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Teaching the Green Deal

Designing a course programme
empowering in- and pre-service teachers
in teaching European Green Deal Issues

Peter Bom, Lida Klaver, Tamara van Heel,
Symen van der Zee, Patrick Sins, and Jasmijn Maseland



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Prof. dr. Charles Hopkins'* and dr. Katrin Kohl's** response to the EASE project:

“It is a great initiative and best-practice of how to make sense of a global education concept in a regional setting!”

“It has long been suggested that Education for Sustainable Development (ESD) was a key enabler of all 17 SDGs and should be engaged in local, national, and even international sustainable development implementation schemes. We see EASE as a novel attempt at using an ESD adaptation to implement the EU initiative, and as such, is an important innovative undertaking.”

* Charles Hopkins is UNESCO Chair in Reorienting Education towards Sustainability at York University, Toronto, Canada.

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Foreword

Education is one important venue to shape a sustainable and democratic future. In an era defined by complex challenges such as climate change, resource scarcity, and shifting global dynamics, it is essential that young people develop the knowledge and skills necessary to navigate and contribute to these pressing issues. Citizenship education plays a critical role in this process, as it exercises students to think critically, engage in informed discussion, and take shared responsibility as citizens of the world.

This book presents the results of the EASE project, a carefully designed initiative that builds upon the foundations of Scientific Citizenship—an approach that gives a central place to socio-scientific issue in citizenship education, developed with the financial support of TechYourFuture (TYF). As the initiator of the original project, I am proud to see how this work has evolved, deepening the conceptual underpinnings and refining the methodology to support educators in tackling sustainability topics in the classroom.

The strength of this approach lies in its sound design. The EASE project was not just about developing a course; it was also about assessing its effectiveness. The research findings presented in this book show that many teachers, both pre-service and in-service, struggle with integrating sustainability education into their teaching. They often lack both the subject matter knowledge and the pedagogical tools to engage students in meaningful discussions about the European Green Deal and other sustainability challenges. By systematically addressing these barriers, the EASE course provides teachers with a structured, research-informed approach that enhances their ability to facilitate complex discussions and decision-making processes in the classroom.

At the heart of this educational approach is group problem-solving, an approach rooted in deliberative democracy that encourages students to collaboratively explore socio-scientific issues. The four didactic principles—thinking together, arguing, network thinking, and decision-making (developed in my PhD thesis)—are not just theoretical constructs; they have been tested in educational practice and shown to improve students' ability to engage with real-world problems. The authors have developed and refined these principles with depth. The book not only outlines the theoretical foundations but also provides concrete examples of how they can be implemented in diverse classroom settings.

What makes this project particularly valuable is its practical impact. Teachers who participated in the EASE course reported feeling more confident in addressing sustainability issues, facilitating discussions, and guiding students in making well-reasoned decisions. Moreover, students exposed to this approach demonstrated greater engagement, critical thinking, and a deeper understanding of the complexities surrounding sustainability and citizenship.

I hope this book serves as an inspiration for educators, policymakers, and researchers alike. The challenges we face require informed, engaged, and responsible citizens—this book provides the tools to help educators nurture precisely those qualities in their students.

Dr. Laurence Guérin
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Introduction EASE

Climate change and environmental degradation pose existential threats to Europe and the wider world. To address these challenges, Europe is implementing a growth strategy aimed at transforming the European Union (EU) into a modern, competitive, and sustainable economy. The European Green Deal (EGD) serves as the overarching framework to make the EU's economy sustainable for future generations, with a target of achieving climate neutrality by 2050. To shape this vision, Europe's next generation needs to acquire knowledge, develop critical thinking skills, and adopt values and behaviours that foster active engagement with the EGD (European Commission, n.d.). This mission is in line with the commitments made by 18 EU member states at the UNESCO World Conference on Education for Sustainable Development (ESD), which aims to strengthen and accelerate ESD worldwide in support of achieving the Sustainable Development Goals by 2030 (UNESCO, 2020; 2022). In the further elaboration of these commitments, it is recommended to train teachers in teaching sustainable development and advocate for more and better opportunities for teacher development and self-assessment of their teaching approaches (UNESCO, 2024). The Education Assembly for a Sustainable Europe (EASE) project addresses these goals by designing and evaluating pre-service and in-service teacher training courses (EASE courses). These courses equip primary school teachers and pre-service teachers with the knowledge and skills required to teach lessons addressing Education for European Sustainable Development (EESD; the European equivalent of ESD). The EASE courses intend to support teachers to gain the necessary general science knowledge about climate change and biodiversity, teaching skills to foster students' arguing and ability to take in different perspectives and collaboratively search for solutions.

Teacher training courses are highly needed since research indicates that many primary school teachers lack the subject matter expertise, including knowledge about the European Union and EGD-related topics, necessary to teach broad and complex themes effectively (Guérin et al., 2013; Inspectie van het Onderwijs, 2022). They also often lack the pedagogical strategies needed to handle such complexities (Chen & Xiao, 2021; Guerin et al., 2013). Additionally, teachers report that preparing for and implementing active teaching strategies is a time-intensive process. Consequently, teachers within the EU may be inadequately prepared to teach complex EGD topics and to apply active teaching methodologies that systematically foster European citizenship competencies, such as critical thinking, connected learning, and argumentation.

The EASE project builds on the principles of deliberative democracy, an epistemic theory that emphasizes citizen autonomy and acknowledges the complexities of issues tied to the EGD (Guérin, 2018). This approach recognizes the contentious nature of such issues while identifying viable solutions. Deliberative democracy advocates for collective decision-making, with careful deliberation being the most effective way to achieve sound decisions.

To translate this theory into practical pedagogy, Guérin (2018) developed the “group problem solving” approach, which is grounded in four educational principles: (1) argumentation, (2) connected learning, (3) decision-making, and (4) collaborative thinking. EASE employs this approach to design teacher training courses centred on EESD. In this context, group problem solving enables teachers to guide students through structured deliberation processes, fostering collaborative reasoning and the exchange of knowledge about policies and societal, economic, and environmental considerations related to the EGD.

The overarching goal of EASE is to enhance teachers' and students' participation in democratic processes while strengthening their understanding of EGD-related issues. This is vital for the EU's future, to support educators and young people to face challenges and actively engage with their communities and in the social and political life of the Union. EASE serves as a tangible realization of the UNESCO commitments on ESD (UNESCO, 2020; 2024).

This e-book reports on examining opportunities to educate and empower teachers to implement ESD goals in the context of EGD issues. Chapter 1 delves into the educational principles underpinning the group problem solving approach. Chapters 2 and 3 detail the development, implementation, evaluation, and improvement of courses focused on ESD goals in the context of EGD for pre-service and in-service teachers. The final chapter offers concluding insights into how teachers can be better equipped to deliver high-quality education about the EGD.

REFERENCES

- Chen, L., & Xiao, S. (2021). Perceptions, challenges and coping strategies of science teachers in teaching socioscientific issues: A systematic review. *Educational Research Review*, 32, Article 100377. <https://doi.org/10.1016/j.edurev.2020.100377>
- European Commission (n.d.). *Green education*. Retrieved from <https://education.ec.europa.eu/fo-cus-topics/green-education>
- Guérin, L. J. F., van der Ploeg, P. A., & Sins, P. H. M. (2013). Citizenship education: The feasibility of a participative approach. *Educational Research*, 55(4), 427–440. <https://doi.org/10.1080/0013181.2013.844945>
- Guérin, L.J.F. (2018). *Group problem solving as citizenship education*. Saxion Progressive Education University Press.
- Inspectie van het Onderwijs. (2022). *Peil.Burgerschap einde basisonderwijs 2019-2020*. <https://www.onderwijsinspectie.nl/documenten/themarapporten/2022/03/09/peil.burgerschap-einde-basisonderwijs-2019-2020>
- UNESCO. (2022). *Berlin Declaration on Education for Sustainable Development; Learn for our planet: Act for sustainability*. UNESCO World Conference on Education for Sustainable Development 2021, online. <https://unesdoc.unesco.org/ark:/48223/pf0000381228>
- UNESCO. (2020). *Education for sustainable development: A roadmap*. UNESCO. <https://doi.org/10.54675/YFRE1448>
- UNESCO (2024). *Recommendation on education for peace, human rights and sustainable development*. <https://unesdoc.unesco.org/ark:/48223/pf0000388330>

PART 1

Teaching the Green Deal

1.1 FROM VISION TO TEACHING MODEL

In EASE, we build on the principles and goals of an approach based on the idea of deliberative democracy (Guérin, 2018). This view assumes a society in which citizens make informed decisions together and have a say. The deliberative democracy view aims to encourage citizens' autonomy, takes into account the complexity of issues relevant to the EGD, and recognizes the controversy of such issues. Deliberative democracy allows learners to build and articulate individual perspectives and develop their collective problem-solving ability. This aligns with the UNESCO ESDs for 2030 Roadmap (UNESCO, 2020) and mirrors UNs' sustainable development goals of empowering individuals to address interconnected social, environmental, and economic challenges (United Nations, n.d.).

For educational practice, this means teaching students to collaboratively think about and deliberate on solutions to social problems. For example, you can get students to work on the following issues: if we want to heat all houses in the Netherlands without gas, would it be better to solve this by solar boilers or by switching to heat pumps; what is a good solution to remove particulate matter from the air; what is the best way to prevent the plastic soup from growing; and how do we deal with nanotechnology?

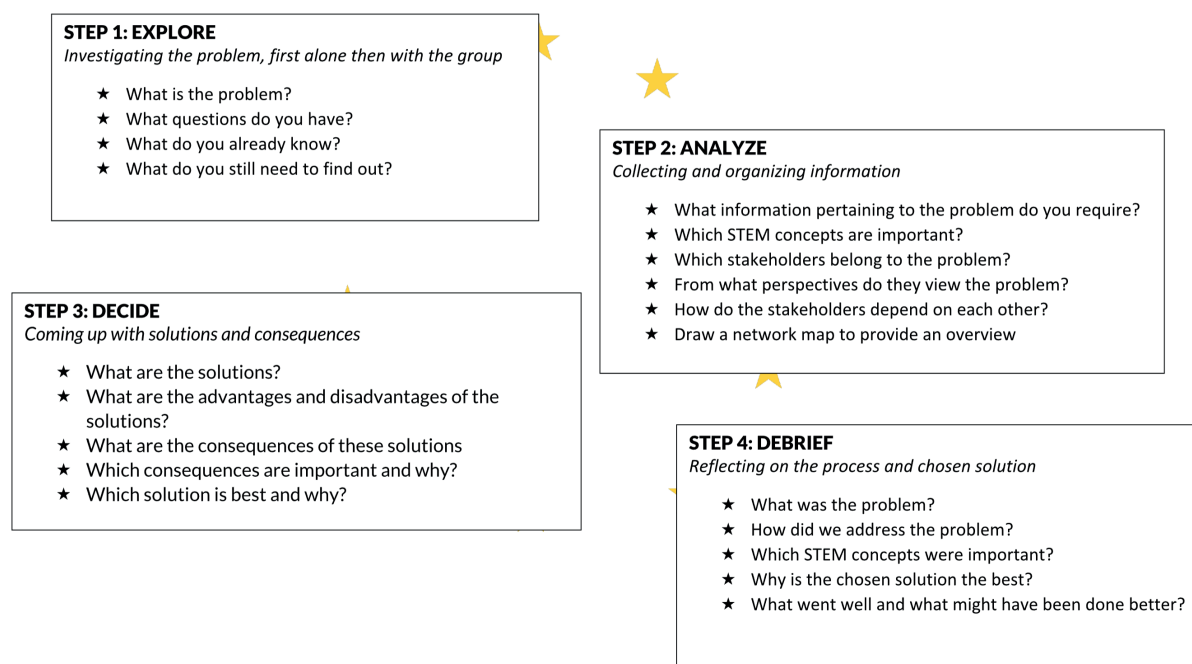
This vision of deliberative democracy was translated into a practical didactic approach for teachers called Scientific Citizenship (Tolkamp et al, 2019). This approach is similar to socioscientific issues approaches that in which issues with social and scientific dimensions are central; students are introduced to the science knowledge needed to better understand the citizenship issues (Klaver, 2025). Since the issues concerning the EGD have both natural science and social aspects, the Scientific Citizenship approach is well suited to addressing these issues in the classroom. Scientific Citizenship uses the educational design model group problem solving (GPS).

GPS involves students working in groups on learning activities, discussing and making decisions together about social issues. In the process, students learn to think critically and ultimately come to a solution together. The GPS lesson model consists of the following four steps:

1. Students explore the issue by investigating what they already know about the topic and what they still need to find out.
2. In this step the issue is analysed. Students immerse themselves in the topic and start collecting information from different sources. Therefore, they collect information not only from books but can also question experts or organize a visit to a company or institution.
3. Students work toward a decision that they make collectively based on good arguments.
4. The groups present their solutions to each other. And there is reflection on how the process of group problem solving went.

Figure 1 shows the central questions involved in each of these steps.

Figure 1
Educational design model Group Problem Solving (GPS model).



Note: Adapted with permission from “Bèta en technologie in burgerschapsonderwijs”, Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

For the teacher to support students’ group problem solving competencies, the following four didactic principles are important (Guérin, 2018; Tolkamp et al., 2019): (1) thinking together, (2) arguing, (3) network thinking and (4) decision making. These four didactic principles are elaborated in the next section.

1.2 DIDACTIC PRINCIPLES OF SCIENTIFIC CITIZENSHIP

In this paragraph the four didactic principles of Scientific Citizenship are outlined.



Principle 1 - Thinking Together

The essence of the principle of thinking together is in the exchange students have with each other. This ensures that all students are involved and should avoid one student being dominant from the start. Thinking together is also referred to as ‘Exploratory Talk’. In these ‘thinking together’ conversations, students exchange relevant information for joint consideration. Their devised solutions, arguments and opinions are discussed, and alternatives may be offered. Students look for similarities to move forward (this can be done, for instance, with the placemat method). Without fulfilling this principle, opinions and arguments remain with the individual and it is impossible to take another person’s interests into account. By thinking together, the EGD issue can be more precisely understood, and solutions and decisions are more strongly substantiated.

Note: Adapted with permission from “Bèta en technologie in burgerschapsonderwijs”, Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

Thinking (learning) together is a group process. To be effective, the thinking process must be carried out collaboratively. In this way, students can fully benefit from the knowledge and insights gained in the group.

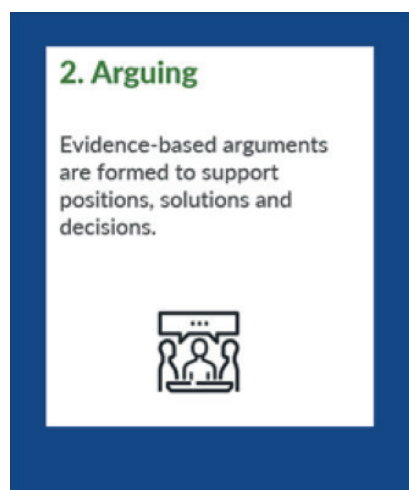
Thinking together in class means that students build on each other's contributions and ideas by asking each other questions, critically responding to the shared information and answers, and that all students actively try to contribute to the shared understanding within the group. Thinking together in a group is stimulated when learners have different types of information on the same topic. Students will need to engage with each other to explain ideas, listen to each other and ask questions of each other to consider different perspectives. By aggregating, sharing and disseminating knowledge, their individual as well as common knowledge is increased and improved. While thinking together, students also learn to formulate arguments to support or contradict a perspective or solution and to (re)consider jointly thought-out solutions.

The essence of the collaborative thinking principle is that students acquire new knowledge or concepts by benefiting from each other's content by relating and integrating it.

Activities for thinking together

One activity that is very suitable for practicing 'thinking together' with students in class is Socratic conversation. A kind of explorative talk, yet in a Socratic conversation students' opinions are explicitly included. A Socratic conversation is a structured dialogue in which students think more deeply about important questions, such as the EGD issues and sustainability in the classroom. The conversation starts by asking for students' opinions on a question or statement that is meaningful to the students. You can do this by having the students think about a concrete experience of their own that ties in with the question. As a teacher, it is important to ask in-depth questions. Often this is the why- or how-to question or by applying other questioning strategies. Make sure that not only you as a teacher ask the questions, but that the students question each other. In this way, they practice groupwise exploring each other's opinions.

An important feature of a Socratic conversation is that students respect each other's ideas. The Socratic conversation ends by jointly establishing a conclusion, core assertion or principle.



Note: Adapted with permission from "Bèta en technologie in burgerschaps-onderwijs", Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

Principle 2 - Arguing

In the learning activities of the GPS model, students will often argue with each other. These arguments are formulated based on evidence and are used to support positions, solutions, and decisions. In discussions, learners engage with each other's arguments.

The didactic principle of arguing therefore revolves around collective argumentation skills, the argumentation skills of a group. These argumentation skills are reflected in interactions as learners ask for explanations when exchanging evidence, as they respond substantively and adequately to another's argument, as to how an argument is countered, but also how a student deals with students' counterarguments. Within this principle, arguing does not aim to win the discussion, but the arguments (for and against) are used to reach a deepening of the problem or solution. The aim of the principle of arguing is that if students are able to argue well (as a group) the group can come to a better formulation, a better analysis of the social issue, and ultimately provide a rationale for the best-fit solution. The quality of the arguments used in discussion depends, among other things, on the extent to which students respond to each other's arguments and on the knowledge used.

Within this principle, it is important that every learner has space to contribute an argument. It is also important that students listen to each other respectfully. To avoid only the dominant students making themselves heard, various working methods can be used. Students can be explicitly asked to give their argument or view on the subject, based on the information they have gathered earlier. When learners have good argumentation skills, it increases learners' autonomy. This is because learners learn how to defend, confirm, or revise their own position or viewpoint. By hearing and using good arguments in which facts are used to support a position, more knowledge about the issue is automatically gained. Thus, arguing (together) leads to an enrichment of thinking together.

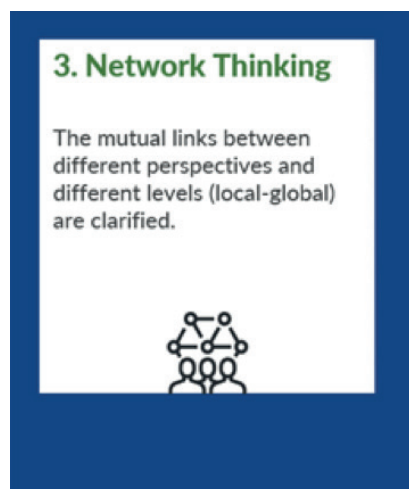
Activities for arguing

Using an argumentation bingo card, students can practice identifying different types of arguments, as well as whether an argument is an opinion and not based on evidence. Some students are assigned to keep track of the argumentation bingo card during a class discussion and to feed back at the end what types of arguments they heard.

Multiperspectivity - Sustainable clothing

For example, a cotton farmer might have a different view than an environmentalist on how to save water when producing clothes.

A solution that works fine at the local level is not always a meaningful solution at the global level.



Note: Adapted with permission from "Bèta en technologie in burgerschaps-onderwijs", Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

Principle 3 - Network Thinking

An important step in the GPS model is to explore the different perspectives, parties involved and decision levels (such as local versus global). When learners start network thinking, the interconnections between these different perspectives and different levels are established. Learners start actively looking for the similarities and differences in the perspectives and levels. Network thinking reveals the network and interconnections of a social problem, this is also called multiperspectivity.

The aim of the principle of network thinking is for students to understand different perspectives. Thus, different people are involved (actors) who each view the problem, but also the solution, in their own way. The aim of network thinking is not to arrive at a solution that meets all needs. That is impossible, because every change has consequences, which can be positive and negative and have a different impact per actor and level.

Starting from the principle of network thinking, learners learn to understand the complexity of the issue by getting to know different actors, the diverse interests of the actors and looking at the issue from different contexts. Through various learning activities, interconnections of different perspectives that were not immediately visible at first glance are made visible.

Activities for network thinking

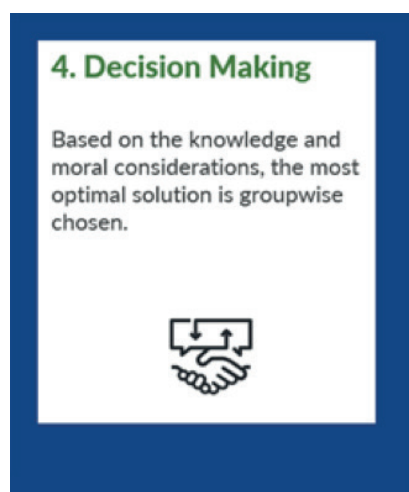
For students to practice network thinking, there are various learning activities. These provide students with new insights and make connections between different insights. For example, role-plays give students the opportunity to learn about the different perspectives and interests of actors involved. For

role-playing, several passports can be made available for each actor, but students can also work with a blank passport and an assignment to fill it in for different actors.

Other activities include showing films, telling narratives or introducing students to different actors through their own research, such as a company that makes toys from wood and a company that manufactures toys from plastic or the living conditions of an agricultural worker in the Netherlands and in Romania.

The role of visual support

To support learners in “seeing” the connections in a network, visual supports are very useful. Visual support, such as a network map or a mind map, unburdens working memory. Using these visual supports, relationships and connections are visualized.



Note: Adapted with permission from “Bèta en technologie in burgerschaps-onderwijs”, Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

Principle 4 - Decision Making

The decision-making principle brings together all the skills and acquired knowledge of the other principles. Students can make decisions group-wise, when they formulate a solution on a societal issue where they use the knowledge gained during ‘thinking together’ and ‘network thinking’ to form arguments (principle ‘arguing’) and then evaluate the solutions and decide together.

In a Green Deal issue (or socioscientific issue), making decisions is a complex process. This is due to the number of different actors involved, the knowledge required and the level at which the issue is situated (local, regional, national or global). In addition, every solution has both positive and negative consequences. By applying the principles of ‘thinking together’ and ‘network thinking’, the complexity of the issue can be better understood and addressed.

When no attention is paid to making an informed decision, the issue is simplified, and the most logical and easiest solution is often chosen: a ‘short-cut’. This short-cut is then made because it is difficult to view different perspectives, knowledge, and

aspects when making decisions. However, the most obvious solution is not immediately the best solution. When the group makes a decision on which solution is the most appropriate option based on the knowledge and insights gained, learners are supported to make moral and informed trade-offs. To prevent students from making a short-cut, there are various forms of work that can support students in the process of making a decision, such as the expert method elaborated below.

Making informed decisions promotes learners’ autonomy. They are given a voice. It is not the teacher who decides what is right, but the students themselves who learn to weigh arguments and make a decision together.

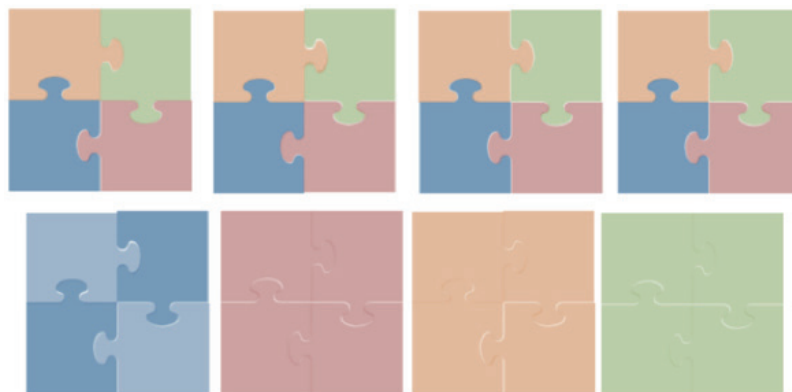
Activities for Decision Making

The Expert Method (also known as jigsaw, see Figure 2 for a visual representation of the activity) is an effective activity in which skills such as cooperation, communication and critical thinking are practiced. In a structured approach, groups of students delve into a topic, these groups are the so-called ‘expert groups’. In the expert group, students delve into a particular piece of information or an actor. You can give the students sources or hints where they can gather information about their specific topic.

New groups are then formed, the 'jigsaw' groups in which decisions will be made. Each jigsaw group includes one student from an expertise group. In the jigsaw groups, students share their findings and knowledge from their expertise. After all the information has been shared within the jigsaw group, the students start asking each other questions and discussing the topic. Based on the information within the jigsaw group, a solution can be chosen. Arriving at a solution or decision can occur within the jigsaw groups, as well as with the whole class.

Figure 2

Visual representation of the Expert or Jigsaw Method



REFERENCES

- Guérin, L. J. F. (2018). *Group problem solving as citizenship education: Mainstream idea of participation revisited*. Saxion Progressive Education University Press. <https://research.rug.nl/en/publications/group-problem-solving-as-citizenship-education-mainstream-idea-of>
- Klaver, L. T. (2025). *Do your students engage with socioscientific issues? Socioscientific capital in civic science education*. Saxion Progressive Education University Press. <https://doi.org/10.3990/1.9789036563499>
- Tolkamp, J., Guérin, L., & Klaver, L. (2019). *Bèta en technologie in burgerschapsonderwijs*. TechYourFuture. <https://www.techyourfuture.nl/wp-content/uploads/2023/04/Praktijkboek-Beta-Burgerschap.pdf>
- UNESCO (2020). *Education for sustainable development: A roadmap*. UNESCO. <https://doi.org/10.54675/YFRE1448>
- United Nations (n.d.). *The 17 goals of sustainable development*. <https://sdgs.un.org/goals>

PART 2

Design of the EASE course

2.1 DESIGN PRINCIPLES

To develop the professional development (PD) programme, the literature on effective teacher professionalization was reviewed and compared. General review studies on teacher professionalization and more specific studies focusing on professionalization with respect to the teaching of socio-scientific issues (SSI) were examined. Based hereon, seven effective principles were established, which form the basis for the design of the teacher professionalization. Table 1 depicts the found design principles and the sources that mention them.

Table 1

Design principles teacher professionalization

Principle	Sources	Session
1. PD systematically integrates SSI theory and practice.	Timperley et al. (2007) Van den Bergh et al. (2014) Van Driel et al. (2012)	All sessions
2. PD provides opportunities to take part in active learning related to teachers' daily work (developing tasks, assessments, observation, reflection, analysing student learning, presenting theory).	Firestone et al. (2020) Timperley et al. (2007) Van Driel et al. (2012)	Session 1, part 1 and 2 Session 2, part 2 Session 3, part 2 Session 4, part 2 and 3 Session 5, part 2 and 3 Session 6, part 2
3. PD is collaborative in nature. Teachers develop their understanding and skills of SSI subject matter and student learning through interaction, argument-driven discourse and collaborative reflection.	Kinskey & Zeidler (2020) Lee & Yang (2019) Mukagihana et al. (2021) Van Driel et al. (2012)	Session 1, part 2 Session 2, part 2 and 3 Session 3, part 3 Session 4, part 2 and 3 Session 5, part 2 and 3 Session 6, part 2
4. PD is coherent in terms of its goals and design, and based on a theory of improvement that specifies how features of the intervention(s) relate to each other and the goals of the PD.	Timperley et al. (2007) Van Driel et al. (2012)	All sessions
5. PD provides detailed SSI content related to the instructional programme.	Mukagihana et al. (2021) Timperley et al. (2007) Van Driel et al. (2012)	Session 1, part 2 Session 2, part 1, 2 and 3 Session 3, part 1 Session 4, part 1 Session 5, part 1

Principle	Sources	Session
6. PD systematically includes modelling of SSI classroom practices by a teacher educator or experienced teacher (opportunities to see approaches implemented in real or simulated classroom situations) and engages teachers as SSI learners (make implicit knowledge explicit, examine own and others' beliefs, consideration of the nature of science, appreciation of complexity).	Evagorou & Mauriz (2017) Gray & Bryce (2006) Leung (2021) Struyven et al. (2010) Timperley et al. (2007) Van Velzen (2013)	Session 1, part 1 and 2 Session 2, part 2 and 3 Session 6, part 2 if guest speakers are invited and they present something
7. PD includes redesigning SSI lesson plans based on reflection on data of one's own classroom (being observed, observing students, questioning students) and providing theory informed feedback to each other.	Foult et al. (2020) Kinskey & Zeidler (2020) Lee & Yang (2019) Leung (2021) Schnellert et al. (2008) Timperley et al. (2007) Van Driel et al. (2012)	Session 2, part 2 Session 3, part 2 and 3 Session 4, part 2 Session 5, part 2 and 3 Session 6, part 1

The above-mentioned design principles were used to design the teacher training course. The final course programme will be shown in paragraph 2.4. The column 'Session' in Table 1 shows in advance in which part of the programme the different design principles recur.

2.2 GOALS OF THE EASE COURSE

The goals of the EASE course are based on literature on teaching about SSI and the EGD, European Education for Sustainable Development (EESD), teacher professionalization for it, and the challenges teachers face when it comes to teaching SSI/EGD/EESD. In general, the EESD goals align with the recommendations in the report on the project Teacher Education for ESD in the Asia-Pacific (UNESCO, 2019) and the UNECE document Competencies for ESD teachers (UNECE, 2008).

Below the more specific goals concerning the participants' knowledge, skills, and attitudes are presented.

A. Knowledge about EESD

1. Knowledge of the connection between curriculum standards, citizenship education, SSI education, EESD, and the EGD.
2. Knowledge of the essence of SSI (Evagorou [2015] and Evagorou et al. [2014] in Evagorou & Puig Mauriz, 2017)
 - a. Knowledge of and about the science involved in SSI (Chen & Xiao, 2021; Garrecht et al., 2022; Kiliç et al., 2013; Kinskey & Zeidler, 2020; Kokolaki & Stavrou, 2022; Özden, 2015; Sadler, 2011)
 - b. Knowledge of the moral/ethical considerations regarding SSI (Garrecht et al., 2022; Kinskey & Zeidler, 2020; Kokolaki & Stavrou, 2022)
 - c. Knowledge of the social considerations associated with SSI (Kokolaki & Stavrou, 2022; Sadler, 2011)
3. Knowledge about the educational principles for group problem solving.
 - a. Knowledge of argumentation and the evaluation of arguments (Kinskey & Zeidler, 2020)
4. Knowledge about the resources students bring into EESD (Klaver et al., 2023).

B. Skills regarding EESD

1. The ability to redesign learning activities according to the educational principles for group problem solving: (1) argumentation, (2) connected learning, (3) decision making and (4) thinking together.
2. The ability to stimulate students' group problem solving skills.
 - a. The ability to help students make connections between science, SSI (Kinskey & Zeidler, 2020; Kokolaki & Stavrou, 2022), and the EGD.
 - b. The ability to facilitate moral and ethical development of students (Garrecht et al., 2022; Kinskey & Zeidler, 2020)
 - c. The ability to facilitate discussion and argumentation in the classroom, evaluate students' SSI arguments during the discussions in the classroom, and provide feedback (Bossér et al., 2015; Chen & Xiao, 2021; Evagorou [2015] and Evagorou et al. [2014] in Evagorou & Puig Mauriz, 2017; Kinskey & Zeidler, 2020)
 - d. The ability to facilitate science learning in the context of SSI (Kinskey & Zeidler, 2020; Kokolaki & Stavrou, 2022).
3. The ability to value students' resources in EESD (Bossér et al., 2015; Klaver et al., 2023).

C. Attitudes towards EESD

1. Being interested in SSI (Chen & Xiao, 2021; Kiliç et al., 2013) and the EGD
2. Feeling responsible for addressing SSIs (Chen & Xiao, 2021; Kiliç et al., 2013) and the EGD in the classroom
3. Feeling secure about the uncertainties and unpredictability related to SSI (Garrecht et al., 2022)
 - a. the handing of control to students (Bossér et al., 2015; Chen & Xiao, 2021; Garrecht et al., 2022; Kahn, 2021; Sadler, 2011),
 - b. being honest about knowledge limitations (Sadler, 2011)
 - c. willingness to position themselves as knowledge contributors rather than the sole authority (Bossér et al., 2015; Sadler, 2011)
 - d. confidence to touch upon controversial aspects (Bossér et al., 2015; Chen & Xiao, 2021; Garrecht et al., 2022)
 - e. open-mindedness to student positions that differ from the teacher's own (Kahn, 2021)

The above goals that relate to participants' knowledge, skills and attitudes are translated in the study guide into student learning objectives that meet the following requirements:

- They form the basis for the design and implementation of teaching and assessment.
- They indicate to students what they are expected to learn during the course. They also indicate what will be tested and assessed.
- They give (to colleagues and external institutions) an impression of the teaching and of the minimum level achieved by successful students.

The learning objectives as they are presented in the study guide are as follows.

After the EASE course, participants will be able to:

1. Describe the vision of different actors for different themes of the European Green Deal.
2. Draw up their own lesson objectives for a lesson in which a European sustainable development problem is central, from the core objectives of 'Citizenship' and 'Orientation to yourself and the world' (Ministerie van Onderwijs, Cultuur en Wetenschap, 2006; SLO, 2024).
3. Explain to primary school students about different themes within the EGD (both from a scientific and social point of view), connecting to and using students' prior knowledge, experiences, and beliefs.
4. Use the four didactic principles when redesigning learning activities.
5. Guide learners while applying the four didactic principles and using effective teaching approaches.

2.3 FEEDBACK IN THE PROCESS OF DESIGNING THE COURSE

After finishing the first version of the EASE course five experts studied the study guide and the accompanying script for teacher educators and provided these documents with feedback. Below, this feedback is discussed and it is explained how the feedback is used to improve the course programme.

Teacher experience

The first issue the experts highlighted, was that the course relies too much on experienced teachers who 1) are familiar with various activities to enable students to collaborate and 2) know how to guide students in a classroom or group discussion. In response to the first issue, we added in the study guide for each step of the GPS model an appendix describing an activity that can be applied in the step in question. Less experienced teachers (such as pre-service teachers) may use these descriptions, more experienced teachers adapt these activities according to their own insights or use a self-devised activity appropriate to their practice situation. Furthermore, to support participants in guiding students during group discussions, a table of conversation techniques has been added in the study guide. During the second meeting, the participants are asked to study a transcript of a conversation of a teacher with a group of students and to determine which conversation techniques in the table are used by the teacher and with which of those techniques the discussion could have been deepened. By discussing these questions with each other, the participants become aware of the effect of the conversation techniques, lowering the threshold for applying them. For experienced teachers the focus is more on how the conversation techniques can be applied in the specific situation of the EGD issues, while for less experienced teachers it is more about mastering the techniques themselves.

Pedagogical climate

Another point raised by one of the experts is that the course focuses mainly on didactics and hardly on pedagogy while creating a good pedagogical climate is important during collaborative assignments as recommended in the EASE course. To improve this, we provided standard questions focusing on the pedagogical climate to assist participants in providing each other adequate peer feedback in sessions 3 and 4. For example: 'how do you ensure a good pedagogical climate when the students work together in groups?' As participants pose these questions to each other, they reflect on the consequences concerning the pedagogical climate of their lesson design and consider possible improvements. Although we considered raising the subject of pedagogical climate more thoroughly in the EASE-programme, we decided not to do so since this subject is already sufficiently covered in other parts of teacher education. Therefore, the EASE programme refers pre-service teachers to the knowledge addressed in those specific parts of teacher education. Participating in-service teachers are expected to be acquainted with the strategies related to the pedagogical climate or at least possess such knowledge within the team.

Goals

The next issue several experts drew attention to is that the goals were not sufficiently sharply formulated resulting in participants not having a clear idea of the success criteria. So, we revised the goals and formulated them more specifically, focusing on output. For example, instead of 'After the course, the participant will be able to set goals for a lesson focusing on a sustainable development problem', this goal was formulated as follows: 'After the course, the participant will be able to draw up their own lesson objectives for a lesson in which an EGD theme is central, based on the curriculum standards of "Citizenship" and "Orientation to Yourself and the World" (Ministerie van Onderwijs, Cultuur en Wetenschap, 2006; SLO, 2024)'.

Subject knowledge

Two experts mentioned that participants may not have the assumed prior knowledge of science. In the script, participants are assumed to have a basic knowledge of, for example, 'enhanced greenhouse effect', but the experts indicated that this is certainly not always the case. They therefore recommend a more extensive exploration of the underlying natural science knowledge. As a result, we adapted the programme of the first meeting and added an explanation by the teacher educator to clarify the four

issues in relation to the Green Deal: 1) the enhanced greenhouse effect, 2) loss of biodiversity through nitrogen emissions, 3) loss of biodiversity through pesticide use, and 4) issues surrounding waste (including plastic soup).

Apart from the above-mentioned issues, the experts also mentioned several minor suggestions, such as: some textual adjustments to make the study guide easier to read, consistent use of terms, explaining certain terms in more detail and making more specific reference to the appendices. By following these suggestions and addressing the issues, the programme and the accompanying study guide have been improved significantly.

2.4 THE FINAL EASE COURSE

Structure of the sessions

In the EASE course, teachers and students learn how to shape (their own) sustainable development lessons using the group problem solving approach (GPS lesson model) and the four didactic principles. The full course consists of six sessions that are designed based on the seven design principles for EESD. During the first four meetings, participants reflect on the EGD issues and the elaboration of the four didactic principles and how these take shape in practice within the GPS lesson model. During the last two meetings, the participants are designing their own lessons. Table 2 depicts an overview of the sessions. In most cases participants will try out (a part of) the designed lessons in their own practice between the 5th and 6th session, however this is not obligatory.

Table 2

EASE course overview with content and didactical themes per session

Session	EGD Issue	GPS model step(s)	Didactical Principle
1	Increase of CO ₂ , decline of biodiversity, and plastic waste.	1 and 2	All principles in general
2	Costs and benefits of clean energy.	2	Arguing/thinking together
3	The own environment	2 and 3	Network thinking
4	Climate action	3 and 4	Decision making
5	Own choice	All steps	All principles
6	Own choice	All steps	All principles

In view of different types of participants, for example, participants with significant teaching experience or those having limited time, the EASE course can be shortened.

Three scenarios are:

- Try out – 2 sessions
- Intermediate – 4 sessions
- Top gun – 6 sessions

The programme below describes the full ‘Top gun’ scenario. In the ‘Try out’ version only session 1 and 2 are included, in the ‘Intermediate’ version session 2 and 3 are merged, as well as session 4 and 5.

Ideally, each meeting takes 3 hours. If this is not possible, decisions need to be made to create meetings that fit within 1,5-hours and meet the goals (see paragraph 2.2) and the design principles (see paragraph 2.1) for the EASE course. During the programme, participants are asked to complete a preparation assignment prior to the meetings.

Description of the sessions

Session 1: Learning about the European Green Deal issues

In order to obtain an impression of where the EASE course is about, prior to this session, students read through the introduction to the study guide (Appendix A). Then the first session starts with an introduction of the issues addressed in the European Green Deal (EGD), followed by a demonstration of a GPS lesson. Herein, participants experience a lesson on EGD themselves. By reflecting on this lesson, the participants discover how the GPS lesson model and the didactic principles work in practice. The session ends with the assignment to try-out the first two steps of the GPS model in practice.

Session 2: Thinking together and arguing

Prior to this meeting, participants deepen their understanding of the content by reading an article on the global warming issue. They also conduct and record a talk with some students (3 or 4) on that topic. In the second session the participants use the (transcripts of) audio recordings to evaluate their students' argumentation in small groups using guiding questions like: what do you think of your students' argumentation? How did the activity itself go? How did the didactic principle of argumentation work for you? Were you satisfied, would you do it differently another time? During this evaluation they examine their students' praxis of the didactic principles of thinking together and argumentation. After that the participants experience the principles arguing and network thinking by performing a role-play around the energy transition. Taking different perspectives is central to this.

Session 3: Network thinking

Prior to this session, participants read an article on the various processes occurring to make the Netherlands climate neutral and Appendix A and H of the study guide about Network thinking. Furthermore, they take stock of what climate and environmental issues are going on in their group by using an appropriate work format for this (for example Appendix F of the study guide). During the session, participants create a network map around a topic within their students' perceptions. From there, they develop a lesson design for their own class in which their students have to create a network map and learn how to take different perspectives. This session ends with the assignment to try out the lesson design in their own practice and collect data on what their colleagues and/or students think of their EGD-lesson.

Session 4: Decision making

Prior to the session the participants have tried out their EGD-lesson and collected data. The session starts with a discussion of the didactic principles network thinking and decision making. Then, in groups, participants discuss how they experienced practicing their EGD-lesson and the collected data. Next, the participants discuss how teachers in general should guide students in the process of making decisions together and how to review with students the process of thinking together, arguing, network thinking, and decision making (the 3rd and 4th steps of the GPS model). In groups, participants figure out how they, as a teacher, can ensure that the students make joint decisions based on arguments. Finally, the participants discuss with which actions their students would probably like to contribute to solving the problem using the network drawn in session 3. This session ends with the assignment to study the Scientific Citizenship teaching materials on file and choose lessons suitable for the participant's own practice.

Session 5: Designing EGD-lessons

This session starts with an introduction about the EGD outlining the broader picture (i.e., connection to global approaches to sustainable development) and discusses which of the Scientific Citizenship teaching materials participants think fit with the EGD and are suitable for their own group (and why). Then, groups of participants who want to work with (roughly) the same teaching materials are formed. Within those groups the participants (re)design a lesson series on one of the EGD issues for their own group, according to the GPS model. The design should clearly indicate what science knowledge students gain and how the four didactic principles are applied. In the final part of the session, participants are

instructed to decide how to test the designed lesson series by collecting feedback from students or colleagues. If possible, they apply the designed lessons in their class.

Session 6: Presentations

In the pre-service teacher training, for this session, guests (e.g., mentors or colleagues of participants' internship such as the citizenship/culture/science coordinator or school director) are invited. Prior to this session, participants prepare a short presentation (pitch) of the lesson series design and the feedback from their colleagues and students. In the session, the participants pitch their lesson design, the collected feedback, and their recommendations for practice, followed by questions from the other participants and a short discussion. In the pre-service teacher training the guests act as judges and determine which lesson series they thought was best and why.

The EASE study guide and teacher educator script can be found in Appendix A and B, respectively.

REFERENCES

- Bossér, U., Lundin, M., Lindahl, M., & Linder, C. (2015). Challenges faced by teachers implementing socio-scientific issues as core elements in their classroom practices. *European Journal of Science and Mathematics Education*, 3(2), 159–176. <https://doi.org/10.30935/scimath/9429>
- Chen, L., & Xiao, S. (2021). Perceptions, challenges and coping strategies of science teachers in teaching socioscientific issues: A systematic review. *Educational Research Review*, 32(100377), 1–14. <https://doi.org/10.1016/j.edurev.2020.100377>
- Evagorou, M., & Puig Mauriz, B. (2017). Engaging elementary school pre-service teachers in modeling a socioscientific issue as a way to help them appreciate the social aspects of science. *International Journal of Education in Mathematics, Science and Technology*, 5(2), 113–123. <https://doi.org/10.18404/ijemst.99074>
- Foulk, J. A., Sadler, T. D., & Friedrichsen, P. M. (2020). Facilitating preservice teachers' socioscientific issues curriculum design in teacher education. *Innovations in Science Teacher Education*, 5(3), 1–18. <https://innovations.theaste.org/facilitating-preservice-teachers-socioscientific-issues-curriculum-design-in-teacher-education/>
- Garrecht, C., Czinczel, B., Kretschmann, M., & Reiss, M. J. (2022). 'Should we be doing it, should we not be doing it, who could be harmed?': Addressing ethical issues in science education. *Science and Education*. <https://doi.org/10.1007/s11191-022-00342-2>
- Gray, D. S., & Bryce, T. (2006). Socio-scientific issues in science education: Implications for the professional development of teachers. *Cambridge Journal of Education*, 36(2), 171–192. <https://doi.org/10.1080/03057640600718489>
- Kahn, S. (2021). No child too young: A teacher research study of socioscientific issues implementation at the elementary level. In W. A. Powell (Ed.), *Socioscientific issues-based instruction for scientific literacy development* (pp. 1–30). IGI Global. <https://doi.org/10.4018/978-1-7998-4558-4.ch001>
- Kilinc, A., Kartal, T., Eroglu, B., Demiral, Ü., Afacan, Ö., Polat, D., Demirci Guler, M. P., & Görgülü, Ö. (2013). Preservice science teachers' efficacy regarding a socioscientific issue: A belief system approach. *Research in Science Education*, 43(6), 2455–2475. <https://doi.org/10.1007/s11165-013-9368-8>
- Kinskey, M., & Zeidler, D. (2020). Elementary preservice teachers' challenges in designing and implementing socioscientific issues-based lessons. *Journal of Science Teacher Education*, 1–23. <https://doi.org/10.1080/1046560X.2020.1826079>
- Klaver, L. T., Sins, P. H. M., Walma van der Molen, J. H., & Guérin, L. J. F. (2023). Strengthening science education through attention to student resources: A conceptualization of socioscientific capital. *Journal of Research in Science Teaching*, 60(5), 1162–1192. <https://doi.org/10.1002/tea.21827>
- Kokolaki, A., & Stavrou, D. (2022). Pre-service primary teachers develop teaching artifacts on contemporary socioscientific issues. *Journal of Science Teacher Education*, 1–20. <https://doi.org/10.1080/1046560X.2022.2078546>

- Lee, H., & Yang, J. (2019). Science teachers taking their first steps toward teaching socioscientific issues through collaborative action research. *Research in Science Education*, 49(1), 51–71. <https://doi.org/10.1007/s11165-017-9614-6>
- Leung, J. S. C. (2021). Shifting the teaching beliefs of preservice science teachers about socioscientific issues in a teacher education course. *International Journal of Science and Mathematics Education*. <https://doi.org/10.1007/s10763-021-10177-y>
- Ministerie van Onderwijs, Cultuur en Wetenschap. (2006). *Kerndoelenboekje basisonderwijs*. Ministerie van Algemene Zaken. <https://www.rijksoverheid.nl/documenten/rapporten/2006/04/28/kerndoelenboekje>
- Mukagihana, J., Nsanganwimana, F., & Aurah, C. M. (2022). Effect of instructional methods on pre-service science teachers learning outcomes: A meta-analysis. *Education and Information Technologies*, 27, 2137–2163. <https://doi.org/10.1007/s10639-021-10696-9>
- Özden, M. (2015). Prospective elementary school teachers' views about socioscientific issues: A concurrent parallel design study. *International Electronic Journal of Elementary Education*, 7(3), 333–354.
- Sadler, T. D. (2011). Socio-scientific issues-based education: What we know about science education in the context of SSI. In T. D. Sadler (Ed.), *Socio-scientific issues in the classroom: teaching, learning and research* (pp. 355–369). Springer Science Business Media. https://doi.org/10.1007/978-94-007-1159-4_20
- Schnellert, L. M., Butler, D. L., & Higginson, S. K. (2008). Co-constructors of data, co-constructors of meaning: Teacher professional development in an age of accountability. *Teaching and Teacher Education*, 24(3), 725–750. <https://doi.org/10.1016/j.tate.2007.04.001>
- SLO. (2024). *Conceptkerndoelen leergebied burgerschap + toelichtingsdocument*. SLO. <https://www.slo.nl/publicaties/@23473/conceptkerndoelen-leergebied-burgerschap/>
- Timperley, H., Wilson, A., Barrar, H., & Fung, I. (2007). *Teacher professional learning and development. Best evidence synthesis iteration*. Ministry of Education. <https://www.educationcounts.govt.nz/publications/series/2515/15341>
- UNECE (2008). *Competencies for ESD teachers; A framework to integrate ESD in the curriculum of teacher training institutes*. https://unece.org/fileadmin/DAM/env/esd/inf.meeting.docs/EGC/CSCT_Handbook_11_01_08.pdf
- UNESCO (2019). *Report on the project: Teacher Education for ESD in the Asia-Pacific Region*. <http://ceteesd.ed.okayama-u.ac.jp/pdf/200511.pdf>
- Van Driel, J. H., Meirink, J. A., van Veen, K., & Zwart, R. C. (2012). Current trends and missing links in studies on teacher professional development in science education: A review of design features and quality of research. *Studies in Science Education*, 48(2), 129–160. <https://doi.org/10.1080/03057267.2012.738020>

PART 3

Implementation and evaluation of the EASE course

To find out whether the final version of the EASE course meets the set goals described in session 2.2, the course was implemented in different groups of pre-service and in-service teachers and evaluated. In this part, first the implementation is outlined followed by a qualitative and a quantitative evaluation.

3.1 IMPLEMENTATION OF THE EASE COURSE

Overview

The EASE course has been implemented in five different groups of teachers. In November/December 2023 the first implementation occurred in Rotterdam with a group of twenty parttime pre-service teachers. Unfortunately, this was cancelled after two sessions because the participants did not think the EASE course fitted in the programme of their teacher training. This will be discussed more in-depth below. The second implementation was also in Rotterdam with 15 pre-service teachers. The third implementation was with a group of pre-service teachers (3rd years). In this case the EASE course was embedded in an international minor (Saxion minor *Innovative Educational Approaches*). Session 1, 2, and 3 were carried out with the whole group in the Netherlands. Since most students had an internship abroad, the 4th (and final) session was carried out online in small groups. The participants were 21 Dutch and 2 Italian students and 1 student from the United Kingdom. The fourth implementation was with a large group of fifty two pre-service teachers (3rd year of teacher training). This group was split into four groups since it was not considered feasible to carry out the learning activities in a large group. The fifth and final implementation was with a group of 12 in-service teachers of a primary school in Enschede. Table 3 summarises the five implementations carried out and the type of data collected.

Table 3

Overview of the various implementations of EASE course

Group	Period	EASE course type	Participants	N	Data collection
Rotterdam parttime	Nov. – Dec. 2023	Cancelled after 2 sessions	Pre-service teachers	15	Pre-test initial questionnaire
Rotterdam Bachelor	March – Jun. 2024	4 sessions (intermediate)	Pre-service teachers	15	Pre- and post-questionnaires
Saxion Minor	Feb. – Jun. 2024	4 sessions (intermediate)	Pre-service teachers	24	Pre- and post-questionnaires
Saxion Bachelor	May – Jul. 2024	6 sessions (top gun)	Pre-service teachers	52	Pre- and post-questionnaires, two focus group interviews
School	Sept. – Nov. 2024	4 sessions (intermediate)	In-service teachers	12	Pre- and post-questionnaires, one focus group interview

Brief recap of the first implementation in Rotterdam, November 2023

The participants in the implementation of the EASE course in Rotterdam were part-time students already working as teachers in a primary school. These students did not see the relevance of the didactics, deliberative democracy did not resonate immediately. Furthermore, the course strongly aimed at primary upper grades and was therefore not considered as relevant by part of the group. Another problem was that these students were mostly in their thirties and had already had a lot of practical teaching experience. The six sessions version was therefore experienced as too much dry practice; they would rather try out the theory immediately into practice. Moreover, the GPS model can only be applied if certain conditions are met (concerning class climate, prior knowledge level, cooperation skills).

Based on the comments above we made some changes to the programme. In the first place, we added examples of how the Green Deal lessons could be applied in the lower grades of primary school. Further, we focused less on dry practice and more on practical execution. In the following implementations, all participants performed one or more lessons in practice between the second to last and last session.

Recruiting in-service teachers

Finding in-service teachers willing to participate in the EASE course was a challenge. This is possibly due to the teacher's deficit in the Netherlands resulting in teachers who are fully committed to the classroom and have no time left to attend training. In addition, a citizenship coordinator of the municipality of Utrecht explained to us that many schools in the Netherlands are not yet ready for the EASE teacher training. They are still thinking about how citizenship can have a place in the curriculum. Finally, we found a primary school in Enschede who was ready and eager to participate in the EASE course. This school is in a part of the Netherlands where the shortage of teachers is less acute. In addition, this school has been focusing on citizenship for some time.

3.2 QUALITATIVE EVALUATION OF THE EASE COURSE

This paragraph reports and discusses the methods and results of the focus group interviews about two implementations of the EASE course. First, the implementation of the top gun version with pre-service teachers and then the intermediate version with in-service teachers.

Method

To evaluate the EASE teacher training courses, we organized three focus groups. Regarding the first implementation, both pre-service teachers and teacher educators were interviewed, regarding the second implementation only in-service teachers were interviewed. All groups were asked to reflect on their experiences, specifically regarding their participation in the EASE courses, which focused on citizenship education within the framework of the European Green Deal.

Focus group 1: Pre-service teachers (top gun version)

The first focus group comprised seven pre-service teachers who had completed an EASE module ("Beroepstaak"). These third-year bachelor's degree pre-service teachers (aged 19-27) participated in the EASE training while they also did internships in upper and middle primary education, as well as in special education. It was a convenient sample but there were participants from all subgroups. The focus group followed a semi-structured interview guide, which began with informed consent, emphasizing the anonymization and secure storage of data according to ethical guidelines of our university. Participants were informed that there were no right or wrong answers, and the session was recorded for later analysis.

The discussion included the following questions:

- How did you experience the sessions?
- What are your thoughts on the course goals?
- What did you think about the course structure and the teaching methods?
- How did you find the assignments, and what did you learn (in terms of subject matter, didactics, knowledge, skills, and attitudes)?
- Is this knowledge applicable to your future teaching practice? Why or why not?
- Was there anything missing from the course or areas that could be improved?
- Would you recommend the course to others? Why or why not?

The focus group lasted approximately one hour and concluded with an open invitation for participants to add any final thoughts.

Focus group 2: Educators (top gun version)

The second focus group comprised of all four educators from various disciplines (mathematics, language, technology, and history) who had delivered the EASE lessons. Led by two interviewers, this group focused on the educators' experiences in teaching the course.

The interview followed a similar informed consent process and included questions on:

- Their experience delivering the EASE lessons.
- Opinions on the developed materials.
- Student motivation levels.
- Their assessment of how much the students learned.
- The strengths and weaknesses of the teacher training course.
- Suggestions for improvement and whether the course should be integrated into the teacher training curriculum.

The educators' focus group lasted 30 minutes and also ended with an opportunity for participants to share any additional comments.

Focus group 3: In-service teachers (intermediate version)

This focus group consisted of three teachers from the single primary school that had attended the EASE course. These teachers had volunteered after all participants were asked in the last session who would like to participate in the focus group interview. The same informed consent procedure and same set of questions was used as in the focus groups with pre-service teachers.

By conducting these focus groups, we aimed to gain a comprehensive understanding of both pre-service teachers' learning experiences and educators' teaching experiences, with the goal of improving the EASE teacher training programme.

Analysis of the data

The focus groups were recorded, and the recordings were subsequently transcribed. In analysing the transcriptions of the two focus groups, we specifically looked at what the respondents (students, teachers, and educators) indicated concerning three themes:

1. **Quality of the content;** Sub-themes: objectives, materials, teaching methods, and structure;
2. **Practical applicability;** Sub-themes: alignment with target groups, alignment with other lessons and the curriculum, and challenges in the implementation;
3. **Perceived effectiveness;** Sub-themes: positive learning outcomes for pre-service teachers and students, alignment with citizenship education, opportunities for enhancing the curriculum, positive appreciations, and curricular challenges.

What stood out was that experiences regarding the lesson series were mentioned on two levels. For teacher educators, it mainly concerned their own reflections and what they observed in their students. For the pre- and in-service teachers, it concerned both their own experiences with the lesson series and how they perceived their students experienced it. In the following, the pre-service teachers are called 'students', the in-service teachers 'teachers', and the teacher educators 'educators'.

Results: Quality of the content

Objectives

Particularly, students indicated that it was not always clear what the objectives of the lesson series were for them:

“That was especially the final product. I think we focused more on that than on the lessons themselves. In the beginning, there was a lot of information, and it wasn’t clear: what exactly are you supposed to do to pass the course? I think that initial information, the purpose of it, may have come across, but it kind of went by, because we still weren’t sure what we were supposed to do for this module.” (student)

When it comes to the implementation of the lesson series with their students, students noted that the achieved learning outcomes depend on the goal the teacher has in mind. Content knowledge does not always stick during the lessons. An example mentioned was the nitrogen crisis:

“It depends on your goal, it’s theme-dependent and how you explain it. You can talk to a group about molecules and that nitrogen is a molecule, but that goes in one ear and out the other; you don’t get learning outcomes from that. So, it depends a bit on the group.” (student)

The in-service teachers think the objectives of the course are well-suited to current educational needs, combining both content and skills development.

“Well, I think they fit perfectly in this time, and yes, they have substance. Indeed, they include skills, collaboration, and methods—pretty much everything that comes from the literature is combined here. So, that’s great—yes, definitely, and manageable.” (teacher)

Materials

Teacher educators mentioned that the distinction between the four didactic principles and the steps of the GPS model was sometimes confusing:

“Or yes, what I found difficult sometimes? Switching between the four principles and the four steps. Some steps cover more principles, while other steps don’t touch on them at all. But maybe that’s just how it is.” (teacher educator)

Students agreed (they found it confusing that there are 4 didactic steps and 4 principles; principle 1 does not necessarily match step 1, etc.) and attributed this to a lack of explanation and information on the subjects covered, the GPS model, and the didactic principles. The study guide was not understandable for students because all the knowledge was new, so it did not align well with their prior knowledge. The study guide seemed more suitable for teacher educators.

“But I also think because the theme is somewhat abstract for us, the study guide was kind of meaningless, because you don’t know what it’s talking about. You don’t know the themes, you don’t know the Green Deal, you don’t know the GPS model, nor the didactic principles. You can read through it, but you don’t really understand it. So, more explanation from the teacher is needed.” (student)

A suggestion made by a teacher educator was to reduce the number of topics or allow students to choose within a topic:

“I noticed that students prefer to follow a straightforward path, to be sure. ‘Oh, I’ve done step one, so I’ve also covered principle one.’ So, that’s something to be aware of, and if we develop this further, it might be advisable to focus on fewer topics, maybe just two instead of all four.” (teacher educator)

Students suggested that a lesson preparation form specifically tailored to the GPS model, with assignments and requirements outlined, could be a useful tool. The didactic principles could be explained in a justification for the lesson:

“Well, I think it’s actually useful, but I also think that for this lesson series, there should be a specific lesson preparation form where the assignments and GPS requirements are listed.” (student)

Teachers emphasized the need for guided instruction in the EASE training to bridge the gap between didactics and practical lesson design. They felt that the transition from introduction to independent work was too abrupt and suggested adding structured activities, such as collaborative planning or workforms, to narrow ideas and improve effectiveness. This additional step could better support teams, particularly those new to the content, and enhance the training’s impact:

“I think it would have been valuable to guide us a bit more, perhaps with some sort of structured instruction like, ‘Okay, what could you consider?’ and maybe include a workform so that we could work with more concrete ideas. Of course, we had the didactics from the book at hand, but an intermediate step might have been helpful for the effectiveness of the collaboration.” (teacher)

Teachers stated that the course materials, such as the study guide, contain valuable content, but some sentences are complex and can be difficult to understand. The use of technical terms can be confusing for some participants, reducing accessibility.

“Yes, the only point I have is that some sentences need to be read more than once. Then I tend to set it aside.” (111-113 teacher)

Teaching methods

Regarding teaching methods, teacher educators suggested integrating peer feedback:

“Maybe we should integrate a bit of peer feedback, so students can observe how others do it and reflect on their own teaching. I think it’s valuable for them to gain insight by watching how others teach.” (teacher educator)

Regarding working with the network map during the lessons, students indicated that it gave them more insight into different perspectives:

“Our teacher gave us an example, and, in a group, we had to write down all the actors involved. Then we discussed them in class. This helped us see that many actors are affected, and we can use this for our own topics as well.” (students)

The teachers appreciated the teaching methods, like “choose a corner” and collaborative lesson development and the variety of methods, like presentations and interactive assignments:

“Regarding the closing activity: I found the “choose a corner” exercise in the hall very engaging. It sparked good conversations.” (teacher)

Structure

For teacher educators, the structure of the lesson series, as described in the provided materials, seemed clear:

“The module book was clear. I needed to figure out the overall direction, but it was workable.” (teacher educator)

From the students’ perspective, teacher educators pointed out the importance of a clear structure, including deadlines or checkpoints (go/no-go decisions):

“Students tend to rush through lessons without accountability. Setting clear checkpoints for progress could help.” (teacher educator)

One teacher educator elaborated by suggesting that the course should start with knowledge building around the topics, before moving on to the application:

“It would be interesting to first have a few sessions where we focus on understanding the content before jumping to application.” (teacher educator)

There was also a suggestion to reduce the content further and better delimit it for students (see also under materials):

“Maybe narrow it down and set a clearer timeline, so students can focus on one lesson, bring the feedback, and then teach another lesson at the end.” (teacher educator)

Another teacher educator mentioned that the topics were divided among students to keep it manageable. However, students found many topics to be new, causing confusion:

“It’s challenging to grasp the topics in such a short time, and students didn’t seem to study them all equally.” (teacher educator)

“The first session was overwhelming because the European Green Deal was new to us, and we had to present so much content right away.” (student)

Students agreed that the structure could be clearer by starting with the necessary prior knowledge, especially on the topics and GPS:

“If the structure had been clearer from the start, we wouldn’t have wasted so much time.” (student)

Some students felt there was not enough time for thorough understanding, and that the course duration was too short (see also under practical applicability):

“I wish I had more time to deepen my understanding of the subject, especially since students might ask questions.” (student)

“I felt I didn’t have enough time to teach properly.” (student)

“We won’t achieve our intended goals due to the limited time available. This is a weak point of the course.” (teacher educator)

Lessons learned:

- Clearly define objectives—in both materials and lessons;
- Align the study guide better with students’ prior knowledge;
- Provide prior knowledge on topics, didactic principles, and the GPS model, and allow time for this. A strong introduction to sustainable development and relevant European themes would be beneficial;
- Clarify the distinction between didactic principles and GPS model steps;
- Reduce the number of topics to those more relevant to primary school students or allow students to choose within topics;
- Structure the course for students using clear planning with deadlines/checkpoints. Improve the study guide by including a clear line with submission moments for interim products;
- Consider using a lesson preparation form and peer feedback.
- Enhance the readability of the course materials.

Results: Practical applicability

Alignment with target groups

With regard to the practical applicability of the lesson series in the classrooms of their students, teacher educators indicated that this depends on the population within students' internship class (and that in some cases a translation is necessary). The subjects and the didactic approach do not always align with the target group in education, such as special education or lower grades. It fits best with the upper grades:

"In the beginning, it was like: I had a student who worked in special education with less cognitively strong students, and she ran into: hey, how do I shape this now? And then, when I looked at everything, it is very much aimed at the upper group, so that translation would need to be worked on next time. And at some point, the student chose, well, the easiest way, from her point of view, to go to another school and complete the assignment there, while I think it could be adapted just fine. And you learn a lot from that for your own development." (teacher educator)

"Yes, in some cases, you can translate it well to a kindergarten group and have discussions together, exchanging ideas. That's certainly possible. But yes, in such a specific group, where students are basically only guided individually and where there is very little contact possible, that really plays a role." (teacher educator)

A difference in perspective is that teacher educators also see it as an advantage that students can choose what they find interesting and suitable for their target group:

"The advantage, however, is that students can choose something themselves that they find interesting and that fits their target group. Although I think that my group has also come out mainly on waste or specifically plastic. Which is not necessarily bad." (teacher educator)

However, students say they would like more choice from different themes or subjects that are closer to their target group (simplification)—many students chose the plastic waste issue—so they can provide lessons more specifically aimed at their student population:

"Yes, the first lesson went fine. The second lesson felt like you were really talking to a wall; it was all just a bit too much. So actually, I think I should have chosen plastic waste. But yes, you don't really have much choice in that, or so. So there could perhaps be a bit more variation, so you have more options from different themes. Yes, I also understand that there are certain things we can't do anything about." (student)

Alignment with other lessons and the curriculum

Some students found the connection with other lessons in the curriculum and this lesson series to be challenging. The six-week duration is perceived as short, especially since there is another large project running parallel to this course, in which students also have to develop many new skills (see also under structure):

"Yes, the connection with the lessons from J., the research, yes, there I noticed that my students found it difficult to figure out how to position that in the report." (teacher educator)

However, students indicate that the didactic principles could also be integrated into other subjects:

"You can't only use this here, but also in many other subjects for sure. Well, we also have... Maybe you shouldn't do all four [didactic principles] at once, but I think thinking together, making decisions could be done more often in a classroom setting instead of being teacher-directed, absolutely." (student)

Both students and teacher educators indicated that the timing of the lesson series in the curriculum should be reconsidered. The timing at the end of the school year means that there is less space and attention to deliver these lessons properly. Earlier in the year would be more effective:

"If we still want students to give thorough lessons, really take time for it and make space for it, then such a module shouldn't actually be in the last quartile." (teacher educator)

"That would fit better, in my opinion, also in terms of quantity, because that was also the internship coming to an end, and then you still have to give those lessons. It was all quite tight." (student)

"Yes, but I would, well, yes, I would recommend it. But not in this phase of the training. No, exactly." (student)

Challenges in the implementation

Students indicate that the combination of the complex themes, the GPS model, and the didactic principles does not enhance the applicability of the lesson material—resulting in it “not receiving the attention it deserves” or potentially leading to a less effective implementation:

Speaker 2: *"I think the themes are too difficult, and it's not the fault of the didactic principles."*

Speaker 6: *"That was also the case. It's the GPS model and a new subject, and that's exactly what you actually need to understand in six weeks. And yes, as you say, implementing it in a lesson series, to say, is a bit much."*

Speaker 3: *"Then you're still busy with the research, doing that alongside the other reports that also need to be done. It's quite a lot of new information and many other things you have to do alongside it, which makes this also a bit."*

Speaker 2: *"Doesn't get the attention it deserves!"*

Speaker 4: *"Yes, I sometimes honestly find it a bit... I don't know if it's our class or something. But the idea is nice, but the execution is actually always a bit lacking. Then I think: yes, I could have used this time more effectively, or in a class setting where you receive something more. Yes, it sounds a bit easy, but now you always have to take action yourself before that really happens."* (students)

Finally, students say that taking perspectives did not come naturally for their students during the execution of the lesson series:

"Oh, think about how that is for a farmer. Oh yes, oh yes, oh, we forgot that. I think, yes, yes, but that's difficult because they're then working in groups. You almost have to poke a bit at each group to get them to think about that, but that can't be done, so that was indeed challenging." (student)

Developing lesson materials on complex topics like biodiversity and the European Green Deal was challenging for the teachers. They needed to expand their own knowledge to create effective lessons, which made preparation time-consuming. Finding the right teaching methods and creating a clear lesson plan were also challenges.

"Ehh, yes, it was a bit of a challenge. It's a complex topic, so we had to adjust and figure things out ourselves. Like biodiversity—what does it all entail? You hear things but don't know all the details. You really need to have knowledge yourself to create good activities for the children." (teacher)

Lessons learned:

- Tailor instruction/teaching to the student population—simplifying content/methods/topics.
- Reduce the complexity of the EASE lessons by clarifying the connections with other lessons in the curriculum or considering the suggestions mentioned under quality content.
- Consider what a good position for the EASE lessons is within the curriculum of the teacher training programme.
- Give teachers enough source materials to expand their own topic knowledge.

Results: Experienced effectiveness

Positive (learning) outcomes for pre-service teachers and students

According to the judgment of teacher educators, the curriculum landed better when students started teaching—the motivation of the students increased when they also began giving lessons in practice:

“at one point students found it very difficult and had no clear picture of it. But at a certain moment, when you yourself give that example lesson and engage in discussion with them about a certain topic, they start talking about it. And then, when you link it back to the professional tasks, it lands a bit.” (teacher educator)

Students have also indicated, both by themselves and according to the judgment of teacher educators, that they have learned something about the subjects discussed and acquired skills. Students with the greatest motivation have learned the most in terms of subject content and didactics. This also depended on the group in which the internship was conducted:

“I think it’s a very strong introduction for students about sustainability, just at their own level of what’s happening in that area in Europe.” (teacher educator)

“Some have really learned a lot in terms of content and learned a lot from executing it, while others who took the easiest route—maybe a bit harsh to say—but who chose the least resistance, I think they will have learned the least from it.” (teacher educator)

Speaker 7: *“Yes, in terms of content, I also find it nice, and I have actually felt that some are [doing their internship] in grade 1 and cannot be obligated to deal with nitrogen.”*

Speaker 2: *“No, but I still think it would be good for everyone to get a bit more of all the themes.”* (students)

Teacher educators indicated that their students gave lessons more consciously and reflected on their practices:

“You see a strong element of language coming through there, so I found that very nice, and you really see it come back. And what you also see is that when you talk about students who develop significantly, those are the students who, in that lesson series, at some point in practice realize that they still have not reached the starting situation of the next lesson, so I need to adjust something.” (teacher educator)

For students, the lesson series also offers an opportunity to work on language and language production in an integrated manner:

Speaker 2: *“Well, I think it’s a great topic in terms of language. And what children need to demonstrate in terms of language production at school and which aspects of language come up—yes, this is a fantastic topic; a discussion, argumentation, everything is included. They have to present; GPS (project-based learning) includes a bit of presentation. Well, the topic also speaks for itself, and we need to do a bit more.”*

Speaker 5: *“You could also have language lessons for it.”*

Speaker 2: *“I could take this more into the language lessons.”*

Speaker 3: *“And many skills, indeed, for the teacher. How can you stimulate discussion? How can I bring the students to healthy discussions?”* (teacher educators)

Teachers indicated that thematic projects have led to a significant attitude change in students, which is not typically observed in regular lessons. This involves for instance younger students actively separating waste and addressing others about it, and older students becoming aware of biodiversity and taking actions like working on their gardens, balconies, or schoolyards:

“What I also find beautiful is that you ultimately see a change in the attitude of the children. This is a thematic project, so you have that. You don’t get that in a regular lesson [...] In grades 1 and 2, I see that the children are very good at separating waste and even addressing others about it. Yes. In grades 3 and 4, well, the awareness of biodiversity—how important it is—and that they can actually do something about it themselves. With their own gardens, on their balconies, or in the schoolyard, which we are also continuing to work on. So that’s really beautiful, that there is truly an attitude change taking place in students, which you don’t get with other subjects at all.” (teacher)

Alignment with citizenship education

Teacher educators and teachers find the course valuable. It offers an opportunity to shape citizenship education across subjects with social themes. The series of lessons aligns with citizenship education, where good discussions are central. Teacher educators indicated that there is little room for this in the current primary teacher education curriculum. Various teacher skills are called upon. These skills are not only important for students with a specialization in upper-grade teaching. Students learn to design meaningful education independent of a method. Teacher educators indicated that subjects addressed in the lesson series, such as sustainability and a healthy living environment, deserve a solid place in the curriculum:

“This [sustainability], I mean, is topic number one in the societal debate, and aside from that, nature and living environment and a healthy living environment—I can’t imagine that this will ever come off the agenda. So, in whatever form, you could always pick this part up and indeed give citizenship a solid place.” (teacher educator)

“But I think it would be a missed opportunity if we don’t do this for all students because, you know, those skills of bringing a group into conversation and being aware of perspectives and weighing them, yes, those are just essential teacher skills.” (teacher educator)

Also, teachers emphasized the importance of integrating the course with citizenship education, highlighting its relevance in today’s world. The speaker sees the course as a valuable resource for schools and teachers to effectively incorporate citizenship into their teaching:

“Yes, I would definitely do it because I know that this subject and citizenship, yes, are incredibly important in today’s world. So, anything that can help schools and teachers to give this a proper place within their education is very important, yes” [...] “How do you really shape citizenship education and so on? In that regard, it also provides concrete tools for teams that are still very much searching for it. Yes.” (teacher)

Opportunities for enhancing the curriculum

Students indicated that the lesson series has contributed to improving the quality of their lessons by teaching them to use discussion techniques in which they maintain a neutral position as a teacher:

“Also, especially learning questioning techniques and during circle discussions, where I had that you let the children think for themselves and also that you listen neutrally. As a teacher, you actually try to always do that, remain neutral.” (student)

The lesson series also provided a way to integrate subjects. There are opportunities to integrate subjects and thus create more space in the curriculum. Teacher educators, students and in-service teachers all mentioned how the course helped them realize the value of subject integration, emphasizing that there are no simple solutions and that this broader thinking is a significant takeaway:

“I do think that, in that sense, the strengths of natural integration bring together a number of fields and important content, and I think this is the moment to do something with sustainability, for sure.” (teacher educator)

“But I find it easier to apply subject integration now, because now you know citizenship is broad, and you can link a language to it.” (student)

“Well, there is, of course, a lot to learn, and there are no ready-made solutions. So you have to look at things from multiple perspectives to arrive at a shared solution. And I think that’s what makes it so that, at school, it’s usually like, well, one and one is two. But now we really have to look more broadly. And I think that this content really requires that, and I find that very beautiful. That’s what I have learned, at least. Subject integration.” (teacher)

Teacher educators indicated that they have been able to work with alternative forms of work and didactics in the lesson series—such as arguing based on statements:

“I find the connection to citizenship very nice because then you have opinion formation; you can discuss this here with students based on the statements. In the first lesson, we had very nice conversations, and I realize that this comes up very little in the curriculum. In technology, I occasionally have discussions, all about robotics and how society should look, whether or not to include more technology. But this was, as far as citizenship is concerned, the first time I experienced it so clearly.” (teacher educator)

Positive appreciations and curricular challenges

Students expressed their positive appreciation for the lesson series. At first, the material was somewhat abstract; as it became clearer, it became more interesting. Initially, it was not clear what one could do with this in their internship class:

Speaker 2: *“Interesting topic, very nice.”*

Speaker 4: *“At the beginning, it was a very abstract topic, which wasn’t very clear. Maybe I was the only one who experienced it that way, but afterwards, when it eventually became clearer, it was interesting.” (students)*

While students also provide a realistic view and indicate that the lesson series was simply part of the (mandatory) curriculum:

“Yes, this could have been introduced earlier in the programme because I find it very useful. This is really something that should recur more often in the future.” (student)

Students indicated that at this stage of their education, they would have preferred to spend their time on other topics that seemed more meaningful to them, such as conducting parent-teacher conferences, writing reports, and making group plans.

Speaker 2: *“Well, I found it worthwhile to have practiced it once, but this might not be the best place to indicate that. However, there are so many other things I would have preferred to learn instead of this. I would have liked to have more depth in parent-teacher conversations: how do you prepare for that? Are you actually going to see the child that day? Are you going to make transcripts about it? How are you going to create a plan? What questions are you going to ask? Look, those are things that don’t need to be discussed here, but I would have preferred them instead.” (student)*

Speaker 1: *“When I look at the programme, I think I could learn better things. You know, it’s an important topic, of course, it’s something that’s relevant, the EGD (socially relevant education).*

[...]: Waste is important because of course, it’s relevant.” (student)

“But I can maybe do that myself after graduation, deepen myself. Maybe, yes, because very often, that isn’t done. Therefore, if something comes up in the news, you can create a nice lesson around it.

[...] I think that the topic itself is important to address, but I believe there are other things that haven’t been covered in the programme that are much more useful to learn: how to write a report, how to conduct a parent-teacher conference, group plans, that kind of thing. That’s what this is.” (students)

In addition, students experience confusion because the same components within the curriculum are referred to in different ways. The didactics of the GPS model, for example, seem very similar to doing inquiry learning, with some specific nuances:

Yes, I think the theme is very useful, but I think of the GPS model and its principles: yes, we already have inquiry learning because we learn. It sounds like the same thing but just slightly different every time. I get so many rounds or rules that you must include in a report. I think, yes, it often comes down to the same thing. So maybe it should be a bit more about the substance but with more knowledge and less focus on all those principles. And yes. (student)

Teachers highlighted the difficulty of measuring whether goals, such as raising awareness about biodiversity, have been achieved, even when the goals themselves are clear. While factual knowledge can be easily tested, assessing deeper awareness and understanding remains challenging and unresolved:

“The goal is clear, but how do you measure that goal? Because that’s quite difficult. For us, the goal was for the children to become more aware of the importance of biodiversity, and actually, the first part of the goal—what is biodiversity—can be easily tested. But the other part is a bit more challenging. Yes, how do you measure that? I still find that difficult. That’s a question, and we don’t have to solve it right now, but it’s something to think about” (teacher)

Lessons learned:

- The course is highly appreciated in terms of positive learning and motivational outcomes for pre-service teachers and students;
- More room for active work forms, such as teaching a lesson oneself;
- Avoiding terminological confusion by ensuring that the same terms are consistently used in the curriculum;
- More attention to practical skills within the EASE course;
- Integration of subjects is valuable: The interdisciplinary approach of EASE is viewed positively
- Provide teachers with strategies and tools for assessing less tangible outcomes such as shifts in awareness in addition to factual knowledge.

3.3 QUANTITATIVE EVALUATION OF THE EASE COURSE

Below the quantitative evaluation based on data collected from participants in the three completed implications described in paragraph 3.1 is presented.

Methods

To evaluate the EASE course, a questionnaire was administered prior to (T1) and after the EASE course (T2) to measure participants’ development of the knowledge, skills, and attitudes that were the objectives of the course. In addition, after the course participants were asked to evaluate the usability of what they learned, the overall quality of the course, and the effectiveness of the course for their development.

Instrument Development

Considering the learning objectives, and a self-assessment of participants’ knowledge and skills with questionnaire items would be similar to measuring participants’ self-efficacy beliefs, we decided to focus on measuring self-efficacy for EESD¹.

Since EESD is a new approach to education for sustainable development, there are no instruments that measure teachers’ self-efficacy for EESD. Because of the similarities between EESD, the group problem solving approach, and SSI-based teaching, we first explored instruments that measure teachers’ SSI teaching self-efficacy to use as inspiration. We used the instruments of Kilinç et al. (2013), Muğaloğlu

et al. (2016), Lee et al. (2006), and Kara (2012), who developed their instruments based on the Science Teaching Efficacy Belief Instrument (STEBI). Muğaloğlu et al. used the STEBI items and replaced the words “scientific” in the STEBI items with the words “socio-scientific”. Lee et al. (2006) developed a questionnaire that measured Korean secondary science teachers’ general perceptions of teaching SSI and other personal and situational factors related to the implementation of SSI. One of the three scales measured teachers’ personal science teaching efficiency beliefs with regard to dealing with SSI. Kara (2012) also used these scales and similar items and confirmed its structure among Turkish pre-service biology teachers. We also used an adapted version of the Dimensions of Attitude Toward Science (DAS) Instrument by Van Aalderen-Smeets and Walma van der Molen (2013), which is developed for primary teachers. This questionnaire was adapted previously to SSI education in the context of the project ‘Working together towards scientific citizenship’ in which teachers learnt to teach about SSI according to the group problem solving approach (Guérin et al., 2021; Personal communication). Finally, we used the questionnaire of Yahaya et al. (2015), who developed the Teacher Sense of Efficacy Scale (TSES) to measure pre-service secondary biology/science teachers’ sense of efficacy for learning and teaching controversial family health issues. They used Bandura’s Social Learning Theory for describing efficacy. See Appendix C for the relations between the learning objectives of the EASE course, existing questionnaires, and the items of the EESD questionnaire.

During the first (aborted) pilot at the parttime bachelor teacher education programme in Rotterdam, a pretest questionnaire was administered that 11 of the 28 participants did not finish. This questionnaire consisted of 12 items about knowledge, 22 items about skills, and 9 items about attitudes. To ensure that participants finish the questionnaire, we have decided to shorten it to 8 items, focusing on those items that best measure the most prominent learning objectives. See Appendix C for the initial extensive questionnaire and the final shortened version.

In addition to measuring participants’ self-efficacy prior to and after the course, in the questionnaire after the course we have also asked the participants to evaluate the course. We developed questions to measure the usability of what they learned, their overall assessment of the quality of the course, and the effectiveness of the course for their development.

Instruments

The final T1 questionnaire consisted of (1) an introduction on the study and EGD issues (including a short video), (2) a question to ask explicit permission for research by the EASE project team, (3) the development of a personal code to allow the researchers to compare the participants’ answers on T1 and T2, (4) general questions about the characteristics of the participants’ (internship) school, their function in their school, years of work experience in education, age and gender, and (5) eight Likert scale items assessing participants’ EESD self-efficacy beliefs.

The T2 questionnaire also consisted of (1), (3), and (5). In addition, at T2 (6) eight Likert scale items were included for the participant to evaluate the course.

All Likert scale items could be answered on the following scale: 1 Totally disagree, 2 Disagree, 3 Neutral, 4 Agree, and 5 Totally agree.

On average, participants finished the T1 questionnaire in 4.83 minutes (SD = 1.72, min. = 1.25, max. = 10.43). Excluding one outlier of 103 minutes, the T2 questionnaire was finished in on average 3.46 minutes (SD = 3.57, min. = 0.62, max. = 21.59).

¹ Self-efficacy is not the only attitude that is relevant with regards to the goals of our training and the likelihood that teachers implement EESD in their classrooms. Other attitudes that are relevant are, for instance, teachers’ collective efficacy beliefs, their perceived relevance of EESD, their emotions with regards to EESD, and the extent to which they believe that they are dependent on material or colleagues for EESD. However, investigating the effect of the training on all these attitudes with our small sample would arise the problem of multiple comparisons. Because we believe that the training is most likely to influence teachers’ self-efficacy beliefs and self-efficacy is most prominent in the goals of the training, we have decided to focus primarily on teachers’ self-efficacy.

Procedure

The questionnaire was administered prior to the course (T1) during the first lesson through a link on the digital learning environment and a QR-code on the smartboard. The questionnaire after the course (T2) was administered via both the digital learning environment and email after the first deadline for the course assignments.

Participants

Within the full sample at T1, 7 participants did not give active permission for the study and 6 participants did not enter a personal code. At T2, 5 participants did not enter a personal code. These participants were omitted from further analyses. This resulted in a sample of 80 participants at T1 and a T2 dataset of 50 participants. Combining these two datasets resulted in a sample of 91 participants of which 39 participants responded to both the T1 and T2 questionnaire and 33 participants responded to the self-efficacy items at both T1 and T2.

See Table 4 for the characteristics of the full sample and the sample of participants that were included in the analysis comparing T1 and T2.

Table 4
Participant Characteristics

Characteristic	Full sample		Test sample	
Questionnaire language	T1	T2	T1	T2
Dutch	77	48	32	32
English	3	2	1	1
Schooltype				
Primary education	72		31	
Special primary education	4		1	
Special education	3		1	
Other (secondary education)	1		0	
Schoolconcept				
Regular	63		24	
Dalton	8		5	
Montessori	4		3	
Jenaplan	2		0	
Freinet	1		0	
Other (Unit, Bilingual)	2		1	
School denomination				
Public	45		13	
Roman-Catholic	16		11	
Protestant-Christian	4		3	
General special education	14		6	
Function ^a				
Teacher	35		20	
Lower grades (ages 4-6)	9		5	
Middle grades (ages 7-9)	15		8	
Upper grades (ages 10-12)	11		7	
Intern	73		31	
Lower grades (ages 4-6)	10		5	
Middle grades (ages 7-9)	34		12	
Upper grades (ages 10-12)	29		14	
Coordinator	3		3	
Administrator	7		5	
Educational assistant	6		4	

Characteristic	Full sample		Test sample
Internal counselor	6		4
Other (No, Tutor, Collegial consultant, Confidante, Secondary teacher)	6		4
Gender			
Female	64		28
Male	16		5
Experience			
I am still studying	67		26
Less than 5 years	2		1
5 to 10 years	3		1
10 to 15 years	2		1
15 to 20 years	2		2
More than 20 years	4		2
Group	T1	T2	T1 and T2
Saxion bachelor	37	24	17
Saxion minor	19	13	9
Rotterdam bachelor	12	5	1
School	12	8	6

Analysis

To check whether the participants in the test sample differed from those participants with missing data, the self-efficacy scores of these two groups were compared. The differences were investigated using two-way bootstrapped independent sample t tests in SPSS. Vertical bar graphs were made in Excel to visually inspect the differences between the test sample and participants with missings.

For both the self-efficacy and evaluation items, descriptive statistics (means and standard deviations) were computed for the full sample and the test sample in JASP. Also for each group (Saxion bachelor, Saxion minor, Rotterdam bachelor, and school), descriptive statistics were computed.

To investigate the development of students' self-efficacy beliefs, scores on T1 and T2 were compared using one-way bootstrapped paired samples t tests in SPSS. Vertical bar graphs were made in Excel to visually inspect the differences in this test group between T1 and T2, also per group.

For the evaluation items, all participants that answered these items on the T2 questionnaire were included in the analysis, not only the test group. Means per subgroup were visualized using bar graphs in Excel. Moreover, frequencies were visualized as stacked horizontal bar graphs in Excel, showing the percentage of participants giving a certain answer.

Results

Missings check

Comparisons of the scores of students with missings to the students in the test sample show no significant differences, neither for the T1 data, nor for the T2 data. All bootstrapped independent sample t-test were non-significant. See Appendix D for a visualization of these differences.

Comparing T1 and T2

See Table 5 for the descriptive statistics of the full sample and test sample at T1 and T2. The differences between T1 and T2 for the test sample are visualized in Figure 3. This shows that all the scores at T2 are on average higher than at T1. Note also that most standard deviations are lower at T2 than at T1.

The bootstrapped paired samples t tests show that these differences are all significant, except for the differences in attitudes (see Table 6). Participants' beliefs about the importance of education about

EGD issues and the extent to which they dare to teach about EGD issues did not significantly increase at alpha .05. However, both participants scored already relatively high on these attitudes at T1. Looking at the 95% confidence interval shows that the development of participants' beliefs about their knowledge is most positive (knowledge about EGD issues and about how to teach about them).

Table 5
Descriptive Statistics for Self-Efficacy

Item	Full sample				Test sample (n = 33)			
	T1 (n = 77)		T2 (n = 45)		T1		T2	
	M	SD	M	SD	M	SD	M	SD
I have enough knowledge about EGD issues to teach about this.	2.48	0.97	3.69	0.73	2.45	0.97	3.70	0.73
I know how I can effectively teach about EGD issues.	2.39	0.86	3.62	0.75	2.36	0.93	3.70	0.68
I can adapt existing materials so that they are suitable to teach about EGD issues to my students.	2.79	0.92	3.69	0.67	2.88	0.93	3.70	0.68
I can teach students to work with a group on solving EGD issues.	3.01	0.98	3.87	0.76	3.18	1.01	3.85	0.80
I can stimulate students' moral thinking through teaching about EGD issues.	3.00	1.00	3.84	0.64	3.18	1.04	3.88	0.60
I can stimulate learning about science and technology through teaching about EGD issues.	2.94	0.91	3.60	0.86	3.09	0.88	3.61	0.93
I think it is important that students receive education about EGD issues.	3.78	0.88	4.02	0.87	3.88	0.93	4.09	0.95
I dare to teach about EGD issues.	3.60	0.94	4.04	0.60	3.70	0.92	4.03	0.64

Figure 3
Means for T1 and T2 of the Test Sample (n = 33)

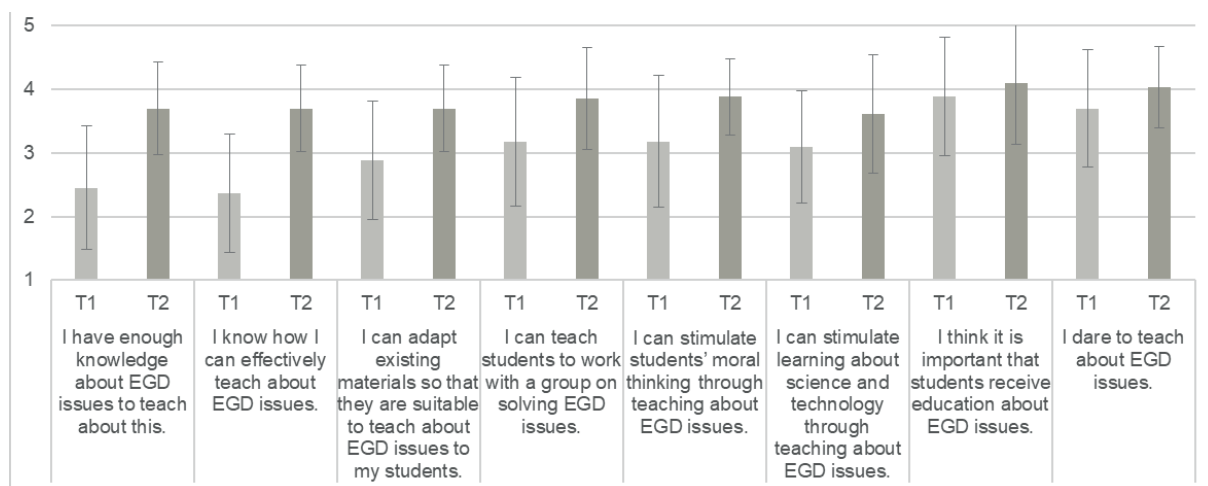


Table 6
One-Way Bootstrapped Paired Samples T-Test Comparing T2 to T1 Scores

Item	<i>t</i>	<i>M dif</i>	Bias	SE	<i>p</i>	Bootstrap	
						95% CI	
						Lower	Upper
I have enough knowledge about EGD issues to teach about this.	6.38	1.24	0.00	0.19	<.001*	0.88	1.61
I know how I can effectively teach about EGD issues.	6.44	1.33	0.00	0.21	<.001*	0.94	1.73
I can adapt existing materials so that they are suitable to teach about EGD issues to my students.	4.63	0.82	0.00	0.17	.002*	0.49	1.15
I can teach students to work with a group on solving EGD issues.	3.45	0.67	-0.01	0.19	.005*	0.30	1.06
I can stimulate students' moral thinking through teaching about EGD issues.	3.30	0.70	-0.01	0.21	.005*	0.30	1.09
I can stimulate learning about science and technology through teaching about EGD issues.	2.78	0.52	0.00	0.19	.016*	0.15	0.85
I think it is important that students receive education about EGD issues.	1.23	0.21	-0.01	0.17	.235	-0.12	0.52
I dare to teach about EGD issues.	1.82	0.33	0.00	0.18	.072	-0.03	0.67

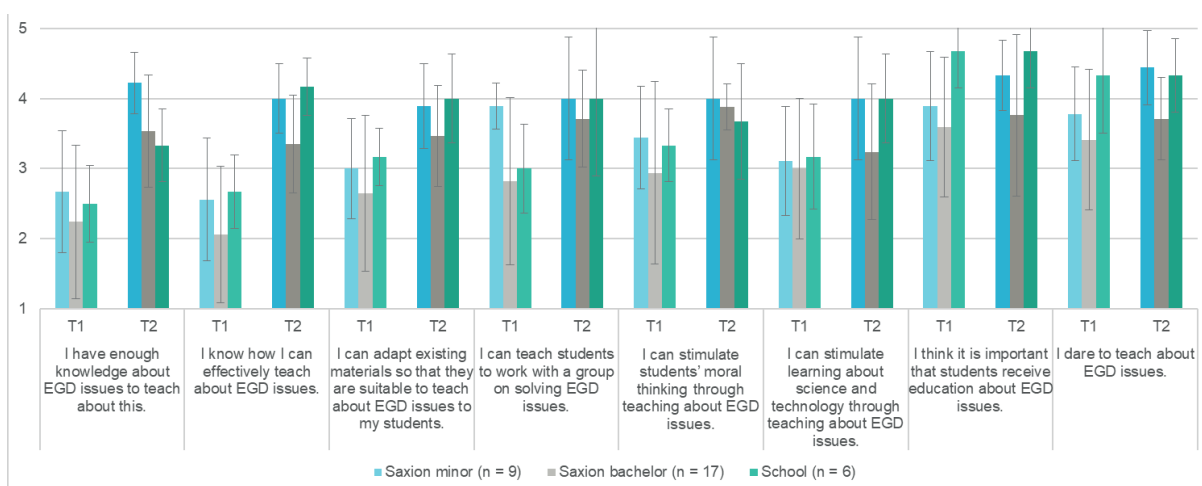
Note. For all tests, the alternative hypothesis specifies that T2 is greater than T1. Degrees of freedom are 32. Bootstrap results are based on 1000 bootstrap samples.

* Significant at $\alpha = .05$

Subgroups descriptives

Figure 4 visualizes the means and standard deviations of the test sample at T1 and T2 per subgroup. This shows that, at Saxion, the minor students scored on average higher than the bachelor students, both at T1 and T2.

Figure 4
Means for T1 and T2 of the Test Sample per Subgroup



Note. The subgroup 'Rotterdam bachelor' is not visualized, because this was only 1 student with scores of 4 on all items at both T1 and T2.

Evaluation of the course

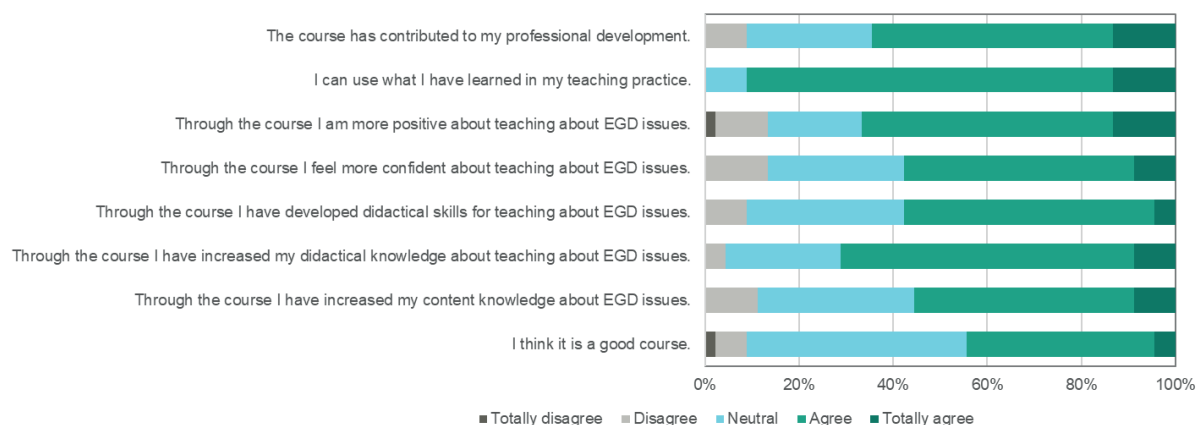
After the course, participants were asked to evaluate the usefulness, effectiveness, and quality of the course. See Table 7 for the means and standard deviations. Figure 5 shows the frequencies and Figure

6 shows the means per subgroup. Overall, the participants were quite positive about the course, especially about the usefulness of what they learned in their teaching practice. The results also show room for improvement, with many students evaluating the effectiveness and quality of the course neutrally. Figure 6 shows that, on average, especially the Saxion bachelor students score relatively low.

Table 7
Descriptive Statistics for Evaluation of the EASE Course

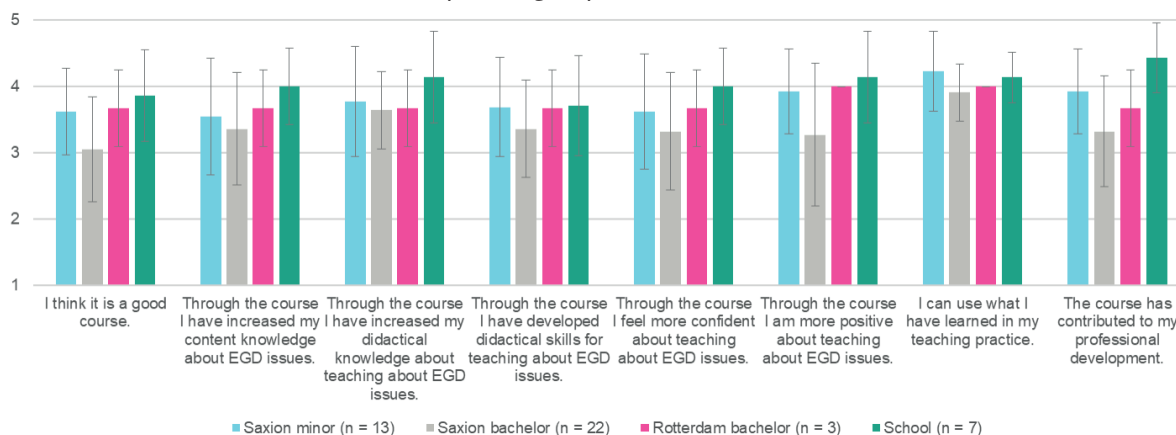
Item	<i>M</i>	<i>SD</i>
The course has contributed to my professional development .	3.69	0.82
I can use what I have learned in my teaching practice.	4.04	0.47
Through the course I am more positive about teaching about EGD issues.	3.64	0.93
Through the course I feel more confident about teaching about EGD issues.	3.53	0.84
Through the course I have developed didactical skills for teaching about EGD issues.	3.53	0.73
Through the course I have increased my didactical knowledge about teaching about EGD issues.	3.76	0.68
Through the course I have increased my content knowledge about EGD issues.	3.53	0.81
I think it is a good course .	3.38	0.78

Figure 5
Evaluation of the EASE Course, Frequencies



Note. *N* = 45.

Figure 6
Evaluation of the EASE Course, Means per Subgroup



Conclusion

Overall, the quantitative results provide a quite positive view on the EESD course. The comparison between the pre- and posttests showed significant differences for the items measuring participants' self-efficacy beliefs regarding their knowledge and skills for teaching EESD. The development of the two attitudes (importance of teaching about EGD issues and daring this) was not significant. The evaluation of the course was overall quite positive, with all means (also per subgroup) above 3, which meant neutral.

The development of students' knowledge and skills is as expected because these items aligned with the goals of the course. Similarly, a positive development of students' attitudes was also expected but not found. This could be because influencing knowledge and skills seems easier than influencing attitudes (Savelsbergh et al., 2016) but it may also be that explicit attention for participants' attitudes was lacking within the course. This is an important component of teacher training courses that aim to improve teachers' attitudes (Van Aalderen-Smeets & Walma van der Molen, 2015), but this was not one of the design principles for the EESD course.

The four different groups that participated in the course show differing results on the pre- and post-measurement of their self-efficacy beliefs and on the evaluation of the course. This is not remarkable because the four groups differed regarding participants (e.g., pre- and in-service teachers, age), course characteristics (e.g., number of meetings, final assignment), and teacher educator (e.g., developer of the course or not, science background or not). For instance, it is noticeable that the Saxion bachelor students scored relatively low on both measures. This could have many reasons. One of the likely reasons is the fact that the Saxion bachelor students were taught by colleagues that were not directly involved in the development of the EESD course, while this was different for the minor students and bachelor students from Rotterdam. Moreover, the background and expertise of the teacher educators of the Saxion bachelor course was not always in teaching science and technology. Another reason could be the fact that the minor students have chosen their minor while the EESD course was obligatory for the bachelor students.

This could maybe also explain why the T1 scores of the bachelor students were relatively low compared to the other participants. The Saxion bachelor students did not chose to learn about EESD; this may be related to a lower engagement with EGD and teaching about EGD beforehand.

Furthermore, we see that the development of the ability to teach students to work with a group on solving EGD issues is relatively small for the Saxion minor students. This may be explained by their already relatively high scores at T1. The development of the ability to stimulate learning about science through teaching about EGD issues is relatively small for the Saxion bachelor students. This could be explained by the teacher trainers of this course: these were not science teacher trainers.

3.4 IMPRESSIONS OF PRE- AND IN-SERVICE TEACHERS' PRAXIS

During the EASE course, participants designed lessons about an EGD issue, based on the GPS model. As teacher educators for the Rotterdam students, the Saxion minor students, and the in-service teachers, two of the authors of this ebook have assessed the lessons that the participants developed. Moreover, the teacher educators of the Saxion bachelor students were asked to share some exemplary work of their students. In what follows, we first give an impression of the lessons that the pre-service teachers designed and then of the lessons designed by the in-service teachers.

Lesson activities of pre-service teachers

Most participating pre-service teachers designed lessons that followed the GPS model steps, although the fourth step (debriefing) was often missing or barely addressed. Below, the activities pre-service teachers have designed are discussed per GPS model step:

1. *Students explore the issue by investigating what they already know about the topic and what they still need to find out.*

To start this step, participants often used activities like a quiz, placemat (see study guide), or choose a side where statements were posed and students had to choose whether to agree or disagree by walking to the left or right side of the classroom. In the latter activity participants posed statements as: 'It is fine to throw waste into nature because it eventually decays' or 'it is important to keep our environment clean by picking up litter when we see it lying around'. These introducing activities were followed by activities such as mind mapping or making infographics to clarify what the students already knew on the subject and what they wanted to know more about.

2. *In this step the issue is analysed. Students immerse themselves in a party and start collecting knowledge from different sources. Then it is not only knowledge from books; they can also question experts or organize a visit to a company or institution.*

To shape this step, most participants chose to start by making a network map with the whole group. Some participants had made the network map themselves because they thought this was too difficult for their students. One participant had made part of the network map himself and completed the map with his students by asking them which stakeholders were still missing. Next, the group was split into small groups which delved into the perspective of one of the stakeholders of the network map. To this end, most participants used the activity to make passports for their stakeholder, which is also suggested in the study guide.

3. *Students work toward a decision that they make collectively based on good arguments.*

In this step some participants organised a debate. All small groups had to prepare the debate, and, in the debate, they were to bring forward the arguments of their stakeholder. Each small group had a few minutes to do so, and, in the end, they made a joint whole class decision on what to do. Other participants worked more directly to a decision by using the jigsaw or expert method. Each small group of students represented one of the stakeholders and had to find out what their stakeholder should do to solve the litter problem in the neighbourhood. Next, they worked out with the whole group what they could do to help the stakeholders.

4. *Students reflect on how the process of group problem solving went.*

As far as this step is concerned, there was not much variation in activities. Most participants carried out a whole-class talk. However, some participants had their students first fill in a questionnaire and then discussed the process with the whole class based on the students' responses. The advantage of doing so was that students first expressed their opinions individually and the participant knew the different opinions before the discussion started.

Lesson activities of in-service teachers

The in-service teachers of the attending primary school had decided to engage in a school-wide Green Deal theme. For three weeks, the afternoon activities evolved around the Green Deal. In the highest grades (10-12 year), the steps of the GPS model were followed. Although elements from the GPS model were used in the lower grades, the teachers opted not to follow the model strictly in these groups. Going deeper into knowledge about, for example, global warming and the social discussion about it requires too high a level of abstraction for these students.

In the lowest grades (4-6 year), for instance, the children were read from a book about animals who wanted to clean the forest. Following this, it was decided in a class discussion that there was also too much waste in school and that they wanted to repurpose (recycle) the waste. Thus, like in the book, the children decided to reuse the waste. They brought their toys that were broken to the repair shop run by

the students of upper classes (more about this later). Next, a tree was placed in the school on which all students could attach their question about a EGD issue (Figure 7).

In the middle grades (7-9 year), activities were carried out to enhance students' knowledge and awareness of biodiversity. The teachers took their students outside and observed the school environment. Next, they made a plan to improve the biodiversity in the environment by removing tiles to provide opportunities for plants and animals and creating special places to stay for animals like hedgehogs and bees. Finally, the students displayed all they had learned on posters (Figure 8).

In the highest grades (10-12 year), the steps of the GPS model were followed. They focused on the EGD issue environmental pollution caused by waste. The students delved groupwise into different aspects of this issue. In the 3rd GPS step they decided to set up a repair shop and a nature museum. With the repair shop they wanted to reduce waste by preventing broken things from being thrown away and ending up as trash; the nature museum was meant to raise parents' and students' awareness of the beauty and diversity of nature and how that is jeopardised by human behaviour. Through these activities, they wanted to contribute to a better environment (Figure 10). Both activities were realised. At the repair shop, children and their parents could have their broken items fixed for two weeks. If the students could not fix it themselves, they asked parents or experts in the neighbourhood for help. An example of something the students could fix themselves is a puzzle the teachers wanted to throw away because some pieces were missing. In the repair shop the missing pieces could be made so that the puzzle was again ready for use (Figure 9).

Figure 7

Wonder tree placed in the school hall.



Figure 8

Posters presented by students (7-9 years)



Figure 9

Puzzle was fixed in the repair shop



Figure 10

Item on plastic soup in the Nature Museum



REFERENCES

- Guérin, L. J. F., Klaver, L., Walma van der Molen, J., & Sins, P. (2021). *Onderzoeksrapport Samen werken aan Bèta Burgerschap*. TechYourFuture. <https://www.techyourfuture.nl/wp-content/uploads/2023/04/Onderzoeksrapport-Samen-werken-aan-Beta-Burgerschap.pdf>
- Kara, Y. (2012). Pre-service biology teachers' perceptions on the instruction of socio-scientific issues in the curriculum. *European Journal of Teacher Education*, 35(1), 111-129. <https://doi.org/10.1080/02619768.2011.633999>
- Kilinc, A., Kartal, T., Eroglu, B., Demiral, Ü., Afacan, Ö., Polat, D., Demirci Guler, M. P., & Görgülü, Ö. (2013). Preservice science teachers' efficacy regarding a socioscientific issue: A belief system approach. *Research in Science Education*, 43(6), 2455-2475. <https://doi.org/10.1007/s11165-013-9368-8>
- Lee, H., Abd-El-Khalick, F., & Choi, K. (2006). Korean science teachers' perceptions of the introduction of socio-scientific issues into the science curriculum. *Canadian Journal of Science, Mathematics and Technology Education*, 6(2), 97-117. <https://doi.org/10.1080/14926150609556691>
- Muğaloğlu, E. Z., Doğança Küçük, Z., & Güven, D. (2016). Pre-service science teachers' self-efficacy beliefs to teach socio-scientific issues. *Eğitim Fakültesi Dergisi*, 29(1), 95-110. <http://kutuphane.uludag.edu.tr/Univder/uufader.htmE>.
- Savelsbergh, E. R., Prins, G. T., Rietbergen, C., Fechner, S., Vaessen, B. E., Draijer, J. M., & Bakker, A. (2016). Effects of innovative science and mathematics teaching on student attitudes and achievement: A meta-analytic study. *Educational Research Review*, 19, 158-172. <https://doi.org/10.1016/j.edurev.2016.07.003>
- Van Aalderen-Smeets, S. I., & Walma van der Molen, J. H. W. (2015). Improving primary teachers' attitudes toward science by attitude-focused professional development. *Journal of Research in Science Teaching*, 52(5), 710-734. <https://doi.org/10.1002/tea.21218>
- Van Aalderen-Smeets, S. I., & Walma van der Molen, J. H. (2013). Measuring primary teachers' attitudes toward teaching science: development of the dimensions of attitude toward science (DAS) instrument. *International Journal of Science Education*, 35(4), 577-600. <https://doi.org/10.1080/09500693.2012.755576>
- Yahaya, J. M., Zain, A. N. M., & Karpudewan, M. (2015). The effects of socio-scientific instruction on pre-service teachers' sense of efficacy for learning and teaching controversial family health issues. *International Journal of Science and Mathematics Education*, 13, 467-491. <https://doi.org/10.1007/s10763-014-9537-x>

PART 4

Conclusions and recommendations

Our findings show that this study's EASE course provides in- and pre-service teachers with the required knowledge and skills to teach about EGD issues. In addition, the participants' confidence to teach EGD issues seems to be improved. Teachers indicated that the course was instructive both in terms of EGD content and didactic skills and that they considered the topic increasingly important during the course. However, the results also showed some areas for improvement. For instance, the complexity was too high for several participants; regarding the EGD issues content as well as the didactic knowledge.

The EGD issues addressed in the course were: global warming, declining biodiversity and the waste problem. However, in our study it was practically not possible to always employ science teachers, therefore these sessions were performed by other teacher educators who did attend a short training on the EGD issues. To ensure that pre-service teachers have these complex issues explained clearly it is advisable that these sessions are carried out by teacher educators specialising in science education. As it was done in the EASE course with the in-service teachers and with the Saxion minor and Rotterdam bachelor students.

Besides, participants experienced the didactic knowledge as complex since there were four didactic principles and a lesson model (GPS model) which were not easy to link together. Therefore, it would be advisable to specify in the study guide per GPS model step which of the didactic principles are to be applied there. In addition, in the sessions the teacher educator should draw specific attention to how didactic principles are applied in the different steps of the GPS model.

In addition to the above-mentioned, the participating pre-service teachers also stressed that they appreciated the use of the network map. While drawing up the network map, it became clear to them who exactly is affected in the EGD issue but also who will be affected if changes take place. This overview of the people involved in the problem helped them to see the EGD issues more as a social problem. In the current EASE course, the network map is introduced in the third session, but it could probably be better introduced at an earlier stage, maybe even in the first session. This might aid participants to be more motivated from the beginning since in our experience primary teachers are more interested in social than scientific issues.

Besides the above recommendations pertaining to the implementation of the EASE course, it is also recommendable to share this studies' findings in a global setting. Since teacher training on ESD is a global concern, this study might contribute to the development of teacher training world-wide. Finally, we would like to recommend the EASE course. The course appears to be highly suitable to support in- as well as pre-service teachers in gaining self-efficacy regarding knowledge and skills necessary for carrying out well-designed Green Deal lessons. We tested the course with different types of teachers in different circumstances; in each case we have tried to be responsive to their situation. Based on the results, the course is ready to be upscaled, however, we recommend further improving the course at the same time. Hopefully the lessons learned and recommendations from this design-based research will help teacher educators and researchers in improving (primary) teachers' competencies for ESD and, more specifically, teaching the Green Deal in their own context.

Acknowledgements

We are very grateful to the people who helped to successfully complete the EASE project. First of all, we would like to thank the management and teachers of the Enschedese Schoolvereniging for enabling us to test the EASE course with in-service teachers, especially Lianne Molkenboer and Roos Hartman for all their effort in organising it. We also want to thank teacher educators Frank Brinkman, Leo Klapwijk, José Koggel, and Mario Schutte for their contribution in conducting and evaluating the EASE course and dr. Renske de Leeuw for her help in writing the study guide. In addition, we thank the students from the teacher training institutes of Rotterdam University of Applied Sciences and Saxion for participating in the EASE course, completing the questionnaires and answering our questions in the interviews. Finally, we want to thank dr. Maria Hendriks, Pieter-Jan Ruiter, Patrick Schutte, and Ineke Vermeulen for their critical review of the initial study guide and course script, dr. Katrin Kohl and prof. dr. Charles Hopkins for their feedback and encouragements, and dr. Laurence Guérin for writing a great foreword.

APPENDIX A.

EASE study guide (Intermediate scenario)

EASE-PROJECT, TEACHER TRAINING MINOR
INTERNATIONAL EDUCATIONAL APPROACHES



EASE-project is a collaboration between
the school of education of Saxion (Deventer/Enschede)
and Thomas More (Rotterdam).

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2024



INTRODUCTION

The EASE Project

Many teachers consider teaching about sustainability important but are unfamiliar with how to tackle the topic in the classroom. How do you address sustainable development issues? And what can you do as a teacher to contribute to this?

In the project EASE (European Assembly for a Sustainable Europe) we equip in- and pre-service teachers with the knowledge and skills needed to teach about sustainable development. Specifically, we contribute to the professional development of pre- and in-service teachers to teach sustainable development lessons on themes within the European Green Deal. Project EASE is an Erasmus+ project carried out in collaboration with teacher trainers and researchers from Saxion and the Rotterdam University of Applied Sciences.

The European Green Deal (EGD) is the European Union's scheme to make its economy more sustainable. To help shape this future, teachers need to take action. This includes encouraging students to acquire knowledge, become critical thinkers and teach them values, attitudes and behaviors so that they actively participate in issues related to the EGD. For example, a clean and circular economy, reducing greenhouse gases and improving global environmental standards.

Group Problem Solving

In EASE, we build on the principles and goals of an approach based on the idea of deliberative democracy (Guérin, 2018). This view assumes a society in which citizens make informed decisions together and have a say. The deliberative democracy view aims to encourage citizens' autonomy, takes into account the complexity of issues relevant to the EGD, and recognizes the controversy of such issues, but also understands what kind of solutions are possible or what kind of solutions have already been developed.

For education, this means teaching students to come up with collaborative solutions to social problems. For example, you can get students to work on the following issues: if we want to heat all houses in the Netherlands without gas, would it be better to solve this by solar boilers or by switching to heat pumps, what is a good solution to remove particulate matter from the air, what is the best way to prevent the plastic soup from growing, and how do we deal with nanotechnology?

We have translated this vision into a practical didactic lesson model for teachers called group problem solving (GPS; see Appendix A). GPS involves students working in groups on learning activities, discussing, and making decisions together about social issues. In the process, students learn to think critically and ultimately come to a solution together. The GPS lesson model consists of the following four steps:

2. Students explore the issue by investigating what they already know about the topic and what they still need to find out.
3. In this step the issue is analyzed. Students immerse themselves in a party and start collecting knowledge from different sources. Then it is not only knowledge from books; they can also question experts or organize a visit to a company or institution.
4. Students work toward a decision that they make collectively based on good arguments.
5. The groups present their solutions to each other. And there is reflection on how the process of group problem solving went.

As a guide for the teacher to support students as they move through these steps, we have set up four didactic principles. These are: (1) thinking together, (2) arguing, (3) network thinking and (4) decision making. Thinking together is about students learning to work together where knowledge is synthesized, shared, and disseminated among themselves. Arguing involves students learning to use evidence and

knowledge to support positions, solutions, and decisions. Network thinking involves students learning about the interconnections between different perspectives and different levels (local-global). Finally, students also learn to choose solutions based on thorough and collaborative consideration (decision making).

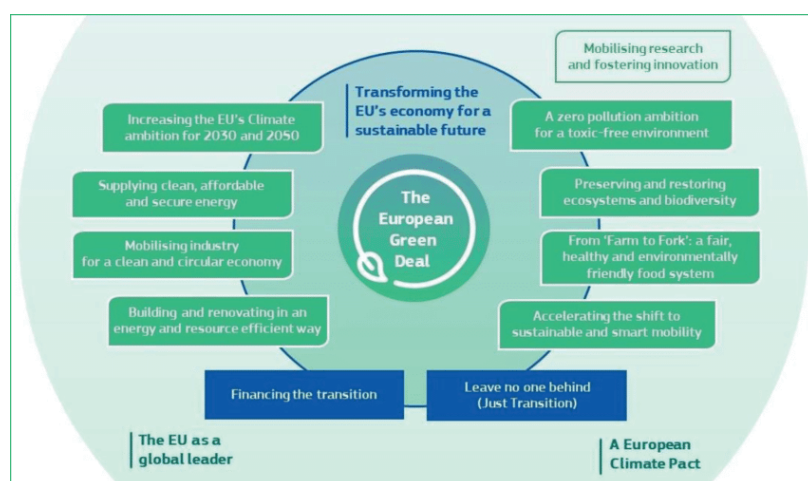
European Green Deal

The European Green Deal (EGD) is an ambitious European Union (EU) plan to make Europe climate neutral and protect biodiversity. Figure 1 shows the goals being pursued to ensure a sustainable future and reduce the negative effects of climate change. As a teacher, you can play an important role in embedding sustainability in education and fostering an environmentally conscious attitude among students.

One of the main goals of the European Green Deal is to achieve climate neutrality by 2050. This means reducing greenhouse gas emissions to zero. To achieve this, we need to reduce CO₂ emissions by switching to clean energy sources, promoting energy efficiency, and encouraging sustainable practices. In addition, the European Green Deal also focuses on protecting biodiversity and restoring ecosystems. The loss of natural habitats and the decline of plant and animal species pose serious threats to our planet. The belief of the European Commission is that the above goals can only be achieved in a sustainable manner. This means that the burden to achieve this plan must be shared in a fair way.

Figure 1

Overview of the EGD-goals



Note: copied from: <https://economie.fgov.be/nl/themas/intellectuele-eigendom/innovatie-en-intellectuele/green-deal-voor-europa>

GENERAL INFORMATION

Learning Objectives

After completing the course, participants will be able to:

- o Describe the views of different actors in the themes of the European Green Deal (EGD).
- o Draw up their own lesson objectives for lessons in which a European sustainable development problem is central and indicate how these are related to the National curriculum requirements regarding to 'Citizenship' and Science'. (The Dutch national requirements are called "Kerndoelen" (Tule-SLO; citizenship > mens en samenleving, science ≈ Natuur en Techniek)
- o Explain to primary school students the main issues addressed in the EGD (e.g., biodiversity loss and the energy transition), both from a scientific and social point of view, and using students' prior knowledge, experiences, and beliefs.

- o Use the four didactic principles when redesigning learning activities.
- o Guide learners while applying the four didactic principles, using effective activities.

The sessions and preparation time

Number of sessions: 4

Duration per session: 90 minutes

Preparation time: 2 hours per session

CONTENT OF THE SESSIONS

Structure of the sessions

During this course, teachers and students learn how to shape (their own) sustainable development lessons using the group problem solving approach and the four didactic principles. The course consists of four sessions. During the first three sessions we will focus on the elaboration of the principles and how you as a teacher can apply these principles during the process of GPS. In the last session (online) we discuss everyone's practical experience with using the didactic principles in the EGD lessons.

Description of the sessions

Table 1 displays an overview of the sessions. The fourth session is an assessment.

Table 1

Overview sessions

Session	Subject	Date	Time	Place
1	EGD issues	28-02-2024	11:00 u	P 0.19
2	The 4 didactic Principles	13-03-2024	09:15 u	P 0.19
3	Designing an EGD-lesson	25-02-2024	12:30 u	P 0.19
4	Present your EGD-lesson	June 2024	Negotiable	Online

Session 1: Learning about sustainability

Prior to the session

Read the introduction of this study guide and Appendix A.

Content of the session

This first session will start with an introduction of the issues addressed in the European Green Deal, followed by a demonstration of a GPS-lesson. Herein, you will experience a citizenship lesson on EGD yourself. By reflecting on this lesson, we will discover how the structure and didactic principles function. The session will end with the assignment to have a conversation with students on an EGD topic.

Assignment for the next session

Conduct a conversation of 5-10 minutes with at least two students (aged 9 - 13) about one of the European Green Deal issues. Record and transcribe this conversation and translate the transcription in English.

Session 2: Using the four didactic principles

Prior to the session

Read Appendix B, C, D and E.

Bring the transcript of the conversation you had with your students (the English version).

Content session

In this session, we start with the assignment. Using the transcripts, we analyze the conversations and examine the student's reasoning and the guidance from you as the teacher. Further, we study and practice *thinking together*, *arguing*, *network thinking* and *decision making* in the context of hope (and action) when it comes to environmental issues. We end with an exploration of potential ingredients for EGD lessons with hope (and action).

Assignment for the next session

Draw up a lesson design on an EGD issue that recognizably incorporates the four didactic principles.

Session 3: Drawing up a lesson design (with hope and action?)

Prior to the session

Study Appendix F, G and H.

Bring your lesson design on an EGD issue.

Content session

We take a critical look at each other's design to optimize the lesson designs and do not go home until everyone is completely content.

Assignment for the next session

Perform the designed EGD-lesson in your internship class and make a presentation showing how you taught your students the science and social aspects associated with the EGD issue in question.

Session 4: Presenting and discussing the EGD-lesson

Prior to the session

Prepare the presentation.

Content session

In an online session, you and two other students will present the process of designing and implementing the EGD lesson (Please note the criteria in advance; see learning objectives).

Assessment

Whether the learning objectives (p. 5) have been achieved will be assessed in an on-line session. In a presentation, you show:

- o The views of at least four different actors in the EGD topic of your lesson-design.
- o A lesson-design in which in-depth scientific knowledge on an EGD topic is tailored to the level of the target group and how this content is related to the National curriculum requirements regarding to 'Citizenship' and Science'.
- o How the EGD topic is approached from a social point of view and is built on students' prior knowledge, experiences, and beliefs.
- o How the four didactic principles are used while (re)designing the EGD-lessons.
- o How effective strategies are used to apply the four didactic principles in practice.



APPENDIX A: THE VISION OF STEM CITIZENSHIP

The vision of citizenship education underpinning this programme is based on the so-called deliberative (in dialogue) conception of democracy. A deliberative democracy is a society in which citizens make informed decisions together and have a say. Important in this respect is that citizens have autonomy, develop understanding of and about complex issues and that pros and cons are weighed against each other before a (joint) decision is taken. In a deliberative democracy, group problem solving is the core competence.

In the classroom, group problem solving can be practiced as well. Using the STEM Citizenship approach, your class will start working in groups on solutions to social problems and issues, in which STEM and technology play an important role. These are technological and sustainable issues that are currently central to our society and, above all, are extremely suitable for working on citizenship competences. In the context of EASE, the main focus of the learning activities is that students engage with socio-scientific issues (SSI) related to topics in the European Green Deal (EGD). In Europe, and thus also in the Netherlands, we face sudden climate changes. In summers, for instance, there are dry and hot summers with forest fires not only in countries like Portugal and Spain, but also in the Netherlands. One period the rivers are dry, preventing ships from moving, and another period the rivers overflow their banks and houses are flooded.

These current situations and problems require group decisions and actions. To arrive at these decisions with the class, you go through four didactic principles.

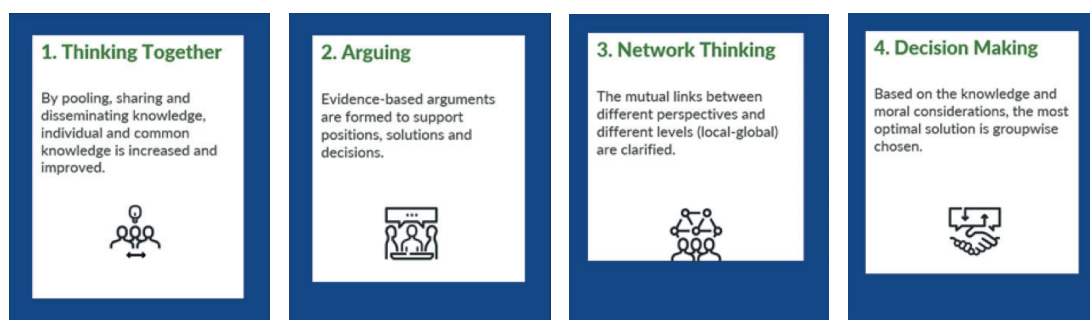
Four didactic principles to crack the hard nut

The vision of STEM citizenship has been translated into a practical didactic approach for teachers. To promote the core competency of group problem solving, four didactic principles have been established for the teacher (see Figure 2). These principles guide the preparation, implementation, and evaluation of learning activities.

In this programme, we focus on the following four principles: (1) Thinking Together, (2) Arguing, (3) Network Thinking, and (4) Decision Making. These four principles provide direction for student learning.

Figure 2

Didactic principles of EASE



Appendices B, C, D and E elaborate on each principle. In addition, examples of teaching activities are given for each principle, pitfalls are identified and discussed, and try-outs are presented that support the teacher to apply the didactic principles in daily lessons.

Preparation, implementation, and evaluation

The four didactic principles form the basis for the teacher's actions and choice of learning activities. Teachers organize learning activities according to the steps of the teaching design model: (1) explore, (2) analyse, (3) decide, (4) debrief. The idea is that this way every teacher can get started with the STEM Citizenship approach.

To prepare your EASE lesson series, it is important to first choose an SSI (or a EGD issue). Content knowledge gives the headroom and peace of mind to focus on students and the organization of learning activities during lessons. Moreover, with some prior knowledge, you can offer the student a steppingstone from which they can continue working in an investigative and discovering way. From this content preparation, you can start designing the EASE lessons so that the learners are group problem solving the social problem. The educational design model group problem solving (GPS model) has been developed for this purpose.

The educational design model: Group Problem Solving

Using the GPS model, you can get started on citizenship education as a teacher.

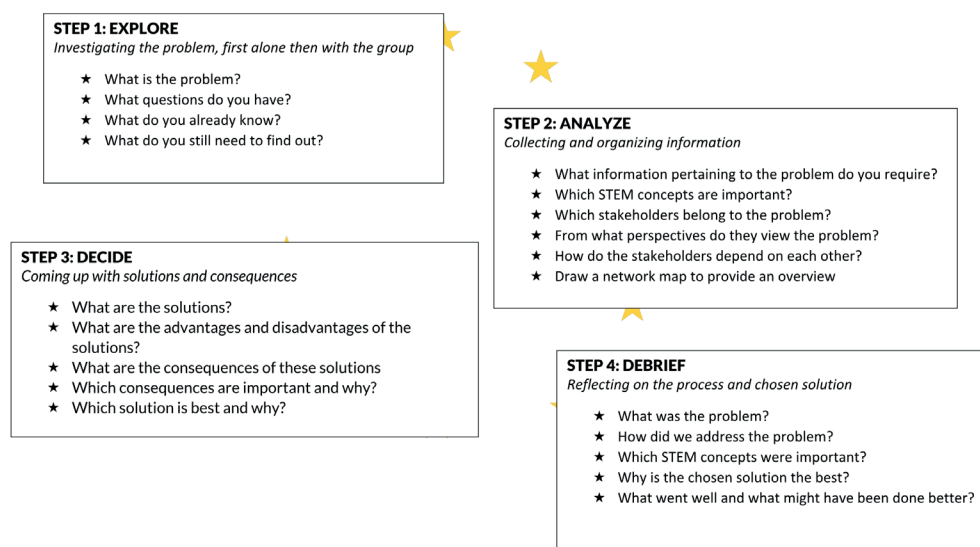
Figure 3 presents the model.

During group problem solving, students work in groups on various learning activities, engage in discussions with each other and make joint decisions about possible solutions to the social issue they have been working on. The four steps structure the learning process, with students first exploring the problem, then analyzing the problem further, then making a decision together. A lesson or lesson series is concluded with looking back and sharing the results (debriefing).

The Scientific Citizenship method has worked out suitable teaching methods for each step. These teaching methods provide tools to give substance to learning activities. See Appendix F for an overview of the teaching methods.

Figure 3

Educational design model (GPS model) in the STEM Citizenship approach



Note: Copied from: Tolkamp, J., Guérin, L., & Klaver, L. (2019). Bèta en technologie in burgerschapsonderwijs. TechYourFuture

Step 1: Explore

As a first step, students explore the issue by investigating why the issue is important (determine relevance), what they already know about the topic (activate prior knowledge) and what they still need to know (identify required knowledge).

Exploring the issue is necessary to activate prior knowledge and prepare students to gain new knowledge and inspire and motivate them about the topic of the lesson.

Step 2: Analyse

In the second step, learners engage in purposeful information search and, from a critical attitude, weigh and select the information found. Using the information, new knowledge about the problem is gained and insights into the problem can be deepened. The teacher can choose to explain relevant concepts and offer specific information. Students can also search for information themselves. This information need not only come from books or the internet. Learners can also question experts or organize a visit to a company or institution. In this step, students can be split into groups, each of which looks into a party involved (explore different perspectives). This so that in step 3 they can use the different perspectives to have a discussion and come to new or different insights. In their 'expert group', children can prepare arguments together.

Step 3: Decide

In the third step, the expert groups are shuffled. In 'decision groups', students work towards a decision they make together, taking into account the interests of the different parties involved. Learners work out different solutions and scenarios for the social issue and compare the possibilities, identifying the pros and cons of the solutions. In this step, consequences of solutions can also be worked out as a deepening exercise; what are the short- and long-term consequences of a proposed solution for different stakeholders?

By engaging in discussion with each other, arguments (based on the collected information and elaborations) are used to arrive together at the best possible solution. It is important that during the discussion, students listen to each other, respect each other and are open to other points of view. The social issues dealt with in STEM citizenship lessons usually do not have an absolute solution, as there are always pros and cons.

Step 4: Debrief

The last and fourth step involves reflecting on what was learned and how the process of group problem solving went. It is possible to reflect on which concepts were important and relevant to reach a solution; which professions and parties were involved in the social problem; what the students found relevant to learn; what the students thought of the working methods used to reach a discussion and group decision; what the students thought of the collaboration and what could be done differently next time. In this step, the different decision groups can present their solutions to each other or to parents, for example, and they can also think about possible next steps. Will the children also commit to implementing what they think is the optimal solution?



Note: Adapted with permission from "Bèta en technologie in burgerschapsonderwijs", Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

APPENDIX B: PRINCIPLE 1 - THINKING TOGETHER

The essence of the principle of thinking together is in the exchange students have with each other. This ensures that all students are involved and should avoid one student being dominant from the start. Thinking together is also referred to as 'Exploratory Talk'. In these 'thinking together' conversations, students exchange relevant information for joint consideration. Their devised solutions, arguments and opinions are discussed, and alternatives may be offered. Students look for similarities to move forward (this can be done, for instance, with the placemat method, see appendix F). Without fulfilling this principle, opinions and arguments remain with the individual and it is impossible to take another person's interests into account. By thinking together, the EGD issue can be more precisely understood, and solutions and decisions are more strongly substantiated.

Thinking (learning) together is a group process. To be effective, the thinking process must be carried out collaboratively. In this way, students can fully benefit from the knowledge and insights gained in the group.

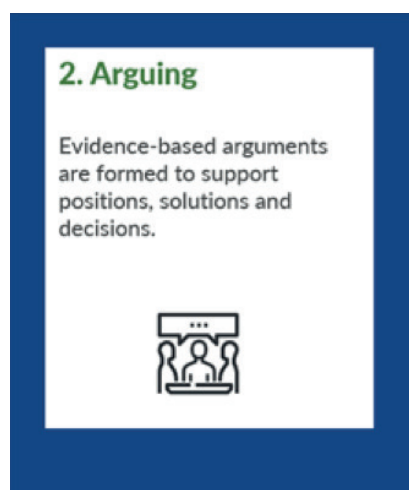
Thinking together in class means that students build on each other's contributions and ideas by asking each other questions, critically responding to the shared information and answers, and that all students actively try to contribute to the shared understanding within the group. Thinking together in a group is stimulated when learners have different types of information on the same topic. Students will need to engage with each other to explain ideas, listen to each other and ask questions of each other to consider different perspectives. By aggregating, sharing and disseminating knowledge, their individual as well as common knowledge is increased and improved. While thinking together, students also learn to formulate arguments to support or contradict a perspective or solution and to (re)consider jointly thought-out solutions.

The essence of the collaborative thinking principle is that students acquire new knowledge or concepts by benefiting from each other's content by relating and integrating it.

Activities for thinking together

One activity that is very suitable for practicing 'thinking together' with students in class is Socratic conversation. A kind of explorative talk, yet in a Socratic conversation students' opinions are explicitly included. A Socratic conversation is a structured dialogue in which students think more deeply about important questions, such as the EGD issues and sustainability in the classroom. The conversation starts by asking for students' opinions on a question or statement that is meaningful to the students. You can do this by having the students think about a concrete experience of their own that ties in with the question. As a teacher, it is important to ask in-depth questions. Often this is the why- or how-to question or by applying other questioning strategies. Make sure that not only you as a teacher ask the questions, but that the students question each other. In this way, they practice groupwise exploring each other's opinions.

An important feature of a Socratic conversation is that students respect each other's ideas. The Socratic conversation ends by jointly establishing a conclusion, core assertion or principle.



Note: Adapted with permission from "Bèta en technologie in burgerschapsonderwijs", Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

APPENDIX C: PRINCIPLE 2 - ARGUING

In the learning activities of the GPS model, students will often argue with each other. These arguments are formulated based on evidence and are used to support positions, solutions, and decisions. In discussions, learners engage with each other's arguments.

The didactic principle of arguing therefore revolves around collective argumentation skills, the argumentation skills of a group. These argumentation skills are reflected in interactions as learners ask for explanations when exchanging evidence, as they respond substantively and adequately to another's argument, as to how an argument is countered, but also how a student deals with students' counterarguments. Within this principle, arguing does not aim to win the discussion, but the arguments (for and against) are used to reach a deepening of the problem or solution. The aim of the principle of arguing is that if students are able to argue well (as a group) the group can come to a better formulation, a better analysis of the social issue, and ultimately provide a rationale for the best-fit solution. The quality of the arguments used

in discussion depends, among other things, on the extent to which students respond to each other's arguments and on the knowledge used.

Within this principle, it is important that every learner has space to contribute an argument. It is also important that students listen to each other respectfully. To avoid only the dominant students making themselves heard, various working methods can be used. Students can be explicitly asked to give their argument or view on the subject, based on the information they have gathered earlier. When learners have good argumentation skills, it increases learners' autonomy. This is because learners learn how to defend, confirm, or revise their own position or viewpoint. By hearing and using good arguments in which facts are used to support a position, more knowledge about the issue is automatically gained. Thus, arguing (together) leads to an enrichment of thinking together.

Activities for arguing

Using an argumentation bingo card (see Appendix F), students can practice identifying different types of arguments, as well as whether an argument is an opinion and not based on evidence. Some students are assigned to keep track of the argumentation bingo card during a class discussion and to feed back at the end what types of arguments they heard.

Multiperspectivity - Sustainable clothing

For example, a cotton farmer might have a different view than an environmentalist on how to save water when producing clothes.

A solution that works fine at the local level is not always a meaningful solution at the global level.



Note: Adapted with permission from "Bèta en technologie in burgerschapsonderwijs", Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

APPENDIX D: PRINCIPLE 3 - NETWORK THINKING

An important step in the GPS model is to explore the different perspectives, parties involved and decision levels (such as local versus global). When learners start network thinking, the interconnections between these different perspectives and different levels are established. Learners start actively looking for the similarities and differences in the perspectives and levels. Network thinking reveals the network and interconnections of a social problem, this is also called multiperspectivity.

The aim of the principle of network thinking is for students to understand different perspectives. Thus, different people are involved (actors) who each view the problem, but also the solution, in their own way. The aim of network thinking is not to arrive at a solution that meets all needs. That is impossible, because every change has consequences, which can be positive and negative and have a different impact per actor and level.

Starting from the principle of network thinking, learners learn to understand the complexity of the issue by getting to know different actors, the diverse interests of the actors and looking at the issue from different contexts. Through various learning activities, interconnections of different perspectives that were not immediately visible at first glance are made visible.

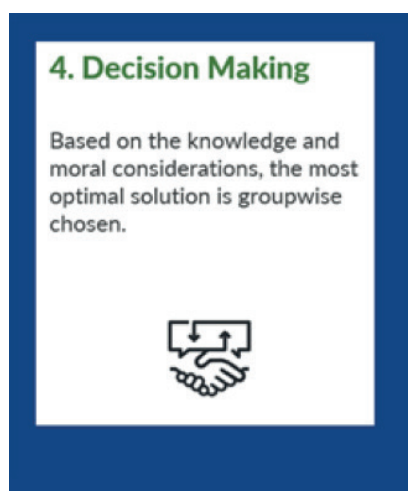
Activities for network thinking

For students to practice network thinking, there are various learning activities. These provide students with new insights and make connections between different insights. For example, role-plays give students the opportunity to learn about the different perspectives and interests of actors involved. For role-playing, several passports can be made available for each actor, but students can also work with a blank passport and an assignment to fill it in for different actors (see Appendix F).

Other activities include showing films, telling narratives or introducing students to different actors through their own research, such as a company that makes toys from wood and a company that manufactures toys from plastic or the living conditions of an agricultural worker in the Netherlands and in Romania.

The role of visual support

To support learners in “seeing” the connections in a network, visual supports are very useful. Visual support, such as a network map or a mind map, unburdens working memory. Using these visual supports, relationships and connections are visualized.



Note: Adapted with permission from “*Bèta en technologie in burgerschapsonderwijs*”, Tolkamp, J., Guérin, L., & Klaver, L. (2019). TechYourFuture.

APPENDIX E: PRINCIPLE 4 - DECISION MAKING

The decision-making principle brings together all the skills and acquired knowledge of the other principles. Students can make decisions group-wise, when they formulate a solution on a societal issue where they use the knowledge gained during ‘thinking together’ and ‘network thinking’ to form arguments (principle ‘arguing’) and then evaluate the solutions and decide together.

In a Green Deal issue (or socioscientific issue), making decisions is a complex process. This is due to the number of different actors involved, the knowledge required and the level at which the issue is situated (local, regional, national or global). In addition, every solution has both positive and negative consequences. By applying the principles of ‘thinking together’ and ‘network thinking’, the complexity of the issue can be better understood and addressed. When no attention is paid to making an informed decision, the issue is simplified, and the most logical and easiest solution is often chosen: a ‘short-cut’. This short-cut is then made because it is difficult to view different perspectives, knowledge, and aspects when making decisions. However, the most obvious solution is not immediately the best solution. When the

group makes a decision on which solution is the most appropriate option based on the knowledge and insights gained, learners are supported to make moral and informed trade-offs. To prevent students from making a short-cut, there are various forms of work that can support students in the process of making a decision, such as the expert method elaborated below.

Making informed decisions promotes learners’ autonomy. They are given a voice. It is not the teacher who decides what is right, but the students themselves who learn to weigh arguments and make a decision together.

Activities for Decision Making

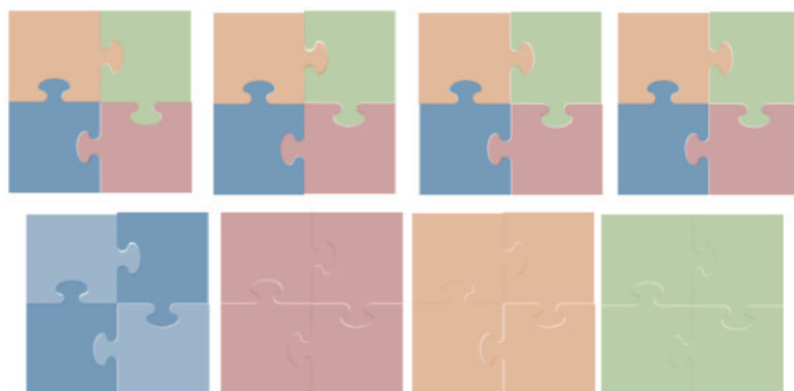
The Expert Method (also known as jigsaw, see Figure 2 for a visual representation of the activity) is an effective activity in which skills such as cooperation, communication and critical thinking are practiced. In a structured approach, groups of students delve into a topic, these groups are the so-called ‘expert groups’. In the expert group, students delve into a particular piece of information or an actor. You

can give the students sources or hints where they can gather information about their specific topic.

New groups are then formed, the 'jigsaw' groups in which decisions will be made. Each jigsaw group includes one student from an expertise group. In the jigsaw groups, students share their findings and knowledge from their expertise. After all the information has been shared within the jigsaw group, the students start asking each other questions and discussing the topic. Based on the information within the jigsaw group, a solution can be chosen. Arriving at a solution or decision can occur within the jigsaw groups, as well as with the whole class.

Figure 2

Visual representation of the Expert or Jigsaw Method



APPENDIX F: FORMATS FOR ACTIVITIES AND READ MORE...


1. ARGUMENTS BINGOCARD

Activity: Have children monitor on the bingo cards below during a discussion in class or during a text in which a discussion is written out. Which of the 4 elements occur in the discussion? What type of argument is given? Who recognizes the most arguments?

<p>Position or Opinion</p> <p>what someone thinks</p> <p>Identifiable by "I think"</p> <p>I think Rome is a beautiful city</p>	<p>Argument</p> <p>Someone explains why (s)he thinks, feels or does something</p> <p>Identifiable by words as "because, as, since, due to"</p> <p>I think Rome is a beautiful city as there are so many very old buildings.</p>
<p>Proof</p> <p>Proof includes facts you can check</p> <p>Identifiable by information/facts you can find</p> <p>Rome has many old buildings. You can check that out on Google maps.</p>	<p>Counterarguments</p> <p>An argument of someone who disagrees with someone else's argument.</p> <p>Identifiable by words as "but, at the other hand, though"</p> <p>But not everybody likes old buildings.</p>

2. PASSPORT

Activity: Let students design their own passports for the actors involved in the European Green Deal problem. For this, the passports from below, can be used as a format.

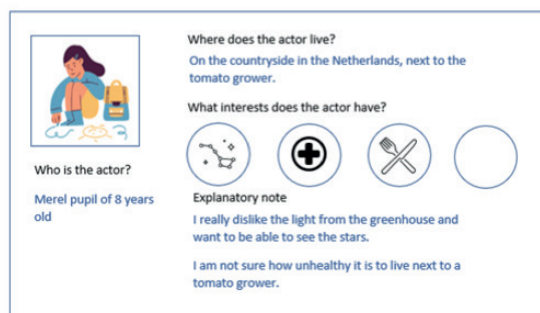


Who is the actor?
Tomato grower

Where does the actor live?
On the countryside in the Netherlands.

What interests does the actor have

Explanatory note
I want to continue my family business without making the tomatoes too expensive.



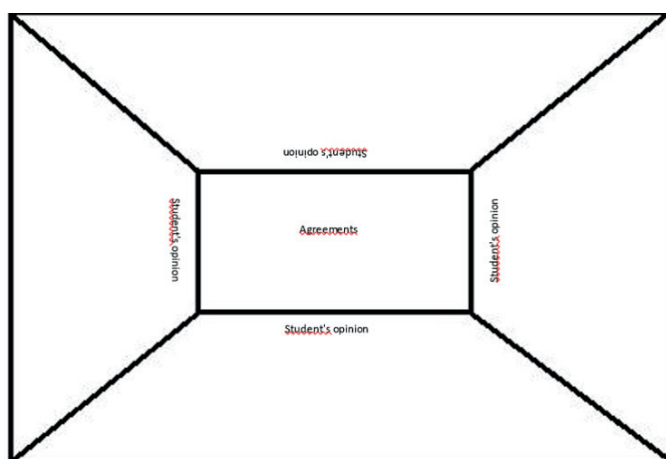
Who is the actor?
Merel pupil of 8 years old

Where does the actor live?
On the countryside in the Netherlands, next to the tomato grower.

What interests does the actor have?

Explanatory note
I really dislike the light from the greenhouse and want to be able to see the stars.
I am not sure how unhealthy it is to live next to a tomato grower.

3. PLACEMAT



4. Read more

Kennisrotonde. (2020). *Wat kunnen basis- en middelbare scholen doen om duurzaam afvalgedrag van hun leerlingen te bevorderen?* <https://www.kennisrotonde.nl/vraag-en-antwoord/duurzaam-afvalgedrag-bevorderen-op-basisscholen-en-middelbare-scholen>

Guérin, L.J.F. (2018). Deliberatieve democratie in de klas: hoe dan? *Montessori Magazine* (2)41. https://www.saxion.nl/binaries/content/assets/onderzoek/meer-onderzoek/vernieuwingsonderwijs/deliberatieve-democratie_guerin.pdf

Guérin, L.J.F. (2020). *Position paper Bèta Burgerschap; Handelingsperspectieven voor de toekomst*. TechYourFuture. https://www.techyourfuture.nl/files/downloads/Beta_Burgerschap/TechYourFuture_Position_paper_Beta_Burgerschap_juli2020.pdf

Sins, P.H.M., & Van Der Zee, S. (2012). De effectiviteit van samenwerkend leren. In R. R. F. Berends & P.H. M. Sins (Eds.), *Samenwerken in het daltononderwijs: geschiedenis, praktijk en onderzoek* (pp. 105-148). Saxion Dalton University Press.

Tolkamp, J., Guérin, L., & Klaver, L. (2019). *Bèta en technologie in burgerschapsonderwijs* [Science and technology in citizenship education]. TechYourFuture. <https://www.techyourfuture.nl/wp-content/uploads/2023/04/Praktijkboek-Beta-Burgerschap.pdf>

APPENDIX G: CONVERSATION TECHNIQUES

Conversation Techniques to stimulate arguing and thinking together

Conversation Technique	Example
Clarifying Rephrasing in a different (often more precise) way	I think you're saying... Let me see if I understood correctly... <i>What do you see/smell/hear/taste/feel</i>
Clarifying by summarizing Having another student summarize what has been said	Can you summarize that briefly? How else could you say that? <i>Can you tell me what happened?</i>
Exploring the topic through expansion Encouraging students to add to the mentioned ideas	Can you say something else about this? Who else knows more about this? <i>Can you do it in a different way (or with different materials)?</i>
Exploring the topic through criticism. Challenging students to criticize each other's ideas	Do you agree with that? Why or why not? Who thinks differently?
Deepening the topic through substantiation Challenging students to support their ideas with facts	Why do you think that happens? How do you know that for sure? <i>Can you prove that?</i>
Deepening the topic by explaining Asking students to explain their ideas further	When you said... what did you mean exactly? Can you explain that?
Deepening the topic through prediction Asking students to make predictions	What do you think will happen if... happens (or changes)? <i>What do you think will happen if I(/you) do this (or that changes)?</i>
Waiting Allow students to think and to formulate a good response	Waiting (about 5 seconds)

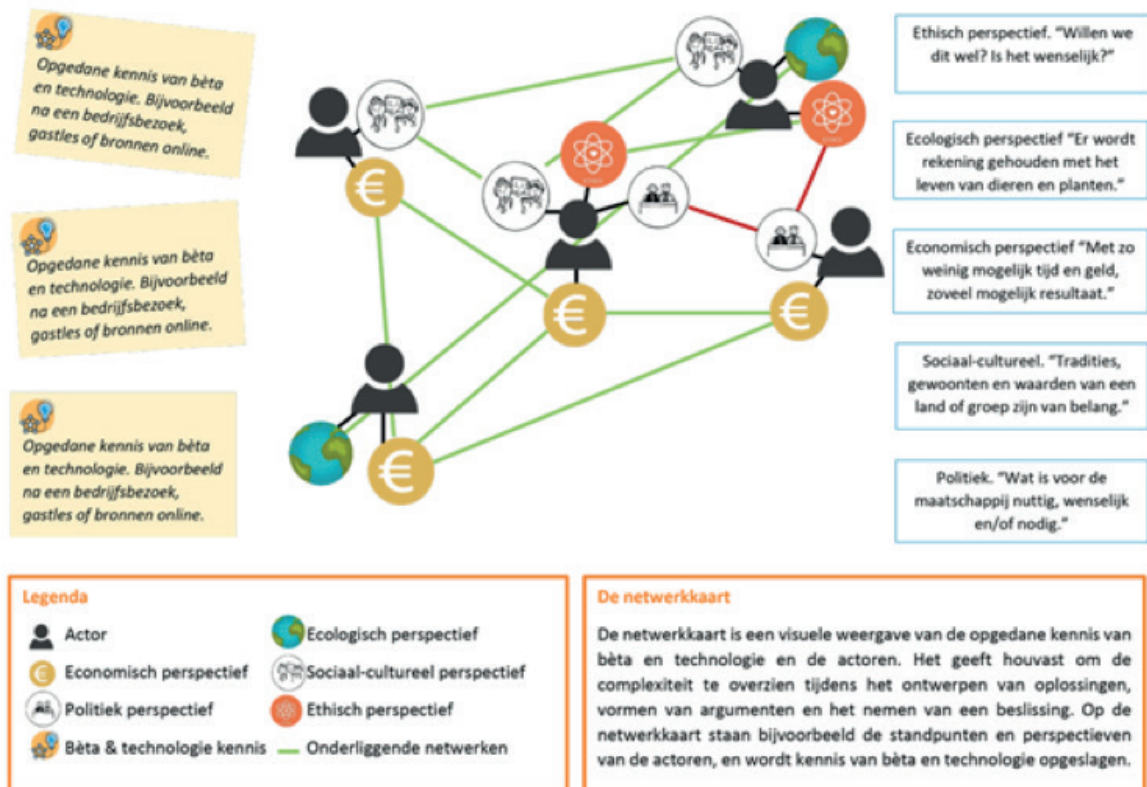
Note 1. Adapted from: Krajcik, J. S., & Czerniak, C. M. (2018). *Teaching science in elementary and middle school: A project-based approach*. Routledge.

Note 2. Italic texts are meant to stimulate hands-on activities.

APPENDIX H: CREATING A NETWORK MAP

A network map shows, in the context of a particular social issue, how the various stakeholders (with their own interests) and material goods relate to each other. A network map shows:

- o Which stakeholders (actors) are involved in the issue
- o From which perspectives they view the problem (e.g., what are their interests)?
- o How the stakeholders relate to each other. (e.g., using a connecting line of a certain color).



Note: Copied from: Tolkamp, J., Guérin, L., & Klaver, L. (2019). *Bèta en technologie in burgerschapsonderwijs*. TechYourFuture.

APPENDIX B

EASE course script (Top Gun - 6 sessions)

Meeting 1 Introduction

Lesson part	Description learning activities	Duration (min.)
Kick-off	The teacher educator briefly introduces the EGD themes and then explains the teaching method 'choose your subject'.	5
Introduction/ Energizer (teaching method; choose your course)	Using the 'choose your subject' teaching method, participants explore and develop their own knowledge and opinions on sustainable development (EGD themes). This activity also initiates group formation. Guiding statements during this activity: <ul style="list-style-type: none"> • I am consciously making sustainable choices every day. • I have made my house sustainable (insulation, solar panels, a heat pump, off the gas). • I eat meat every/ almost every day/ meat half the week/ no meat/ I am vegan. • When making purchases in shops and online, I try to get as little single-use plastic as possible with my products. • Weekly, I read and/or watch background information to increase my knowledge on sustainability. • I have a petrol/ diesel/ hybrid/ electric car/ no car. 	15
Sample lesson (teaching method; Post-it brainstorm)	After the introduction, the teacher educator gives a sample lesson. In the sample lesson, the participants put themselves in the role of an upper primary school student. Except for two participants, who are given the role of observers. Observation points for the observers are: <ul style="list-style-type: none"> • What structure do you see in the lesson? • What didactic and subject-related aspects in the lesson stand out to you? <p>In the sample lesson, the first two steps of the Group Problem Solving model (GPS model; 4 steps and 4 didactic principles) are implemented. The teacher educator applies questioning strategies to ensure students argue and think together.</p> <p>Sample lesson</p> <ol style="list-style-type: none"> 1. Step 1 GPS model; Introduce problem with a video about the natural greenhouse effect. After the video, a brief explanation. Then students per group (4 students) get a poster with the 4 questions from step 1 of the GPS model and fill them in together. - First, they write down what globally is the problem (1st question). - Then they write their own question(s) on a post-it and stick it on the poster. Before sticking on a question, the student reads it aloud. Then, for each question, they check whether they know the answer to the questions together (they put that next to the question). Then they circle the questions that remain and write down what they still want to find out. After 20 minutes, the posters are put up at the front of the classroom. (20 minutes). The teacher educator (teacher) walks around and directs through questions (question strategy). 	40

Sample lesson (teaching method; Post-it brainstorm)	2. Step 2 GPS model; Analysis - Classroom presentation (per group) and discussion of the posters. If students do not remember, the teacher explains (science knowledge). Then the teacher concludes with the students which (possible) aspects are related to the problem and who is involved in it (20 minutes).	
Debriefing sample lesson	<p>Group discussion with the whole group. First, the observers tell what structure (steps) and didactic actions they have seen, and it is checked whether the 'students' have recognized the steps and didactics.</p> <p>This is followed by a didactic deepening by the teacher educator. The first two steps of the GPS model are explained, and the last two steps are introduced. This is followed by a course explanation and explanation of the course objectives (see study guide).</p>	20
Processing assignment	Give a lesson according to the first two steps of the GPS model and collect data on students' arguments (e.g., make video or audio recordings of conversations, take account of GDPR). Then reflect on this data using the instructions in Appendix C of the study guide. For meeting 2, bring transcripts showing how students reason/argue and try to interpret the comments, for example as: opinion, argument with/without evidence, counterargument, debunking one's own argument, responding to argument of the predecessor, etcetera. Then reflect on what you think of your students' argumentation.	10

Meeting 2 Thinking Together and Argumentation

Lesson part	Description learning activities	Duration (min.)
Preparation for students	Didactics: Read Appendix A, B and C of the study guide. EGD background: Read Energy transition Netherlands, Green Peace, Scientific fundament.	
Introduction	The teacher educator briefly reviews meeting 1 and checks to what extent the GPS model and the 4 didactic principles have been understood.	10
Reflection on data collection task	This part starts with an introduction by the teacher educator on argumentation skills (see Appendix C of the study guide). Then, in groups of 3 or 4, participants discuss the data they have collected (transcriptions/sound/video of argumentations). Guiding questions are: what do you think of your students' argumentation? How did the activity itself go? How did the didactic principle of argumentation work for you? Were you satisfied, would you do it differently another time? First openly, then using Appendix C.	20
Taking a perspective (teaching method; Expert groups)	This part begins with a brief introduction of the teaching method Expert Groups (Jigsaw method) by the teacher educator. The EGD issue around Energy Transition is then worked out using expert groups. The participants put themselves in the role of a particular 'expert' and analyze a particular problem from that perspective.	45

Taking a perspective (teaching method; Expert groups)	<p>Goals: Deepening the content knowledge about the EGD issue of energy transition and deepening the application of the didactic principles of thinking together and argumentation.</p> <p>The course of this part using the 4-steps of the GPS model:</p> <ol style="list-style-type: none"> 1. Discussing the problem with the whole group according to the four questions of step 1 (GPS model). Starting point is that the participants have read the information at 'preparation for students'. Problem: Global warming has negative consequences for Europe and the Netherlands. How do we get rid of fossil fuels (energy transition)? After discussing the four questions from step 1, the 'expert groups' are introduced. 2. Analysis (step 2) is elaborated using the 'expert groups'. First, the whole group examines the perspectives (which parties are involved). Each party is represented by an expert group of 2 or 3 participants (government, energy companies, water boards, environmental lobby, Formula 1 fans, Schiphol Airport, climate scientists...). Each group, using the questions of the analysis step (GPS model), analyses the problem from its own perspective and then devises solutions to realize the energy transition. 3. Decision (step 3). The teacher educator leads the debate between the different parties. Each party may first present its solutions. Then the groups enter into discussion with each other. The aim is to arrive at a widely supported solution to the problem. 4. Debriefing (step 4). During step 3 above, two participants observe the argumentation and cooperation within the groups (step 2) and in the debate (step 3). In this step, the two observers lead the evaluation hereof. First, the observers discuss what they noticed in the behavior of the teacher educator and fellow participants regarding their argumentation and collaboration during the process, and then they draw conclusions about the extent of science and technology content, argumentation, and collaboration (didactic principles 2, 3 and 4). 	
Closure	<p>The teacher educator takes over from the observers and discusses what lessons have been learned with regard to stimulating students' argumentation and what role the teacher plays in this (modelling; teacher educator explicates and discusses his/her teacher behavior). Finally, the link is made to didactic principle network thinking, this will be discussed in more detail in the next meeting.</p>	15
Assignment for meeting 3	<p>Make an inventory of which climate and environmental topics are alive in your classroom. Use a suitable teaching method for this (see also, for example, Appendix F from the study guide).</p>	

Meeting 3 Network Thinking

Lesson part	Description learning activities	Duration (min.)
Preparation	<p>Didactics: Read Appendix C and D of the study guide.</p> <p>EGD background: read Climate neutral, what does this mean?, In class: Make an inventory of the climate and environmental issues in your class. Use a suitable teaching method for this (see also Appendix F from the study guide).</p> <p>For those who cannot get enough: https://edepot.wur.nl/406796</p>	
Introduction	<p>It starts with a short group discussion, led by the teacher educator, looking back on session 2, the GPS model and the 4 didactic principles (zooming in on network thinking and argumentation). Then, introducing network thinking, the didactics (Appendix D of the study guide), and in the practice of Europe Climate Neutral.</p> <p>Theory on cohesion in sustainable development; The dimensions of sustainable development (from 1:33)</p>	10
Making a network map	<p>Teacher educator introduces the network map task.</p> <p>A network map is a tool to take a perspective and formulate arguments pro/con from a perspective (EGD stakeholder). From each perspective, we also look further into the future and other perspectives (what does it mean for the next generation? What does our action for actor B mean for actor C? For the environment you would do x, but for the economy? And for people's well-being? And is it feasible?)</p> <p>Participants are then given the following task: Make with your group (of 4) a network map about an EGD theme (<i>choose a specific theme within the students' perceived world; perhaps indicate choices/examples such as waste around the school/ too little biodiversity around the school/ reducing CO2 emissions of the school or of village/neighborhood</i>). This could also be the topic of meeting 1. You will have 20 minutes for this.</p> <p>During the group work, the teacher educator ensures that the participants show the different perspectives on the network map. To do this, he/she uses the didactics described in the appendices in the study guide on the didactic principles.</p>	25
Lesson design	<p>The teacher educator asks in group discussion with the whole group how the participants experienced his/her supervision. After linking his/her own teacher behaviour to the didactics from the appendices of the reader, the teacher educator introduces the assignment:</p> <p>With your group, design a lesson for your own group, based on the network map you have just created. In your lesson design, keep in mind that you will indicate how you will ensure that on the network map your students create, the different perspectives become clearly visible. (How to use didactic principles)</p>	20

Presentation	The groups present their own network map and how they arrived at a lesson design from there. After each presentation, feedback is given by the group and teacher educator and a short discussion is held. Important discussion point is: how does the teacher ensure that students think and argue together and take different perspectives and does the network map help in this?	10
Closure	The teacher educator briefly reviews meeting 3 and then presents the processing assignment for the 4th meeting. He/she then brainstorms with the participants on how to conduct the group interview and with which questions the participants will get useful feedback from their students. The feedback from students should be useful to improve their lesson design and teacher behaviour. (What would you like to know from your students? What do you need to improve your lesson?)	15
Processing assignment	Present the lesson design of the network map to colleges and/or students and interview a college and/or a group of students about this lesson (group interview; participants are given a sheet with sample interview questions and instructions on how to follow up on them). Record this interview and make a transcription (tip: use software such as Amberscript).	10

Meeting 4 Thinking Together and Making Decisions

Lesson part	Description learning activities	Duration (min.)
Preparation	Didactics: Read Appendix D and E of the study guide. EGD issue: Watch the video 'Green Deals Approach' on the website: Network of Green Deals.	
Introduction	The teacher educator discusses Appendices D and E with the group, focusing on the following questions: What did you notice? What experience do the participants themselves have? What barriers do they see (for themselves or colleagues)? and how can these barriers be removed?	15
Discussing students' feedback	The teacher educator divides the group into small groups (3 or 4). In the groups, the participants discuss the transcripts of the group interviews with each other (per participant). Next, conclusions are drawn regarding students' thinking together, argumentation and network thinking, what works/does not work. The conclusions of the different groups are then shared in the large group.	25
Deciding and taking action	The teacher educator then introduces the next group assignment: <i>Making a network map is part of the analysis step (step 2 of the GPS model). Step 3 of the GPS model is about making decisions together and step 4 is about debriefing. Guiding the processes during these last two steps requires careful direction. Discuss in groups (same as in meeting 3) how this process can best be steered, which methods can be used (see appendix G of the study guide) and what the teacher's role is in this.</i>	35

Deciding and taking action	First, each group presents their own schematic of steps 3 and 4 (GPS model) and their prediction of what actions their students will come up with. Then the teacher educator looks back on meeting 4 and introduces the assignment for meeting 5.	15
Assignment for meeting 5	Explore the archive of scientific citizenship lesson materials and then decide which lesson series fits into your school's curriculum and which you yourself, after adapting, would like to work with in your classroom.	

Meeting 5 Redesigning Scientific Citizenship Lesson Series

Lesson part	Description learning activities	Duration (min.)
Preparation	Participants study scientific citizenship teaching materials in the archive.	
Recap	The teacher educator begins with an introduction about the European Green Deal outlining the broader picture (i.e., connection to global approaches to sustainable development) and discusses which of the scientific citizenship teaching materials participants think fit within the EGD and are suitable for their own group (and why). Groups are then formed of participants who want to work with (roughly) the same teaching materials. The participants then (re)design a lesson series for their own group according to the GPS model around an EGD issue. The design should clearly indicate which science knowledge students gain and how the four didactic principles are applied.	50
Discussing students' feedback	Participants have broadly designed their own lesson series. Now they explore how they can evaluate their design in order to make subsequent improvements. From whom can you collect different kinds of feedback and how do you ensure that you can use that feedback to improve your design? Participants reflect on this and put their ideas on paper: 1. Participants discuss their ideas in groups and critique each other's ideas. 2. In the large group, the ideas are discussed and argued. Central questions here are: what feedback do you get from whom and how can you make sure that the feedback is really useful for improving your design (e.g., by asking open questions that focus on the intended purpose).	25
Closure	Brief review of the meeting and discuss the assignment for next time.	15
Assignment for meeting 6	1) Collect feedback on the designed lesson series from at least two different types of respondents (colleagues/mentor/students). Make sure that the feedback relates to students' learning of content-related science knowledge (does it fit the students, is there sufficient learning, etc.) and to the didactic principles (is each principle sufficiently present).	15

Assignment for meeting 6	2) Adjust your design based on the feedback obtained. 3) Make a short presentation of maximum 5 minutes (pitch; choose your own form; poster, PowerPoint, vlog, ...) about the adjusted design of your lesson series and show in it how the goals are achieved (goals regarding science knowledge and the four didactic principles) and how you dealt with the feedback you received from colleagues and/or students (point 1).	
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Meeting 6 Pitches (guests are invited to this meeting)

Lesson part	Description learning activities	Duration (min.)
Preparation	Participants prepare a pitch of max. 5 minutes (see assignment) The teacher educator encourages participants to invite one or more colleagues (e.g., the citizenship/culture/science coordinator) or the mentor and makes an invitation to do so. Furthermore, he/she reserves an extra room for the presentations.	
Recap	First, a brief review of the previous meeting, then discuss with the whole group the experiences of collecting feedback on the design (discussing what worked and what did not) and how the design was adapted based on the feedback.	10
Presenting the lesson designs (teaching method pitching; Short convincing presentation)	Participants are divided into 3 or 4 groups (based on content theme). Guests are given the role of judges and divided among the groups. Then each group (with guests) goes to its own room. Within the groups, each participant pitches and presents the designed lesson series in 5 minutes. Afterwards, the judges ask (clarifying/critical) questions to the participant (approx. 10 minutes). When all participants in the group have presented, the judges choose a winner.	60
Closure	The judges of all groups tell who has become the winner of their group and motivate their choice. This is followed by a brief closing of the course by the teacher educator.	20

APPENDIX C

Development of the EESD questionnaire

Learning objective	Inspired by..					Items extensive EESD questionnaire	Item shortened EESD questionnaire
	1	2	3	4	5		
A. Knowledge about EESD							
A1. Knowledge of the connection between curriculum standards, citizenship education, SSI education, European Education for Sustainable Development, and the EGD.						I understand well how teaching about EGD issues is related to citizenship education. I understand well how teaching about EGD issues is related to science and technology. I understand well how teaching about EGD issues contributes to knowledge about Europe.	
A2. Knowledge of the essence of SSI	x					I have enough knowledge about EGD issues to teach about this.	I have enough knowledge about EGD issues to teach about this.
A2a. Knowledge of and about the science involved in SSI		x	x			I have enough scientific and technological knowledge to teach about EGD issues. I understand well enough how science works to teach about EGD issues	
A2b. Knowledge of the moral/ethical considerations regarding SSI						I have enough knowledge about ethical and moral considerations to teach about EGD issues.	
A2c. Knowledge of the social considerations associated with SSI						I have enough knowledge about social considerations to teach about EGD issues.	
A3. Knowledge about the educational principles for group problem solving.		x	x			I have enough knowledge about good didactics to teach about EGD issues. I know how I can effectively teach about EGD issues.	I know how I can effectively teach about EGD issues.
A3a. Knowledge of argumentation and the evaluation of arguments						I have enough knowledge about good argumentation to teach about EGD issues.	
A4. Knowledge about the resources students bring into EESD						I know enough about my students' daily lives to understand how EDG issues play a role in their lives.	

Learning objective	Inspired by..					Items extensive EESD questionnaire	Item shortened EESD questionnaire
	1	2	3	4	5		
B. Skills regarding EESD							
B1. The ability to redesign learning activities according to the educational principles for group problem solving: (1) argumentation, (2) connected learning, (3) decision making and (4) thinking together.					x	I can find materials that are useful for designing education on EGD issues.	
			x			I can adapt existing materials so that they are suitable to teach about EGD issues to my students.	I can adapt existing materials so that they are suitable to teach about EGD issues to my students.
		x				I can develop appropriate learning objectives for teaching about EGD issues.	
		x				I can evaluate the outcomes of teaching about EGD issues.	
B2. The ability to stimulate students' group problem solving skills.						I can teach students to look at EGD issues from different perspectives.	I can teach students to work with a group on solving EGD issues.
						I can teach students to think in "if ... then ..." reasoning about EGD issues.	
						I can teach students to discuss EGD issues.	
					x	I can teach students how to think together about EGD issues.	
						I can teach students how they can make decisions about EGD issues together.	
	x			x	x	I can properly help students who get stuck during assignments on EGD issues.	
		x			x	I can adapt my explanations of EGD issues to the different levels in my class.	
	x	x		x	x	I can deal appropriately with students' questions about EGD issues.	
				x	x	I can motivate students to remain task oriented while learning about EGD issues.	
B2a. The ability to help students make connections between science, SSI, and the EGD.						I can make clear to students what scientific and technological developments have to do with EGD issues.	

Learning objective	Inspired by..					Items extensive EESD questionnaire	Item shortened EESD questionnaire
	1	2	3	4	5		
B2b. The ability to facilitate moral and ethical development of students		x				I can stimulate students' moral thinking through teaching about EGD issues.	I can stimulate students' moral thinking through teaching about EGD issues.
B2c. The ability to facilitate discussion and argumentation in the classroom, evaluate students' SSI arguments during the discussions in the classroom, and provide feedback						I can assess whether students use good arguments in discussions about EGD issues.	
		x				I can give students feedback on their arguments on EGD issues. I can motivate students to discuss EGD issues.	
B2d. The ability to facilitate science learning in the context of SSI		x		x		I can teach students how science develops knowledge about EGD issues.	
						I can stimulate learning about science and technology through teaching about EGD issues.	I can stimulate learning about science and technology through teaching about EGD issues.
B3. The ability to value students' resources in EESD		x			x	I can take into account students' daily lives when teaching about EGD issues.	
		x			x	I can let students use their knowledge, skills and experiences in teaching about EGD issues.	
C. Attitudes towards EESD							
C1. Being interested in SSI and the EGD		x				I think EGD issues are interesting.	
C2. Feeling responsible for addressing SSIs and the EGD in the classroom						I think it is important that students receive education about EGD issues.	I think it is important that students receive education about EGD issues.
C3. Feeling secure about the uncertainties and unpredictability related to SSI		x		x	x	I think I can deal well with the unpredictability of teaching about EGD issues.	I dare to teach about EGD issues.
C3a. the handing of control to students					x	I dare to give students control over their learning when teaching about EGD issues.	

Learning objective	Inspired by..					Items extensive EESD questionnaire	Item shortened EESD questionnaire
	1	2	3	4	5		
C3b. being honest about knowledge limitations						I dare to tell students that I don't know everything about EGD issues either.	
C3c. willingness to position themselves as knowledge contributors rather than the sole authority						I dare to point out a student who knows more about EGD issues than I do as an expert.	
C3d. confidence to touch upon controversial aspects					x	I dare to discuss also the controversial aspects of EGD issues in class.	
C3e. open-mindedness to student positions that differ from the teacher's own						I can guide students in forming their own opinions about EGD issues without imposing my own opinion (even if I think they have an "incorrect" opinion).	

Note. 1 = Van Aalderen-Smeets & Walma van der Molen (2013), 2 = Kilinc et al. (2013), 3 = Lee et al. (2006) and Kara (2012), 4 = Muğaloğlu et al. (2016), 5 = Yahaya et al. (2015).

APPENDIX D

Comparison for Missing Data Sample versus the Test Sample

