

Teaching for Sustainable Development in Teacher Education

This chapter is based on an action research investigation of our own teaching within the specialisation module 'Education for Sustainable Development' (Danish abbreviation, UBU) offered at UCL University College during the period 2018-2021. In the following, the module will be referred to as 'the UBUSP'.

Authors: Ruge, D., & Kristensen, P. (2024) UCL University College, Odense, Denmark translation to English of the Danish original article:

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Introduction

The goal of our study was to assess what knowledge outcomes teacher education students achieved through participation in this module, aiming in this way to identify areas for ongoing development and improvement. Both authors are lecturers at UCL University College and are affiliated with the natural sciences teaching group. The specialisation module demonstrates a didactic model for teaching sustainable development, addressing such questions as: 'Who should learn?', 'What should they learn?', and 'How should they learn?' (Jank & Meyer, 2006).

The UBUSP ran three times as a specialisation module in teacher training from 2018 to 2022. On average, 20 second-year teacher education students from Odense enrolled in the module. Adopting an interdisciplinary and project-oriented approach to teaching for sustainable development, the UBUSP enabled students from the natural sciences, the social sciences, and the humanities to work and contribute together. Participants earned 10 ECTS for the module, which ran from August to December. To some extent, online and international students also participated in the teaching, as due to the COVID-19 pandemic the 2021 session used a combination of physical attendance and online participation. In the autumn of 2022, fifty students were enrolled on the UBUSP, including thirteen international students.

Background

Setting up a specialisation module at UCL had its roots in a variety of different knowledge domains. These included cooperation with researchers from the Research Programme for Environment and Health Education at the Department of Didactics at the Danish School of Education (Aarhus University), as well as participation in initiatives such as 'Green Flag - Green Teacher Education', 'Inspiration for Excursions' (Breiting & Ruge, 2009), and the RCE development project 'Sustainability and Innovation in School and Teacher Education - Pressing Challenges' (Breiting et al., 2010). The latter project was an essential part of the background for UBU at UCL. In this project, a group of UCL students designed an interdisciplinary school project for eighth graders, in which groups of pupils were asked to investigate and propose sustainable development solutions for the Port of Odense. Introducing the project, one of the UCL students attempted to explain the concept of sustainability, which proved to be quite

challenging! Despite several practical examples, such as buildings collapsing due to unstable foundations, the pupils still struggled to grasp the concept. This difficulty is unsurprising, as sustainability is a complex concept even for adults. Nevertheless, during their presentations, the pupils showcased considerable creativity, and moreover the beginnings of a deeper understanding of sustainability that sought to integrate ecological, economic, and social aspects. This school project functioned as an eyeopener and catalyst, inspiring the teacher education students to further develop content and methods for teaching sustainable development.

In line with many other educational institutions, some of us, lecturers on the teacher education degree programme at UCL, have been interested in promoting UBU for several years. About 10-15 years ago, the Danish Outdoor Council's concept of 'Green Flag Green School' spread to a number of schools nationwide. To adapt this concept to teacher education, Odense Teacher's College, as it was then known, along with similar colleges in Frederiksberg and at Nørre Nissum, were invited to conduct pilot projects involving teacher education students. As part of the project at Odense Teacher's College, we arranged for students to visit some schools that were implementing the 'Green Flag Green School' initiative to see how it was working in practice. The point of the 'Green Flag Green School' initiative is that pupils, in collaboration with teachers and other adults, propose ways of making their school more sustainable. These proposals are expected to be practical enough to be feasibly implemented, such as turning off lights or installing solar panels on the roof. The pupils' good ideas were then supposed to be discussed by a committee comprising representatives from pupils, teachers, service staff, and the administration. However, one critique voiced by students regarding the 'Green Flag Green School' initiative was that the praiseworthy ideals of democracy and equality quickly evaporated on the committees: pupils found it difficult to have their voices heard. In the teacher education programme, we attempted to emulate the 'Green Flag Green School' concept by establishing a steering group with representatives from management, teaching staff, service staff, and students. However, here too, democracy and equality were hardly in evidence, as attendance by students, teaching staff and management gradually dwindled. Quite simply, it was hard to get people to attend committee meetings. Perhaps the time was not ripe, because the environmental challenges were not as clearly profiled as they are today. Among the students, only a few prioritised working for sustainable development; and at the management level there was a prevailing belief that introducing new initiatives into the degree programme would be too cumbersome and too costly.

Establishment of the Module

In 2018, it became possible at UCL to establish interdisciplinary specialisation modules worth 10 ECTS credits for second-year students. We proposed a course entitled 'Teaching for Sustainable Development'. The idea was to equip students with the skills to plan, implement, and develop teaching in sustainable development through project-based activities, designing usable teaching materials (Hansen, 2016) and courses - for primary and secondary schools, special schools, outdoor schools, and educational services provided by external agencies. The module was divided into three parts. In the first part, we introduced an interdisciplinary knowledge platform to demonstrate how scientific perspectives from the natural sciences, the social and health sciences, the humanities and the field of didactics may be integrated into education for sustainable development.

Fig. 1 Shows the common knowledge platform for the UBU specialisation module in teacher education at UCL University College (Ruge & Kristensen, 2022 UCL)

What fields of knowledge are integrated within the UBUSP?

Theory of Education: Social learning, social constructivism, a holistic concept of man.

Didactics: An investigative, problem-oriented, critical constructive didactic approach.

Health sciences: Human health and the prevention of disease and epidemics.

Social sciences: Communication, participation, action and democracy. Economics. A humanistic vision.

Natural sciences: Earth's ecosystems and climate change, the crisis of biodiversity.

This knowledge platform provided the students with a common foundation for participation in the UBU module, bridging potential academic differences. Initially, students were exposed to various professional approaches, including site visits to companies working with environmental and energy issues, such as The Fyn Power Station and Fyn Energy, as well as visits to Stige Ø, a former landfill site now transformed into a recreational area for residents of Odense.

In the second part of the module, the focus shifted to teaching methods within UBU, notably UNESCO's framework (UNESCO, 2019), and the incorporation of the UN's Sustainable Development Goals into instructional materials. In this context, visits were organized to various schools where sustainability was taught, such as the 'Green Flag Green School' concept, and schools promoting sustainable food programmes like 'LOMA - local food in Svendborg' (LOMA, 2022).

In the third part of the course, students worked in groups on self-selected thematic issues based on the first and second parts. They were introduced to the project-oriented working methodology outlined by Graf et al. (2019). The students' projects constituted their module assignment, requiring the presentation of theoretical considerations and the development of a didactic concept for UBU. The individual project and this didactic concept were presented and evaluated within the group at the end of the course.

A broad diversity of ideas

The students' projects were highly diverse. They were aimed at various target groups in terms of various parameters: age, individual subjects, interdisciplinary subjects, learning environments, etc. Additionally, content varied in terms of mediums and formats: for example, some students wrote a rap music number on sustainability as an inspiration for the pupils.

- One group of students developed an advanced board game, helping pupils to learn more about the UN's Sustainable Development Goals.
- There was a proposal for expanding the LOMA concept to a special school.
- One group worked on creating a model of how to collect dew for drinking water in countries with dry climates.

- Another group created a website with teaching units and learning materials entitled 'Friends of Water'.
- One group utilized the UN's Sustainable Development Goals for the cross-cultural teaching of pupils in South Africa and Denmark.

Characteristic of all groups is that they have worked in an investigative manner, seeking creative solutions to their problem-solving tasks. In other words, they have found multiple ways of meeting the competency goals of the module.

Aims and methods in UBU teaching.

Competency goals for the module

The competency goals for the module required students to be able to assess, plan, and execute subject-specific and interdisciplinary projects on sustainable development in Danish schools in a manner that contributed to the common goals of multiple different subjects. The skill-based and knowledge-based goals required students to be able to:

- explain and evaluate various theoretical frameworks concerning sustainability, and their own acquired knowledge of definitions of sustainability, as well didactic and general educational theories relating to teaching for sustainable development.
- account for and assess conflicting interests regarding perceptions of sustainable development, and their own acquired knowledge of such conflicting interests, in relation to different attitudes towards sustainable development.
- plan and execute UBU teaching units based on the UN's 2030 goals for sustainable development, while comprehending the connections between local and global environmental issues.
- design teaching units in which pupils discuss future scenarios regarding the ecological limitations of the planet, grasping the concept of 'Ecological Footprint' locally, regionally, and globally, including linear and circular material cycles.
- design interdisciplinary teaching units and materials on sustainable production, while understanding the environmental impact and carbon footprint associated with the production and consumption of various goods, including foodstuffs.
- plan project units that emphasised the development in pupils of action skills regarding the sustainable utilisation of resources, while providing the students themselves with a knowledge of the theory and practice of projects concerning human interaction with nature and technology.
- discuss school development from a sustainable perspective, including whether various initiatives related to school structure and culture might promote the motivation of pupils to engage in sustainable development work.

Theoretical educational and didactic approaches

From 2018 to 2021, when the specialisation module was up and running, the aims, methods, and guiding principles stayed pretty much the same, covering the areas represented by the common knowledge platform (see fig. 1). Our overarching educational and didactic theory was grounded in a social constructivist approach to teaching, and we made extensive use of Klafki's theories about epochal key problems (Klafki, 1996). This meant that we also covered topics related to teachers' core professional knowledge, which

is a subject in teacher education. In our teaching we aimed to adopt an investigative and problem-based approach, oriented towards action and practice, thereby inspiring students to develop action-oriented teaching materials themselves. This was put into practice in connection with the interdisciplinary project work (Part Three), one product of which might be to develop materials for use in Danish schools. The didactic challenge was therefore twofold, because the all-pervasive theme was the importance of teachers assuming the role of 'reflective practitioners' (Weirsø, 2020).

The UBU Module and Internationalisation

Over the three years of the project, international students also participated in the UBUSP module. In 2022, there were thirteen international teacher education students, comprising six from Spain (Vigo and Barcelona), five students from Japan (Tsuru), and two from Switzerland (Bern).

The language challenges were addressed by conducting the joint teaching sessions in English for the entirety of Part I. During company and school visits at which the local guides spoke Danish, lecturers or fellow students assisted by offering translations into English. In Part 1 of the course, groups were composed of both Danish and international students, in such a way that there were 2-3 foreign students from the same country alongside Danish students. This arrangement allowed students to assist each other with language-related issues. Teaching in English was a challenge for both international and Danish students, but the collaboration between Danish and international students has been a valuable learning experience. In fact, there has been a sort of 'double learning' process, combining subject-specific learning through assigned tasks with *intercultural learning*, as it was possible to make comparative analyses of different consequences of the same problem based on conditions in Denmark and in the international students' countries of origin. This added a very special *authentic* dimension to the UBUSP module.

For instance, students compared various consequences of global warming, such as a drought in Spain, melting glaciers in Switzerland, and floods in Denmark. By presenting each other with such concrete examples, students added a global dimension to their studies. Swiss students explained how they went on a study trip to a glacier in connection with Geography lessons in a school; they were able to observe how the glacier was retreating and discuss the implications of this for tourism in the area. Another topic in 2022 was nuclear power as an energy resource, and in this case the Japanese students were able share their own experiences of the serious radiation problems resulting from an accident at a Japanese nuclear power plant. Students from Spain and Switzerland, where there are also nuclear power plants, described the environmental and safety consequences of storing radioactive waste under the seabed or in the mountains. The Danish students initially adopted a naive attitude towards the problems associated with nuclear power, but hearing about nuclear power issues from their peers - and in an international perspective - left a deep impression.

In Parts II and III of the UBUSP, students were working on their own project assignments and were given the option of forming monolingual groups with fellow students from the same country. This allowed them to work on tasks in their own language, although assignment results and presentations, as well as peer feedback, were presented in English. Being able to work in their own language made it easier for students to complete the project

assignment, partly because it facilitated communication within the groups, and partly because it was easier for them to find material on the internet via websites in their own language.

Student's learning outcomes

In order to investigate the students' learning outcomes from participating in the UBU module, from 2019 onwards, Dorte Ruge, who is a researcher at the Centre for Applied Educational Research (CAS, 2022), was able to conduct semi-structured focus group interviews with the students towards the end of each UBU course. Questions and answers were incorporated into our action research. The same interview guide was used throughout the three years, and the collected data were analysed using NVivo software, providing a basis for concluding what academic learning outcomes were gained by the participating students.

Questions and answers

The interview guide for the focus group interviews listed the following questions:

- What topic have you chosen for your project assignment? Why did you choose that topic? How do you think this topic and assignment can contribute to your role as future teachers of sustainable development?
- How do you view the future of 'Planet Earth'?
- What role do you think teachers will play in the future in terms of contributing to solutions to climate and environmental problems?
- As regards UBU, what do you think will be your role when you start working as teachers after completing your education?
- What do you think about project-centred educational theory and didactics as elements in UBU education? Are you familiar with the UN's Sustainable Development Goals? If yes, will you use them in your project assignment? If yes, will you use them in your teaching as future teachers?
- Is there anything new that you have learned or come to reflect on in connection with the UBU specialisation module? Do you have any ideas or suggestions for the next UBU specialisation module at UCL University College?

The following section contains selected quotations that we deemed typical or representative of the teacher education students' responses over the three years in which the study was conducted.

We interpreted the students' responses as indications that they felt they had achieved academic learning outcomes in the form of knowledge and skills that would improve their future work as schoolteachers. Even though there might be no subject specifically named 'sustainable development', their new competencies could be used to integrate UBU across multiple subjects. One example of this is evident in the following quotation, in which students explain why they chose this topic for their individual project assignments:

Question 1)

What topic did you choose and why?

S2: OK, so, we chose to focus on food, in relation to CO² emissions. And we chose that basically because firstly, we thought it was interesting to deal with food, and because we think it's a very relevant topic, because that's where, as an individual, you can change quite a lot.

S1: Yes, and it is something everyone can do, I mean it is so much part of your everyday life, that even the pupils can, like, relate to it in some way /.../

S2: Yeah, because we found out that there were a lot of pupils who didn't think about what they ate, in relation to the carbon footprint and so on, and that's just what we want to change, so that maybe they might just think a bit more about what they ate, and when they ate different things.

Question 2)

How do you see the future for 'Planet Earth'?

S1: Well, when it comes to the Earth as such, I kinda feel like it will manage, you know? So, it is more ourselves we should be worried about. It is our lives that might not go on - even if we wipe ourselves out, Earth will bounce back eventually. But yeah, I'm worried, but I also know that we can figure out the solutions, and actually, we already have many of the solutions, but the problem is that sustainability doesn't always match with money, and that's why we haven't really kicked off finding all these solutions to the problems, 'cause it's not how you make money.

There were indications that the students saw themselves as role models for the pupils, and several of them said they reckoned they would assume a certain responsibility for this area at the school where they would be employed:

Question 3)

How do you see your role in contributing to green transition and sustainable development?

S1: I do not know if it will be a very central role, but I definitely think that as a teacher you can help pass on this mindset, 'cause it's hard to change. I mean, you can compare it a bit to languages, it's hard to learn a language when you're an adult and already know some other languages, whereas when you're a kid, it's kinda easier to learn something new. So, it is easier to kinda shape the kids to do, let us say, the right things. Or at least the environmentally right things.

S3: I also think they should learn about it, either at home or in school.

S1: Yes.

S3: So, we play a very central role in this, can do at least if we, yeah...

S2: I also feel a certain responsibility.

Expressing their personal professional view, the students also felt that now teaching about the environment and climate change is an overwhelming challenge and might even seem a bit depressing. However, they believed that education, information, and opportunities for practical action would provide their pupils with motivation and hope for their own future.

Question 4)

What role do you think you will have as teachers in relation to UBU?

S2: I definitely think I'll bring my own views into it, and what comforts me is what I think will comfort others too.

S1: Also just passing on knowledge, you know, providing some facts about what is going on, and so on and so forth.

S4: Yeah, I think it's important as a teacher to pass on this information, like you say, instead of saying, like, the world is going to end in ten years' time if we don't do this and that, you should just provide facts about what different things do, and what we could possibly do better, you know, real facts...

S3: You have to find a balance, just conveying the facts without wrapping them up in your own opinions.

The students especially highlighted the project-based work as very informative, offering an opportunity for personal immersion in methods and topics they were passionate about. At the same time, they had gained hands-on experience about collaborative learning with other students.

Question 5)

Is working project-oriented in the UBU specialisation module a good idea?

S1: Yeah, I think so, because visiting different places, also later when we're working, we're going to need more than just one subject area. There are always several different subjects involved. We are also going to be working alongside different professions and yes... It is seldom that you only have to use one subject anyway /.../ So it's really good to learn things by seeing where you can use one particular subject, and where you can use another.

Regarding the question as to whether the students had learned anything new or had come to think about something new during the UBUSP project, several students said that the module had influenced not only their thoughts about their own teaching but also their thinking about their own personal lifestyle.

Question 6)

Is there anything new that you have learned or come to think about in connection with the UBU specialisation module?

S1: I really feel like this semester I have personally changed my mindset a lot at home. Like, for example, I started on a more vegetarian diet pretty soon afterwards. And also, just sorting things out, and thinking about what you actually use all these resources for, and not buying a pair of shoes when you already have a pair of shoes /.../ Yes, it has definitely changed things a lot.

Our reflections and views

In summary, our assessment is that the UBUSP, as a didactic model, provided students with good opportunities to achieve academic learning outcomes encompassing cognitive, socio-emotional, and action-oriented competencies (cf. UNESCO's definitions).

Regarding the cognitive, knowledge-based domain, we were pleased to note that students from humanities backgrounds entered the UBUSP with the same energy and constructive

approach as students with natural science or social science backgrounds. In other words, the UBUSP was not only relevant for students with scientific knowledge or STEM profiles (UCL, 2021b). Data from the students' products, project assignments, indicated that while they did draw on their own subject areas, at the same time the investigative approach fostered an interest in being curious about, and wanting to explore, other areas of study that were needed in the module, but which they would not otherwise gain insight into through traditional subject-based teaching. One example of this was working with themes related to the supply and consumption of energy, which presented students with individual, local, national, and international perspectives. In 2022, there was a clear trend towards more bachelor theses focusing on 'Education for Sustainable Development', suggesting that students who earlier, in their second year, had participated in the UBUSP carried this perspective forward into the later stages of their degree course.

In terms of the sociocultural domain, action research investigation of our own teaching practices within the UBUSP, as well as the follow-up research, made it clear to us that the student teachers' academic outcomes were closely linked to the fact that they were able to immerse themselves in a challenge involving educational and didactic theory that they considered both relevant and important, thus achieving the objective and subjective balance expressed in Klafki's concept of *Categorical Bildung*. However, there were also signs that some students experienced this challenge as overwhelming, with consequences that sometimes seemed daunting.

In relation to the domain of action, the way teaching was organised meant that the students had an influence on what problem they wanted to investigate. This gave them a practical setting in which to decide how they would tackle their own problem formulation and what specific teaching materials they would develop, such as teaching units, guides, videos, PowerPoints, workshops, websites, or other resources. Moreover, the didactic approach adopted meant that the teaching materials they developed were of such a quality that the students could use them in many connections: subject teaching, general teaching, teaching practice, their own professional bachelor thesis on the degree programme – or indeed in their own country in the case of international students. So, these findings harmonise well with what is regarded as important and recommended for UBU in teacher education in the 2022 UBU report.

Regarding the theory of 'UBU 1 and UBU2' as two tracks within UBU (Vare & Scott, 2007), the progression in our module 'Education for Sustainable Development' is structured in such a way that factual knowledge, technology, changes in behaviour, and personal action are integrated to form one general educational component. Critical thinking is therefore a fundamental competence in the UBU specialisation module and is promoted by the problem-oriented and project-oriented method that students use in their own project assignments. We have never considered only using UBU in our teaching, perhaps because both of have drawn on the MUVIN project¹, which combined the acquisition of knowledge with the development of critical thinking and action competence in relation to sustainable development (Breiting & Mogensen, 1999).

¹ Miljø Undervisning i Norden: <http://www.muvin.net/handlekompetence-muvin.html>

In a broader perspective, students who have participated in UBU teaching might choose to create their own portal to share their own new UBU teaching materials with other students. In this way they would gain even greater ownership of recent developments in the educational and didactic theory behind UBU, which so far has primarily been formulated by experienced teachers and researchers from universities and teacher training programmes at university colleges, or by educational publishing houses (Lysgaard & Jørgensen, 2020; Højholdt & Kristensen, 2021).

One implication of the results of our study was that it now seemed relevant to investigate whether the recipients, in this case the schools on Funen where the trained teachers would be employed, agree that the students' interdisciplinary ESD competencies were attractive and relevant - and whether these schools might have suggestions for further improvements and collaboration?

A further implication of the didactic model applied in the UBUSP is that it is legitimate to discuss whether this version of a UBU specialisation module helped strengthen particular subject areas, such as the natural science subjects, or whether the interdisciplinary approach was perhaps considered by some stakeholders as the unfortunate dilution of a subject area considered by them to be important? This question also pertains to the changes introduced with the 2022 curriculum guidelines for teacher education, which included the discontinuation of specialisation modules in general. A possible positive implication of this may be that the changes allow for integrating UBU as a fixed element in teacher education, which in fact was proposed by several students as a better model for the future. If we consider the experience gained from the UBUSP regarding project-oriented teaching, positive results in terms of students' academic learning outcomes may also be achievable using a didactic model in which UBU is integrated into existing subjects. However, we assess that in most subjects, it may be difficult to achieve the same depth of material and *Categorical Bildung* offered by the UBU specialisation module at UCL.

From an international perspective, the experience gained from the UBUSP has been incorporated into an ongoing Erasmus Plus project at UCL: *Sustainable Competences in Higher Education* (2022-2024). Based on UNESCO's guidelines, the partners will develop at bachelor level a new interdisciplinary curriculum for 'Education for Sustainable Development' (ESD) in Norway, the Czech Republic, Slovenia, and Denmark. UCL is responsible for the project management and for developing project-oriented teaching methods for ESD using a design-based research approach based on a common *State of the Art report (SustainComp, 2022)*. We hope that by the end of the project, new didactic resources available online will benefit both UBU and ESD - in local, international, and global perspectives.