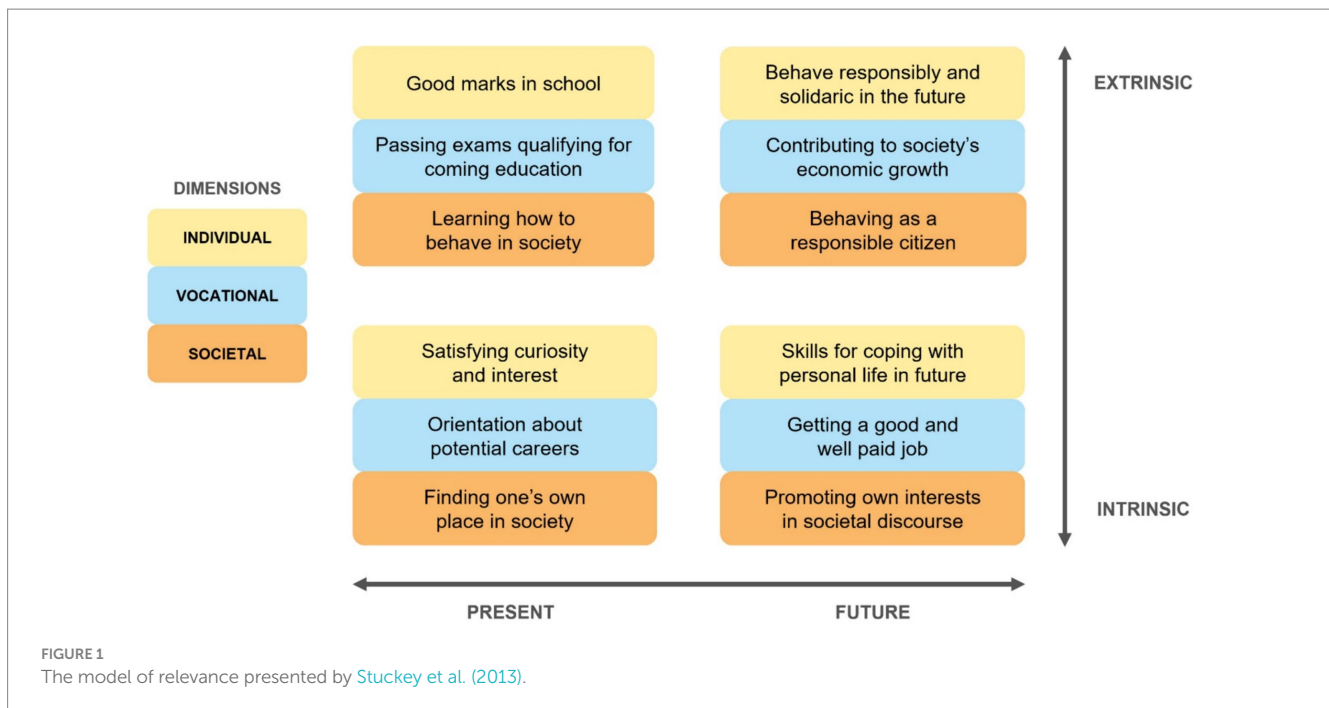
However, the challenge in improving relevance is that there is no consensus on the definition of the term. It is often used as a synonym for interest or meaningfulness (Gilbert, 2006; Rannikmae et al., 2010). In this article, we use the relevance definition developed by Stuckey et al. (2013). According to their model, relevance is a positive experience that may have individual, societal, or vocational context (see Figure 1). We chose Stuckey et al. (2013) model because it provides a more holistic perspective on relevance. In Stuckey's model, interest is placed as part of the individual dimension, but it also considers the needs of learners' professional development and societal influence.

The three dimensions of the model—individual, vocational, and societal relevance—span across time from present to future, and the relevance can be experienced from intrinsic or extrinsic perspectives (Stuckey et al., 2013). Intrinsic relevance encompasses student's personal interests and motives that are always motivating and meaningful (Hidi and Renninger, 2019). For example, personal curiosity about some topic or potential career aspirations. Extrinsic relevance includes ethically justified expectations that are defined by other stakeholders, such as scientists and teachers, or by the mass media and the surrounding environment (Stuckey et al., 2013). For example, the demand for transversal competencies needed to function as an active citizen in the 21st century or the needs of trade and industry for science professionals. In addition, the perception of relevance is always unique and context-dependent. For example, students and teachers' opinions on relevance differ, and there is a gender difference regarding the perceived relevance or interest in school science (Lavonen et al., 2005; Teppo et al., 2017).

Research suggests that students are interested in learning about things they perceive as being connected with their personal life, such as health, food, and SSI such as sustainable development (Sjøberg and Schreiner, 2010; Bybee and McCrae, 2011; Fooladi, 2013; Kotkas et al., 2016). The Youth Barometer 2019 ( $N=1907$ ) indicates that Finnish youth is increasingly interested in social activism, and incorporating this into science education could engage students in learning (Haikkola and Myllyniemi, 2020). Indeed, the evidence suggests that especially in secondary school, SSI-based science education has the potential to incorporate all three dimensions of relevance as it supports students' science career awareness, their interest toward science studies, and helps prepare them to become responsible and active citizens in the future (Burmeister et al., 2012; Stuckey et al., 2013; Eilks and Hofstein, 2015; Tolppanen et al., 2019; Çalık and Wiyarsi, 2021). In addition, research has identified teaching approaches that can support students' interest or motivation in school science. For example, practical work, including hands-on activities, experiments, and group work, as well as extended investigations and opportunities for discussion, has been identified as potentially engaging and enhancing a role for personal autonomy, which is important for the development of interest (Osborne et al., 2003; Lavonen et al., 2005; Hidi and Renninger, 2019). These are among the key features of student-centered approaches such as project-based learning (PBL; Haatainen and Aksela, 2021).

## Project-based learning

Project-based learning is a student-driven, inquiry-or problem-oriented pedagogical approach that organizes learning around clearly defined projects with artifacts as learning results (Bell, 2010; Han et al., 2015; Kokotsaki et al., 2016; Haatainen and Aksela, 2021). Haatainen and Aksela (2021) describe PBL as a socio-constructive learning process where learning is context-specific; learners are involved in planning, executing, and assessing the project; and they achieve their goals through social interactions and the sharing of knowledge and understanding. Similar instructional strategies exist, such as problem-based learning and inquiry-based learning (Savery, 2019). For the purpose of this study, we define PBL as a teaching method which



organizes learning around projects and engages students in collaboration and constructive investigations of authentic problems.

Project-based learning has a lot of potential to enhance 21st-century skills and engage students in real-world tasks (Han et al., 2015; Condliffe et al., 2017; Kingston, 2018) that can promote the relevance of science education. The 21st-century skills are a general term for various skills necessary for success in everyday life, such as critical thinking, problem-solving, and inquiry, which are essential parts of science education. However, skills alone are not enough as learning objectives of PBL, since students also need to develop their understanding of the key concepts of science and contents central to the curriculum (Bell, 2010; Haatainen and Aksela, 2021; Markula and Aksela, 2022). Project-based learning can be seen as a relevant framework for learning science, as studies have shown that it can promote learning of science and mathematics content knowledge (Condliffe et al., 2017; Viro and Joutsenlahti, 2020) and improve students' attendance, self-reliance, and attitudes toward learning (Condliffe et al., 2017; Kingston, 2018). Similar situation is presented, for example, in the work of Danković et al. (2023), where the university carried out a STEM-themed project-based course for upper secondary school students. They found that the participating students were more motivated in upper secondary school and to continue in higher education as well (Danković et al., 2023).

## Methods

The research was carried out as a qualitative case study (Yin, 2014). The methodology was chosen because it enables producing narrative accounts that describe students' perceptions of the experienced relevance (Cohen et al., 2018, 289–302). To fulfill the set aim and explore both the university and USS students' perceptions, the research was guided through the following research questions:

- 1 What kind of relevance did the upper secondary school students experience in the project-based learning course implemented with the university?
- 2 What kind of relevance did the university students experience in the project-based learning course implemented with upper secondary schools?

We decided to formulate one research question for both student groups. With this approach, we can order the results section to address the needs of several stakeholders. For example, educators working in USS are more interested in insights generated from students at the USS level. Vice versa, higher-level educators are probably more interested in university students' perceptions.

## Context of the case study

The joint PBL course titled Global Challenges was developed through a co-design approach (Aksela, 2019) in collaboration with the University of Helsinki and one municipality in the capital area. The course concentrated on SSIs and sustainable development challenges, often referred to as "wicked problems." The chosen instructional strategy was PBL, recognized for its student-centered approach and interdisciplinary focus, as well as its effectiveness in fostering transversal competencies (Han et al., 2015; Haatainen and Aksela, 2021).

The course operated on two levels:

- 1 It was offered as an optional master-level course (five ECTS credits) accessible to all university students at the University of Helsinki, especially those majoring in science education (chemistry, physics, mathematics) or general education, aiming to become future science or class teachers.

- 2 It was an optional course (two ECTS credits) for upper secondary school students of the municipality. In this part, the university students took on the role of instructors.

The university-level course began earlier with teacher-led lectures on PBL as a pedagogical approach aligned with education for sustainability, emphasizing SSIs. University course was five ECTS credits (one ECTS equals to 27 work hours) and lasted for one semester. Subsequently, university students with various backgrounds formed multidisciplinary groups to design the Global Challenges course for upper secondary school students. University students' backgrounds were diverse; their majors included geography, special education, general adult education, mother tongue and literature, computer science, history, and genetics. Each group selected a broad sustainability-related theme such as a sustainable future, responsible consumption and its effects, media literacy, and multiculturalism. These themes, reflecting the interests and expertise of the university students within the group, were chosen by the university students and served as foundations for the projects in the upper secondary course. Each group compiled learning materials, such as articles and videos, and engaged with both internal and external experts to enrich their collaborative understanding of the interdisciplinary theme. During this design phase, the university students developed the curriculum and the structure of the PBL module for the upper secondary school course, managing shared responsibilities such as course descriptions, PBL instructions, and common assessment criteria. This design process was iterative, involving university teacher guidance, group discussions, and peer feedback. After designing, university students implemented the PBL course "Global Challenges," taking on instructor roles for the upper secondary students.

The course for upper secondary students spanned approximately 6 weeks. It engaged students in student-centered projects working in small groups related to the pre-designed broad themes, provided insights into university life, and fostered collaborative interdisciplinary learning. Upper secondary school students formed groups based on themes that interested them, subsequently choosing more detailed subjects. Course sessions included joint discussions, project sharing, peer feedback, and targeted group work under the guidance of assigned university students. The course culminated with presentations of the projects by the upper secondary students.

Essential elements of the course were collaboration and interdisciplinary learning that closely resemble transdisciplinary education as described by [Ashby and Exter \(2019\)](#), where the goal is through active involvement and collaboration to co-construct knowledge to address problems that cannot be solved by a single disciplinary perspective. Engaging both pre-service teachers and upper secondary students as active learners, the course enhanced transversal competencies and delivered interdisciplinary knowledge within a real-world context. Furthermore, for university students, it provided invaluable first-hand teaching experience and insight into collaborative, interdisciplinary PBL implementation.

## Data gathering

The research was conducted in a Global Challenges course which was developed for the context of this research. The course was co-designed with one municipality in the capital area and the

University of Helsinki to support the collaboration between upper secondary schools and HEL.

The data were gathered during two-course instances in 2017–2018. In the 2017 course, data were gathered from 25 university students. In the second data-gathering cycle in 2018, the data set was expanded with seven university students and seven high upper secondary students. Hence, the total number of participants was 39. All participants were informed about the research and data processing procedures, to which they gave their consent and participated in the study willingly.

Data from university students were gathered using questionnaires sent via email. They reflected their perceptions three times during the course—initial questionnaire before the first-course meeting, mid-questionnaire in the middle and final questionnaire after all the course assignments were returned. In the initial questionnaire, university students discussed their expectations, goals, and the meaning of project-based learning. In the first part of the course, the university students planned the USS students' course and learned about project-based learning as a teaching method. In the mid-questionnaire, they were asked about their experiences in the first part of the course, goals, and expectations about relevance of the latter part of the course and about collaborating with the USS students. In the final questionnaire, the university students reflected on the course in general, achievement of their goals, collaborating with the USS students, and the relevance of the course. USS students answered initial and final questionnaires. They did not have data gathering in the middle of the course. They filled in the questionnaires in the first and final course meetings. To maximize the validity of the instrument, the questionnaires were designed based on the relevance model ([Stuckey et al., 2013](#)).

To improve the reliability and validity of data, we implemented data triangulation ([Tuomi and Sarajärvi, 2018](#), 168). To gather comprehensive in-depth data set, we included the year 2017 university students' ( $N=25$ ) reflective learning reports to research data. In addition, we interviewed USS students who participated in the course in 2018. USS students were interviewed in the same groups in which they worked during the project work. The interviews were held about 2 weeks after the course was finished.

## Data analysis

The interviews were transcribed, and the transcripts as well as questionnaire data were analyzed via text-driven theory-based content analysis ([Krippendorff, 2004](#); [Tuomi and Sarajärvi, 2018](#), 127). The analysis was conducted via a theory-based approach because the main dimensions of the relevance model were used in identifying the analysis units ([Stuckey et al., 2013](#)).

First, we read the text-based data through the relevance framework and highlighted all expressions related to perceived relevance (see [Table 1](#)). Then we categorized observations into categories and placed them under the main relevance dimensions. To improve the reliability of the analysis procedure, we implemented three analysis cycles, including inter-rater reliability evaluation ([McHugh, 2012](#)). The cyclical implementation enabled an iterative refinement of the descriptions of experienced relevance categories. During the process, the number of experienced relevance categories for university students was reduced from 10 to 9. The Cohen's kappa value for the finalized categories was 0.81, which indicates strong

TABLE 1 Examples of what kinds of observations were classified according to different relevance dimensions (Stuckey et al., 2013).

Individual	Vocational	Societal
The individual dimension included answers that, for example, were related to interest, excitement, or present or future personal benefit.	The vocational dimension category included answers related to professions, jobs, and acting in them. From pre-service teachers' answers, the skills needed in the work as a future teacher were classified into a category. From USS students' answers, skills and knowledge related to higher education studies.	The societal level includes responses that are related to society, such as the effects of dealing with global challenges. Answers that mentioned social influence and the so-called action competence. In addition, the relevance and goals set by pre-service teachers for USS students.

agreement between raters (McHugh, 2012). The inter-rater evaluation included 16% of all relevant observations.

## Results

We present the results of this case study by research questions, first focusing on the experienced relevance of the upper secondary school students and then on the experienced relevance of the university students. Both sections are presented by relevance dimensions derived from the Stuckey et al. (2013) model.

### Experienced relevance by the upper secondary school students (RQ1)

In this section, we present upper secondary school students' perceptions of relevance and provide answers for the RQ1. First, we present an overview of all the categories found. Then, we address findings by each relevance dimension. In the example quotations, USS1 stands for upper secondary school student one, and so on.

In total, the analysis produced seven relevance categories experienced by the upper secondary students (see Table 2). Looking at the whole, the individual dimension was most present in the data, but also vocational and societal dimensions were observed.

#### Individual relevance

According to the initial survey data, upper secondary students did not have accurate expectations for the course. They were expecting a nice course, something different from what they were used to in their own school. Some of the students mentioned expectations of discussions with current and global issues and globalization themes. In addition, the course was said to have an interesting name, Global Challenges, and that was mentioned as a reason to participate. Other reasons mentioned were different kinds of courses that may be more relaxed than usual USS courses. They also expected to learn new things, develop working methods, gain experience from group work, and get to know the university world.

TABLE 2 An overview of the upper secondary students' experienced relevance.

Relevance dimension	Experienced relevance categories
Individual relevance	1. Personal interest and learning expectations 2. General work skills and research experience 3. Collaboration
Vocational relevance	4. Getting to know the university 5. Future orientation
Societal relevance	6. The importance of the topic for the society 7. Implications for personal life

In the final questionnaire, upper secondary students were asked to describe the most useful things that the course offered. In general, the USS students liked the course. They found it interesting, and learning of new work methods was experienced useful. For example, inquiry skills, research concepts, and information retrieval methods were mentioned as important lessons from the course. In addition, working in a group was an important part of the course, and it was also a significant learning experience. For example, one USS student said that during the project she got more encouraged to work in a group. In addition, one respondent mentioned that the most useful part of the course was taking responsibility for one's own doing and practicing an independent working approach.

- Category 1—Interest:
  - “An interesting theme, and I hope to gain experience and knowledge that can help me in the future” (USS2).
- Category 1—Learn new things:
  - “My goal is to learn new things about the problems that have risen as a result of globalization” (USS7).  
“It was a nice course, and it gave me a lot, I learned new things and got to work in different ways compared to upper secondary school” (USS4).
- Category 2—Developing work skills:
  - “New ways and methods of information retrieval, taking responsibility, managing time” (USS4).
  - “I learned a certain kind of way to seek information, more self-initiated” (USS2)
  - “If I go to university, I have to learn to talk to people more [in group-work and in presentations]” (USS3).

The USS students felt comfortable collaborating with university students. It was especially important to get advice and support while doing their own inquiry. This was needed because they realized that it was difficult to choose the topic for their project. Overall, they felt that the project done in the course was more meaningful than just ordinary project work. One student stated in an interview that he felt like doing something “reasonable and not just seeking information online.” Support was also needed for narrowing down the topic and project management, such as allocating tasks equally within the group.

The upper secondary students participating in the course were familiar with each other beforehand. This was experienced as an

advantage in terms of communication and the functionality of the group. They mentioned that it is easier to hold a friend responsible and arrange working outside school hours. However, one of the interviewees stated that outsiders might have brought different ideas to the project.

- Category 3—Collaboration inside the group: “We were working in a group whole time ... you had to trust the other person to do what it says he will do, and you are able to communicate with others” (USS3).

Getting used to the new learning method took time, but eventually, it started to work out. For example, one group interviewed an expert on their own project, and it was experienced relevant, because they had never done it before. They also gained first-hand expert information by conducting their own interviews. The project was perceived as a good learning experience, and students mentioned that it was important that there was a goal, artifact, instead of just presenting information.

The extent of project work was a new thing for USS students. One group reported doing presentations and more limited group work in several courses before, but they have not been as in-depth. The new working model was eventually found to be rewarding, but this is often the case with project learning because there are difficulties in the beginning. Another group said that a better outcome would have been achieved if there had been more time, the group would have been able to use resources more creatively.

According to upper secondary respondents, collaboration with university students went smoothly and was perceived to be useful. For example, when the USS students found themselves gaining freedom to work, knowing that if needed, then university students were there to help. They also mentioned that it was useful to get feedback for the research plans and guidance in narrowing the research topic. However, upper secondary students needed to get used to the new role of a teacher. In the course, the university students were more like mentors than traditional teachers.

- Category 3—Collaboration with university students:
  - “It was nice to cooperate with the university students” (USS1).
  - “I was wondering a little that are you a teacher or are you just hanging out with us here?” (USS2)
  - “I think they were not necessarily meant to teach but rather to direct us with giving opportunities and to show us what is possible to produce and what the different ways are to present it. I thought it was good that they were there” (USS4).
  - “One of the most useful was getting feedback in the middle of the course. That helped us with our work” (USS7).

In the data, there were only a few critical mentions. One upper secondary student did not appreciate so many mandatory meetings because it took time to travel from Espoo to Helsinki. In addition, many mentioned that because the workload of the course depends on your own effort, it would be important to give more detailed instructions and course descriptions at the beginning of the course.

### Vocational relevance

Through the course, upper secondary students were able to familiarize themselves with the university, meet university

students, and get information of different study opportunities. According to data, this experience increases interest toward higher education and may support transition to the next study level.

- Category 4—Getting to know the university: “Increased my interest in the university. You saw how university students studied or how they did things, for example, the way they study” (USS7).

At the beginning of the course, the upper secondary students did not yet have a clear vision of their future. According to the data, some did not have any plans for a future career. However, based on the students’ responses, the course was useful in that it increased interest in the university. It also provided information about university studies and future possibilities.

- Category 5—Future orientation:
  - “You became more aware of them and when you hopefully apply to university, so you know something about the lives of university students, their routines and how they do things, so that was a good addition” (USS7).
  - “I just learned a new kind of working and maybe got to know things more. I think it was the same as what I would expect from a university course” (USS2).
  - “I felt that the course showed you what is possible. What is possible to study, there are several different options so [the course] gave me information about those I had no knowledge even to consider” (USS4).
  - “[The course] gave good tips and support for a future plan” (USS7).

### Societal relevance

The societal relevance of the course was experienced through the topic of global challenges. The upper secondary students felt that they were dealing with important societal issues. Learning from global challenges caused, at the same time, some feelings of powerlessness but also hopefulness. Respondents realized that even small things could make a difference in slowing down climate change.

- Category 6—Important topic:
  - “Global challenges are very topical. When you learn yourself, you can give to others as well. Now I can tell someone about our topic about the current situation” (USS4).
  - “We realized that there are lots of small things you can do for the climate” (USS6).

Multiple upper secondary students mentioned that the course had implications for their personal life. For example, one said that the course affected his family to start recycling. Some started to pay attention to reducing food waste, considering more about eating meat and thinking about veganism in their own food choices.

- Category 7 – Implications for personal life:
  - “It was nice to dive into important and societal themes... It affects to your opinions and thinking, I do not know if the effect has been yet so big, but I have more information that I can think about” (USS1).

- o “Our family did not recycle before the course. It is hard but we try, so that is a big thing” (USS7).
- o “I try not to waste food or throw anything away” (USS2).

## Experienced relevance by the university students (RQ2)

In this section, we present results analyzed from the university students' questionnaires and reflective assignments and provide answers to RQ2. In the example quotations, UNI1 refers to university student 1, and so on.

In the university students' responses, all relevance dimensions were present, but observations related to vocational relevance were the most diverse. Altogether, the analysis produced nine experienced relevance categories distributed to all relevance dimensions (see Table 3).

### Individual relevance

Individual relevance appeared on the interest toward the course, positive expectations, and realizations (category 1). In addition to positive feelings, they also felt the development of skills such as group work, project management, communication, and generic academic skills (category 2). In the third category, we place observations where students describe positive experiences in general (category 3).

- Category 1—Interest and enthusiasm:
  - o “The course was really good and interesting” (UNI10).
  - o “Topics (such as global challenges) can also be exciting for the teacher, and an enthusiastic teacher can also inspire students” (UNI3).
- Category 2—Skills development: “Project management and planning are also interesting for creativity and action. I am excited to learn and develop my own competence and interaction skills” (UNI4).
- Category 3—Positive experience: “Overall, this project was quite a tedious task in comparison to the number of credits available, but guiding the course and watching the students' joy in learning was rewarding” (UNI22).

### Vocational relevance

Observations that addressed the benefits of collegial cooperation or positive experiences of working in a team or networking were categorized under the vocational relevance dimension.

- Category 4—Collaboration:
  - o “Working with student teachers from other faculties has been particularly rewarding” (UNI29).
  - o “The best part of the course was getting to know fellow teachers and exchanging ideas with them. Working together in my own group was rewarding and educational” (UNI25).
- Category 4—Networking: “I got to know new people: university students and upper secondary school students, i.e., networking” (UNI2).

TABLE 3 An overview of the university students' experienced relevance.

Relevance dimension	Experienced relevance categories
Individual relevance	1. Enthusiasm and interest toward the course topics 2. Developing your own skills 3. Positive and new experience
Vocational relevance	4. Collaboration and networking with other teachers 5. Experience in guiding and working with upper secondary school students 6. Learned things about PBL as a teacher 7. Developing as a teacher in general
Societal relevance	8. Action competence 9. Benefits for the upper secondary school students and orientation in higher education

Overall, working with upper secondary school students was perceived as fulfilling and important. Several university students emphasized the experience working with USS students and practical training in implementing PBL. The university students said that they got a real picture of working with USS students and the teacher's role when implementing project-based learning.

- Category 5—PBL guiding experience:
  - o “I got a clearer picture of the work of upper secondary school students and the role required of the teacher in project learning situations also became clearer” (UNI1).
  - o “Experience in guiding and a balance between how much to guide and how much to let the guided decide for themselves.... I tried to be encouraging and give advice when I felt it was needed, but without giving the right answers” (UNI5).
- Category 5—Seeing the learners' perspective in PBL:
  - o “I'm looking forward to seeing how the students start to approach the phenomenon. I would especially like to understand how self-directed the students are, and in which matters they need to be guided and supported” (UNI1).
  - o “It was difficult for the upper secondary school students to understand that the found information should somehow be processed and used to advantage when trying to realize something new about the phenomenon they are studying. These are all important skills that should be learned” (UNI26).

The university students also reflected on the practical learning from the project-based learning. For example, they reflected on the implementation of the course and how it could be improved the next time it is carried out and are learning about the method and thus professionally useful. For example, the work rules and learning goals should have been agreed upon more precisely with the USS students.

The data showed a little hesitation with the new teaching method, which is the right amount of freedom to give and how much structure is needed. In general, learning and experiencing working in the role of a teacher is also professionally relevant for the students.



- Category 6—Learning from PBL: “From the teacher’s point of view, the challenging part of project learning is not only evaluation and narrowing down the topic, but also moving away from the role of an active teacher” (UNI18).
- Category 6—Developing PBL guidance skills: “I think the cooperation with the upper secondary school students went well. Their work showed the same vagueness as I think in the course, you did not really find out what was expected of them, what was being done in the course. What was the mutual relationship between university students and upper secondary school students: was the relationship senior/junior researcher, project manager/project worker, teacher/student, and whose project was being done and implemented here?” (UNI2).

The last vocational relevance category was positive effect toward the development of teacher as general.

- Category 7—Developing as a teacher in general: “I hope that in the course I can also continue to build my own pedagogical philosophy and teacher identity” (UNI7).

### Societal relevance

Societal relevance was the least visible in the data gathered from university students. According to the analysis, getting to know the sustainable development themes of global challenges and encouraging action competence were experienced important. For example, the importance of awareness of consumption and environmental issues was mentioned as one of the goals and final benefits of the course, regarding both student teachers and USS students.

- Category 8—Action competence:
  - o “I really liked our discussions during the course, which were very broad and made the upper secondary school students think. It was rewarding for me to hear that the upper secondary school students stated that they learned things about the world, consumption, university and studying during the course” (UNI17).
  - o “They [upper secondary school students] considered conscious consumption to be an important theme that played a significant role in their lives. Therefore, motivation was high; they wanted to learn something new about the subject, delve into it and make a tangible project” (UNI22).

University students considered the course’s relevance for USS students. In the responses, they listed generic skills, like inquiry, collaboration skills, taking responsibility, source criticism, and finding a place in society. In addition, getting familiarized with the university and possible interest to apply for a study place were mentioned in the answers. Few mentioned that encouraging USS students was considered important, and they wanted to inspire and lower the threshold for applying to university.

- Category 9—Benefits for upper secondary students:
  - o “The upper secondary school students’ interaction with each other was mostly functional and the course succeeded in developing the upper secondary school students’ cooperation skills” (UNI8).

- o “Upper secondary school students should learn thinking skills, skills of searching for information, critical thinking ... if the understanding of criticism of information and the application of information would increase. There is no objective knowledge because the factors are subjective” (UNI4).

- Category 9—Transition to higher education:
  - o “Hopefully, the threshold for upper secondary school students to apply to university will be lowered thanks to projects like this, because they will discover that they can get along well with university people as well” (UNI2).
  - o “I personally had relatively bad experiences with student guidance in upper secondary school, so maybe I felt a little bit of my duty to be very encouraging and cheerful in terms of the future:—I also said that I’ll see you at university later” (UNI5).

## Discussion

Upper secondary school and higher education collaboration course The Global Challenges focused on global issues chosen by the upper secondary school students. In summary, the highlighted conclusions are as follows: the course was seen as relevant for the upper secondary school students, especially individual and vocational dimensions, as they gained new enjoyable experiences in a university context, and the university students experienced vocational relevance as they gained teaching experience.

The interest in the course topics is also reflected in the experienced relevance by the upper secondary school students. In the data gathered from USS students, individual relevance was emphasized the most. They highlighted their expectations of an enjoyable course, and by the end, they found the topic personally interesting. This finding is aligned with [Aksela et al. \(2016\)](#), who also found that individual relevance was the most significant factor in choosing a course for younger adolescents.

Similar conclusions have been drawn before: the individual dimension is more significant for younger students but shifts toward societal relevance as the student gets older. With older students, education should address the connection between science and society rather than science and the individual ([Stuckey et al., 2013](#)). Our analysis agrees with the literature that with older students, education should emphasize societal relevance. Societal relevance is challenging to grasp and incorporate into science education, but it is essential as scientific literacy becomes a more significant goal of education ([Hofstein et al., 2011](#); [Stuckey and Eilks, 2014](#)). In addition, [Aksela et al. \(2016\)](#) suggested that the importance of societal relevance is increasing as awareness of the world increases.

A USS course that addresses global and societal issues can be highly relevant to a student. According to [Stuckey et al. \(2013\)](#), authentic and controversial discussion topics and content should be introduced to engage students and increase their interest. These topics should particularly stem directly from current societal issues and should not merely be the starting point of education but the focus of it. In addition, our analysis indicated that students were interested in the societally relevant topics that the course addressed. We argue that global challenges and sustainable development are excellent contexts for building bridges between the natural sciences and society.

This is important in the case of USS students because, according to data, societal issues are challenging to intuitively grasp. However, in the interviews, one USS student group said that they learned how small actions can make a difference. This will hopefully translate into actual behavior, as there is often a disconnect between knowledge and action (Kilinc, 2010). A significant portion of the population engages in environmentally harmful behavior, even when aware of environmental problems. With a more action-oriented education, students' perceived ability to influence environmental issues improves.

Kilinc (2010) research shows that through PBL, students develop critical thinking and problem-solving skills, providing an opportunity to apply knowledge in real-life contexts and, consequently, better internalizing the information. While one course's impact is limited, PBL has shown positive signs of change. By changing the course's emphasis and guiding students, the sense of societal relevance can be increased. Making students aware of societal relevance makes them recognize and acknowledge its importance (Eilks et al., 2018). Some of the lack of visibility of societal relevance may be because it is not always immediately apparent. According to Stuckey et al. (2013), relevance can also be something that the student is not yet aware of.

Vocational relevance was present in the interview data, where USS students talked about the usefulness of working in university facilities. They found it important to see and experience university life. All these glimpses can clarify an USS student's thinking about the future and bring out new possibilities. In addition, generic skills that USS education should emphasize include essential skills such as communication and negotiation skills, learning skills, and critical thinking skills. Additionally, improving information retrieval and taking responsibility for work were listed as areas needing improvement. In this sense, the PBL-driven Global Challenges course served upper secondary school students well in their path toward higher education and the working life. This is important to students, as the school environment provides a safe and familiar setting for practicing skills needed in the future.

Most of the university students were pre-service teachers, and some of them will probably have a career in USS level as a subject teacher. For them, the course offered most on the vocational relevance dimension. For example, they saw it as a possibility to learn how to guide PBL activities and get experience in interacting with USS students. Sometimes the new method was considered hard for teachers. Similar results were found for teachers with less pedagogical background in tutoring a student group in a same style settings (Hultberg et al., 2008).

PBL was a new method for USS students, and it was experienced interesting. However, USS students had difficulties getting started with their work, which is often a recurring challenge in PBL, especially when the method is new (Haatainen and Aksela, 2021). However, as one upper secondary school student put it, "You learn by doing," capturing the essence of PBL. Engaging in a new and different way of working and delving into a subject in more detail was seen as meaningful and, therefore, increased the course's individual relevance (Viro and Joutsenlahti, 2020).

The interaction between USS students and university students was an essential factor behind successful projects. USS students found out that deciding the project topic, narrowing it down, and project management in general were difficult. University students were able to support USS students with these challenges.

According to Stuckey et al. (2013), integrating vocational relevance into education is particularly crucial in transitional phases of education, such as USS. It is an educational level where significant decisions about further education or life are made. Based on the interviews with students, adding separate campus tours at the university for the course was not deemed necessary, but they could be considered a nice addition. However, our research indicates that vocational relevance could be increased by delving more deeply into the university's study fields, its operations, and its research. USS students conducted expert interviews during the course, but these interviews could be targeted at university researchers and professors. In addition, the vocational relevance of USS students is intrinsically emphasized through the interaction between USS and university students. University students are role models for studying at the next educational level. This can create a stronger connection to the university and help make decisions for the future career.

## Conclusion and recommendations

This research illustrates how USS students and pre-service teachers experience relevance while participating in a joint USS–HEI course. Because of their qualitative background, they cannot be generalized more widely, but they can be used as a reference when designing similar collaboration models. In this regard, we present some research-based conclusions to consider when developing similar models.

This PBL course served as a catalyst for educational change by bridging the gap between upper secondary and higher education. In contrast to more traditional models, our approach facilitated direct collaboration between upper secondary school and university students. In a global context, this approach is in line with educational trends that emphasize interdisciplinary learning and collaboration.

When developing collaboration courses with upper secondary schools and higher education institutes, there are some factors to consider. It is important to co-design the course with all the stakeholders, including teachers, planners, and even students from school and university, to ensure all goals are in line (Aksela, 2019). Proper marketing is encouraged in USS to get students to choose an optional course. For example, the 2017 course was promoted visibly, and there were also visiting university students promoting the course. These actions were worth it, and there were over 20 upper secondary school students in the course. However, in 2018, advertising was not as visible, and the number of participating students was significantly lower. It is also important to adjust timetables suitable for both sides on time. In Finland, USS students made plans for the following academic year during the previous spring. If the course is only promoted in late autumn, it may be challenging for USS students to fit it into their schedules. The course schedules should be set earlier to ensure that the course is included in the USS course choice options.

This research is especially important for Finland because the transition from upper secondary education to the next level of education is slower than the OECD average. In 2015, only 32% continued to pursue degree-oriented education after USS (Ministry of Education and Culture, 2017). Research literature shows that several factors influence the transition to further education, including the educational background and socio-economic status of parents (Hill et al., 1990). However, being aware of different opportunities

and gaining knowledge about higher education options and general study skills are thought to have a positive impact (Jansen and Suhre, 2010; Lin et al., 2023). Danković et al. (2023) also found that a practical STEM course in collaboration with a university can improve motivation in upper secondary school and in continuing in higher education. In addition, in this study, one USS student mentioned the influence of their parents on their course choice and found additional confirmation for attending the course after discussing it with them. The importance of parents in educational choices has been recognized (Hill et al., 1990). One way to promote the course could be to communicate the information to the students' parents. Finding one's place in society is part of societal relevance, and all education has an impact on this (Stuckey et al., 2013).

Collaboration with upper secondary schools can also be very beneficial for higher education institutes. In teacher education, it can provide excellent learning experiences for pre-service teachers. Doctoral researchers as relatable role models for upper secondary students can enhance students' self-efficacy. Doctoral researchers could be experts for interviews and research presentations. Thus, the collaboration could be useful for doctoral researchers by providing opportunities for science communications and presentation skills.

Some HEIs offer USS students the opportunity to complete courses during USS. These courses are often introductory courses in a specific field and are suitable for students who know their intended field and can choose higher education courses accordingly. For students uncertain about their future, more general courses providing information about higher education study options, general study skills, and generic skills should be available. Naturally, one course does not have any value as a determining factor, but when thoughts arise, they can be helpful in reflecting on building one's orientation. This research indicates that a joint HEI-USS course on PBL in the context of global challenges is experienced highly relevant to both students and stakeholders. The current research has some limitations; the data collection methods from different iterations of the designed course are different. However, they also provide a richer set for analysis because the data are not collected in a same way. In addition, the data provided similar answers. This is also a case study, and the results are not directly generalizable, but they offer information about a quite novel topic. For future research, we suggest continuing the development of various models for HEI-USS collaboration. New models are needed to support the efficient educational transition to higher education and work life. It would be beneficial to explore how sustained collaboration influences academic trajectories in the long term. In addition, in this research, we explored USS students' and student teachers' perceptions of relevance, but there is no up-to-date knowledge of in-service teachers' perceptions. Therefore, it would be important to study USS teachers' perceptions of different collaboration models. It would offer valuable insights for the development of research-based models for teacher training and lifelong professional development for teachers.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation. Note that the raw data is in Finnish.

## Ethics statement

Ethical approval was not required for the studies involving humans because all participants were informed about the research and data processing procedures, to which they gave their consent and participated in the study willingly. There was no need for ethical approval from ethics committee. According to the Finnish National Board on Research Integrity TENK guidelines 2019 "if the minor is 15 or older, their own consent is sufficient for participation in the research." See more: [https://tenk.fi/sites/default/files/2021-01/Ethical\\_review\\_in\\_human\\_sciences\\_2020.pdf](https://tenk.fi/sites/default/files/2021-01/Ethical_review_in_human_sciences_2020.pdf). The studies were conducted in accordance with the local legislation and institutional requirements. Finnish National Board on Research Integrity TENK waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because all the participants were informed and they participated in the study willingly. Written informed consent was not obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article because all participants were informed and they gave their oral consent and participated willingly to the study.

## Author contributions

TI: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. JP: Conceptualization, Data curation, Supervision, Writing – original draft, Writing – review & editing. OH: Conceptualization, Data curation, Writing – original draft, Writing – review & editing. MA: Conceptualization, Funding acquisition, Resources, Supervision, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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