

Service-Learning in STEM subjects

Learning through Civic Engagement for value-based learning

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As a nonprofit foundation, **Siemens Stiftung** promotes sustainable social development, which is crucially dependent on access to basic services, high-quality education, and an understanding of culture. To this effect, the Foundation's project work supports people in taking the initiative to responsibly address current challenges. Together with partners, Siemens Stiftung develops and implements solutions and programs to support this effort, with technological and social innovation playing a central role. The actions of Siemens Stiftung are impact-oriented and conducted in a transparent manner.

The **Freudenberg Foundation** designs all its activities to respond to problems of social exclusion and lack of appreciation. It focuses on children and adolescents, striving to promote the social, linguistic, educational, and vocational integration of the next generation. The Freudenberg Foundation first introduced the service-learning model to Germany as a pilot project in 2001. Since then, it has helped expand, develop, and establish service-learning at schools as part of its core program, including through the **national "Network for Learning through Civic Engagement – Service-Learning in Germany"** which brings together some 150 schools and 30 centers of excellence to advise, support, and partner with schools in implementing service-learning programs. In 2017 the independent non-profit **Foundation for Learning through Civic Engagement – Service-Learning in Germany (Stiftung Lernen durch Engagement – Service-Learning in Deutschland)** was founded to follow Freudenberg Foundation in its role of implementing service-learning in German schools and coordinating the school and partner network (www.servicelearning.de).

Foreword

Where do we look for orientation and grounding? How can we take responsibility for ensuring social cohesion in an increasingly diverse society? Values play an important role in our lives. They set standards, establish criteria, and strengthen our personal and cultural identity. How we deal with issues of science and technology in particular is closely associated with the values we adopt. Today, it is not enough to merely identify and describe the social impact of scientific and technological correlations – we must be able to evaluate them from various perspectives as well. This explains the need for teaching and learning methods that encourage kids to learn about science and technology from an early age while opening the door to realms of experience where they can observe and reflect on values that will help them develop strong personalities and a sense of the common good.

Service-learning is an approach to teaching and learning that enriches how children learn about science and technology through activity-driven, real-world experiences. “Service-Learning – Learning through Civic Engagement” combines cognitive learning in school with hands-on civic engagement, teaching values alongside STEM subjects: By engaging in their cities or communities, students learn the social relevance of science and technology and automatically think about these issues in the classroom. They draw conclusions for how they would like to lead their own lives and actively cultivate a system of values.

The Siemens Stiftung has worked with the Freudenberg Foundation since 2014 and with its spin-off, the Foundation for Learning through Civic Engagement since 2017, harnessing their many years of expertise in science and technology education and their experience with “Service-Learning – Learning through Civic Engagement” to advocate for a research-driven, hands-on science and technology curriculum that also teaches values.

In a successful collaboration with the volunteer organization Freiwilligen-Agentur Halle-Saalkreis and the Ministry of Education in the German state of Saxony-Anhalt, “Service-Learning in STEM subjects” has been pilot-tested for one school year at nine schools in Saxony-Anhalt, Berlin, and Bavaria with a broad range of examples.

This handout is designed to illustrate how cognitive learning in STEM subjects can be combined with civic engagement. In-depth insights into contemporary practice make this handout lively and diverse and help you get your own service-learning project off the ground.

We wish you much success in your efforts to instill values through service-learning as an innovative approach to teaching STEM subjects.

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We thank all the participating schools and their teachers for their commitment, the real-world case studies that resulted, the new work materials, the inspiring testimonials – and above all, their openness:

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We also wish to extend our warm thanks to the participating partners. The time and expertise they lent in developing the concept and organizing and implementing the pilot project was essential in launching and sustaining it. Their dedication to service-learning in STEM subjects greatly enhanced this pilot project. Our special thanks go out to the partner institutions and our colleagues there:

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Handout for “Service-Learning in STEM subjects”

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1 At a glance

Value formation ...

Helping children develop into independent, responsible, socially aware personalities is an important task for everyone who accompanies them in their formative years. The values that children come to consider important form the foundation for both their individual decisions and their actions as part of society. Values serve as key points of orientation, especially during processes of social change. The formation of values begins in very early childhood: Small children already have a clear concept of justice, power, and fairness (Reinders, 2016). Schools have a mandate to nurture moral concepts in children and empower them to further develop and critically question their values. Schools can create realms of experience in which children can reflect on, question, and develop their moral concepts.

... in STEM subjects ...

STEM subjects are especially relevant for the future of our society. Climate change, diminishing natural resources, and the digital revolution are just a few of the major global challenges that surround us and are critical for how well we coexist – not just globally, but locally as well. The significance of these issues often eludes children, even though they are part of their daily experience and will affect their future: What causes environmental disasters, and what can we do to help? What does sustainable consumer behavior mean? What opportunities and risks are associated with the digital revolution? Now more than ever, it is the responsibility of STEM teachers to render the social relevance of the issues tangible and comprehensible to growing minds. STEM classes can impart the necessary knowledge and give students the capacities to explore the underlying issues and questions and view them from various perspectives.

... through service-learning

The service-learning teaching model combines science and technology curriculum with civic engagement by the children in their neighborhoods or communities. The young people have the opportunity not only to apply STEM subjects in practice and reinforce what they learned in the classroom but also to directly experience values through civic engagement. They experience the social relevance of STEM subjects first-hand, experience other realities and perspectives – by working with preschoolers, the elderly, or refugees – and reflect on their own actions. In so doing, they assume responsibility within their own circles and learn that their skills and talents can make a difference. The reflection initiated in the classroom discussion allows students to talk about and further explore their experiences, draw conclusions about how they wish to shape their own lives, and think about the connection between what they learn at school and their actions in the field. All of this in turn helps them develop their moral concepts.

Field projects

Second-graders learn about the fire triangle and its significance as part of their general science studies class. They also learn how to prevent fire and work with the fire department to pass this knowledge onto children in a local refugee housing facility.

Third-graders learn about herbs and their use during their general science studies and gardening sessions, and they build an herb spiral in a home for the disabled to sensitize them to fresh food and healthy eating.

Eighth-graders in physics class study energy, energy consumption, and energy conservation and volunteer at a neighboring school to work for the responsible use of energy. They develop an energy conservation strategy and proposals for "bodily energy" based on conscious nutrition.

Eighth-graders in physics class learn interesting facts about water, energy, and heat and run an academy for kids in the community consisting of five afternoons of experimentation that provide young schoolchildren with an attractive outing in the local countryside.

Seventh-graders in their interdisciplinary “natural sciences” class familiarize themselves with how the forest and local ecosystems work and get involved by reforesting a neglected educational nature trail so that the community can once again enjoy it.

Seventh- and eighth-graders in physics and chemistry class learn about various natural phenomena and offer age-appropriate learning units on soil, water, energy, light, and shadow to students at the local primary school.

Ninth-graders learn about the sensory organ of the skin as part of biology class and about various types of energy as part of their technology studies, and they work with German Cancer Aid, inspecting a local preschool for how well it protects the young children from the sun and advising them on effective measures to guard against overexposure to the sun.

Eighth-graders in physics and technology class learn about the principles of thermodynamics and methods of energy production and work with a residential construction company to develop a strategy for energy-saving upgrades in a local neighborhood. The students help calculate the neighborhood’s carbon footprint and process the data in a model that they present to the residents.

First-, second-, and third-graders learn about healthy eating habits in their general science studies and get involved with a healthy breakfast to promote conscious nutrition in neighborhood preschools.

Sixth-graders in physics, chemistry, and biology class work on the larger topic of water and get involved in a preschool by organizing daylong seminars on water-related issues, leading a creekside walk, and planning the construction of a water playground for the preschool.

Eighth-graders in biology class grapple with the topic of drugs and addiction and volunteer at a local streetwork walk-up center, assisting with day-to-day work such as cooking for the young clientele.

“ *I don’t care what anybody else says: I will continue service-learning in STEM subjects next year. My students have been transformed.* ”

“ *I’ve waited for this my entire career as a teacher. This project has changed my students and reminded me what it is I truly care about: facilitating value formation in my classroom.* ”

2 Meaning and understanding of values and their formation

Our society is undergoing constant change. The processes of change are being driven by global developments and technological progress as well as by migration and demographic shifts. The resulting diversity of (new) living concepts makes our shared existence more pluralistic and opportunity-rich. But this also entails challenges that cause us to question our personal and societal values. What exactly do values mean to us? What role does the forming of values play among children and adolescents? And what do schools need to do to empower young people with a sense of responsibility to act for the common good?

What are values?

Values help us assign importance to ideas, concepts, and actions. How much time we spend with our friends or family depends on the value that we ascribe to personal relationships. The value that protecting the environment holds for us is evident in many ways, such as how we separate our waste or whether we switch off unused lights to save energy. Rarely do we make such decisions ad hoc in a given situation. Instead, we follow a kind of inner compass that governs our behavior and provides an orientation for our actions. The underlying values of this compass are defined as conscious or subconscious standards and principles that guide individuals and groups in their choice of actions (Horn, 2002). They are formed in the course of our socialization – as we grapple with cultural, individual, and social contexts. Research tells us that values, once internalized, remain largely stable over a lifetime (Mandl, Kopp, Niedermeier & Meixner, 2015a; Reinders, 2016). They differ in their importance and are organized in an individual system of values based on our own personal assessment (Schwartz, 1992; Schwartz & Bilsky, 1987).

Why is value formation important?

Values play an important role in our individual development and in our coexistence as a community. They serve as points of orientation (Mandl, 2016). This is especially true during processes of social change, which offer many opportunities but can also trigger fear and uncertainty. Such processes of change bring about a greater diversity of values and trigger a need – for both individuals and society as a whole – to reflect on values-related issues. This reflection is important, because it allows us to have a thoughtful discussion on shared values that provide new orientation and can counteract fears. But values cannot simply be imparted. Values are not instilled through simple transfer, much less indoctrination. The formation of values is a process that unfolds as our personalities develop. This process takes place everywhere and all the time, and it works best when we experience and reflect on values (Schubarth, 2010). If we accept that premise, then it is not only the job of parents and family to foster the development of values and create opportunities to actively examine one's own values. The formation of values must be understood as the shared responsibility of all people and institutions that accompany young people throughout their development – and this includes schools (Rump-Räuber, 2010).

What role does value formation play in educational policy?

If we view values as the bedrock of a social community, then schools have a mandate to facilitate the formation of values of our constitutional and social order (Menzel, 2013). It is from this sense of purpose that the German public mandate for education – at both the state and federal level – emphasizes the necessity of giving young people the opportunity to develop into independent, socially competent, responsible personalities (Schubarth, 2010). This includes more than just a comprehensive general education. Above all, it means developing a reflective and grounded sense of value and learning to make moral judgments. This allows children to make their way in a diverse world, arrive at their own opinions, and play an active role in shaping society. When you ask children themselves who they look to for values, schools also figure prominently: Teachers are named right after parents, far ahead of friends or social media (GEOLino & Unicef, 2014). Teachers are important role models and, whether they know it or now, embody values through their actions.

Why is it important to integrate value formation in STEM subjects?

Children today are confronted early on with scientific and technological issues, some of them controversial: Should a wind turbine be built in the community? Why is it so important to avoid plastic waste? What are the reasons why people should avoid consuming meat or even all animal products? At the same time, there is a growing general consensus in society that existential issues facing humanity such as war, peace, and climate change are closely linked to the issue of values (Schubarth, 2010). Assessing the social significance of these issues requires more than just facts and theories. For this reason, science and technology teaching and learning should address the social relevance of the topics and encourage children to reflect on and critically assess the intersection of science, technology, and society. (See also the “Assessment” section of the educational standards adopted by the German Conference of Education Ministers, 2005.) It's not enough for students to simply grasp complex subject matters. They must also be able to examine the various technical, personal, social, and societal perspectives of the issues. Science and technology classes also offer excellent conditions to facilitate students' value exploration and formation: By collaborating on experiments, for example, children have the opportunity to learn about responsibility, compromise, judgment, team spirit, and social skills (Mandl, 2016). Teaching and learning in STEM subjects also offers an opportunity to quite consciously promote attitudes and behaviors that allow children to participate in society as confident, responsible, socially minded personalities.

Facilitating value formation in the pilot project

In the pilot project “Service-Learning in STEM subjects”, we selected five values that guided our actions in the practical implementation. The schools consciously addressed, reflected on, and promoted these values in the service-learning projects with students:

- **Sustainability** means giving consideration to economically, ecologically, and socially sustainable development for all generations.
- **Taking responsibility** means acknowledging and dealing with the consequences for one's own decisions and actions.
- **Environmental awareness** means caring for the environment and adapting one's actions accordingly.
- **Solidarity** means building a society based on cohesion and mutual support.
- **Social justice** means the fair distribution of the spoils of society (per Mandl, Kopp, Niedermeier & Meixner, 2015b).

“Our students must be able to experience values intellectually and tangibly – and service-learning offers precisely this opportunity.”

“This project helped remind me what I really care about as a teacher: facilitating value formation.”

3 Service-learning: the right method

What is "Service-Learning – Learning through Civic Engagement"?

"Service-Learning – Learning through Civic Engagement" is an approach to teaching and learning in which students combine civic engagement with their cognitive learning in school (Seifert, Zentner & Nagy, 2012). Students get involved in a social, environmental, political, or cultural cause for the common good and gather democratic experience in the process (*service*). But their involvement is not separate from or in addition to their school day – it is part of their learning and closely associated with the classroom content. The civic engagement is planned during class time. The students' practical experiences are discussed in class and linked to lesson plans and curricula (*learning*). A couple of examples:

Students learn in physics class how LED lights work and about their energy-saving potential and independently develop a campaign to encourage the city to upgrade to LED lighting in public spaces.

Students work with digital media in computer science class and study the brain in biology, and they develop senior-friendly workshops to teach senior citizens how to use modern devices to explore digital media.

Service-learning combines civic engagement and cognitive learning in school in pursuit of two core objectives:

- *Change the educational culture and classroom experience* – because students learn how to apply the knowledge and skills they acquire in practice, gain a deeper understanding of subject matter content, and recognize the relevance of what they learn in school; and
- *strengthen democracy and civil society* – because young people are introduced to civic engagement and learn social and democratic skills in the process (Seifert et al., 2012; Seifert, 2013).

Standards of quality in "Service-Learning – Learning through Civic Engagement"

Service-learning is appropriate for all types of schools, all age groups, and all school subjects. The civic engagement can address a wide range of issues, targeted to the unique conditions of each school and community. Amid all the welcome diversity, however, there are shared attributes of "Service-Learning – Learning through Civic Engagement" that provide schools with orientation in the practical implementation. After all, the quality of implementation is critical in achieving the goals of service-learning and realizing the full potential of this educational approach. For this reason, educators have used scientific insights and practical experience to define the following six standards of quality for Learning through Engagement (Seifert et al., 2012):

- **Genuine community need:** The student engagement addresses a genuine need in the community. They take on responsibilities that are seen as meaningful and important by all involved partners.
- **Connection to curriculum:** Service-learning is structurally integrated in school, and the engagement is clearly linked to the curricular content and lesson plans.
- **Reflection:** The students can regularly take time to consciously and deeply reflect on their experiences.
- **Student voice and participation:** Students take an active role and have a real voice in planning, preparing, and designing the service-learning project.
- **Civic engagement outside of school:** The students' hands-on engagement takes place outside of the school and in collaboration with community partners.
- **Appreciation and Feedback:** The students receive feedback on their engagement and work throughout the process and are honored in a closing event.

Impact of service-learning

“Service-learning has an impact on students of all ages, from primary school to universities,” concludes educational researcher Heinz Reinders in his expert paper on service-learning (Reinders, 2016, p. 55). Numerous empirical studies have demonstrated that service-learning has a positive influence on the development of children and adolescents:

- *Impact on learning in schools:* Service-learning can make students more motivated about school and learning, strengthen their problem-solving skills, and give them a deeper understanding of educational content. (Celio, Durlak & Dymnicki, 2011; Conway, Amel & Gerwien, 2009; Yorio & Ye, 2012). Some studies also show that it improves scholastic performance (Reinders, 2016).
- *Impact on personality growth:* Service-learning makes students feel empowered, strengthens their sense of self-worth, lets them practice their communication and team skills, and fosters their capacity to empathize (BürgerStiftung Hamburg, 2011; Conway et al., 2009).
- *Impact on civic skills and social attitudes:* Students who have participated in service-learning have a stronger sense of democratic and social responsibility, are more interested in social problems, and are therefore more willing and able to help contribute to change themselves (Billig, 2004; Celio et al., 2011; RMC Research Corporation, 2007).

Impact of service-learning on the formation of values

We know from research into how values are formed that whenever children come into close contact with new things, it impacts their moral concepts (Reinders, 2016). Service-learning builds this bridge and makes it possible for students to experience contexts that are not part of their day-to-day environment. They experience a plurality of values (whether it's working with preschoolers, disabled adults, refugees, etc.) and reflect on their own actions. Taking on responsibility, applying their knowledge, and gaining practical experience makes values tangible for kids. Experience and reflection become the key moments in the formation of values (Mandl, 2016). Various studies illustrate the overall positive impact of service-learning on the formation of values and the moral development of children and adolescents (Conway et al., 2009). It also has a positive effect on the following specific values (Reinders, 2016):

- *Assumption of social responsibility:* Young people who have participated in a service-learning activity demonstrate a higher sense of responsibility toward their fellow citizens and assign greater importance to social justice (Eyler, Giles, Jr., Dwight E. & Braxton, 1997).
- *Civic engagement:* The relevance of political involvement and charitable activity grows after a service-learning project (Meyer-Lipton, 1998). Service-learning can also increase the willingness for political participation (Kahne, Crow & Lee, 2013).

“We often underestimate even our own children, because we have no idea what they are capable of. We should feel confident in expecting more of them.”

“This type of teaching gives us teachers the opportunity to change as well: to get out of the school and gain new perspectives.”

“My students learned that they can take on real responsibility.”

4 Value formation through service-learning: an enhancement for STEM classes

Using service-learning as an educational approach and nurturing values in schoolchildren enhances STEM classes. Why does this linkage strengthen STEM subjects? And what is especially important for launching the processes of value formation in your classroom?

Raising awareness of the social relevance of STEM subjects

Service-learning is a good fit for any school subject. For science and technology classes, the educational approach has the potential to make the social relevance of the STEM subjects tangible. Through their engagement, students experience the purpose and importance of science and technology for society. But their engagement is not merely an application of what they have learned. The students also help to solve a genuine social problem – with their own skills, abilities, and talents. They get to know other life experiences and perspectives. The follow-up reflection in the classroom lets students discuss their experiences, draw conclusions about how they wish to shape their own lives, and actively build up their moral understanding.

Experiencing values through the practical application of knowledge

The engagement gives students the opportunity to apply what they learned in class to the real world. They learn the purpose of what they study in school, see that their skills and abilities are needed, and work on behalf of others and society. This real-world application makes it possible for the children to experience values and examine their own values. Research shows us that girls in particular benefit from this access to the STEM subjects (Knight, Mappen & Knight, 2011).

Addressing experiences and consciously enabling reflection

Reflection, an important standard of quality in learning through civic engagement, establishes a conscious link between classroom learning in STEM subjects and the application of this learning in giving back to society. To begin the processes of forming values, it's important for students to consciously address the experiences, insights, and open questions from their civic engagement. This means that reflection must be planned and structured as part of the process of re-examining and questioning the service-learning projects. This paves the way for values to be explored and formed.

Empowering students to guide their own learning

The participation of the students is critical to service-learning. Students only experience a sense of empowerment when they have a voice in determining the learning process and planning their civic engagement, when they are involved in decisions, and take responsibility for their actions. This is an important foundation for value formation in STEM subjects. The greater the motivation and active participation in the service-learning project, the more willing and open students will be to discuss, reflect, and critically examine their attitudes and actions. In this way, service-learning gives students the opportunity to acquire science and technology knowledge through their own initiative, discover the important questions to ask in STEM learning, and pursue the answers.

Taking different perspectives through interdisciplinary learning

Scientific phenomena are often interdisciplinary, requiring a holistic perspective, and their applications raise ethical and sociopolitical issues. Service-learning is no different: The engagement in practice raises questions and makes it possible to combine course content from various STEM subjects and draw on ethics and social studies as well. This helps children early on to identify correlations and become aware of the social relevance of scientific issues.

5 Insights into practice

Examples of pilot projects in grades 1–8

Nine pilot schools hosted eleven exciting service-learning projects. These projects are introduced here to offer a glimpse into the practical implementation of service-learning in STEM subjects. We begin with four detailed case studies showing step by step how service-learning is implemented. The shorter examples that follow offer a picture of the potential diversity of service-learning in STEM subjects. All the examples illustrate inspiration and suggestions for how you can bring service-learning to life with your students.

“Sun Pass – sun protection for preschools”

AT A GLANCE

Ninth-graders learn about the sensory organ of the skin as part of biology class and about various types of energy as part of their technology studies, and they work with German Cancer Aid, inspecting a local preschool for how well it protects the young children from the sun and advising them on effective measures to guard against overexposure to the sun.

- Service-learning as a half-year project for ninth-graders
- Educational objective: increase motivation for learning
- Teaching content:
 - Technology: Energy types, energy conversion, regenerative energies
 - Biology: Skin as a sensory organ
 - Geography: Climate and vegetation zones
- Values in focus:
 - Assuming responsibility: Taking care of our own bodies
 - Solidarity: Sensitizing young children to their health

A secondary school wants to give ninth-graders other ways to approach issues of science and technology, because it's hard to get kids this age excited about STEM subjects.

Step 1: Initial planning and brainstorming in the class

The technology and geography teacher read about the work of German Cancer Aid in the newspaper and initiated contact. A representative from the charitable organization then visited the school, explaining to the students why protection from the sun is important from an early age and what the Sun Pass is: The Sun Pass is a certification given to preschools for their sun protection. The representative joined the teacher and class in a discussion about whether the ninth-graders might be interested in such a project. They were very enthusiastic and began to come up with their first ideas: What are the criteria that a preschool must meet to receive a Sun Pass? What contribution could we as ninth-graders make?

Step 2: Finding a partner and developing the idea for civic engagement

The students' first goal was to find a partner for their civic engagement – someone who had a genuine need for sun protection and also wanted their support. They put together talking points in class, then called various preschools. One preschool was interested right away: It has a large outdoor area with a few trees but otherwise nothing to protect the little ones from the sun. In a kickoff workshop that the students prepared in class, they explained the project to the preschool workers and familiarized themselves with the facility and its routines. With a mandate from the preschool to improve its sun protection, the kids returned to their classroom to brainstorm about how exactly their engagement should unfold. They formed into small groups based on the issues discussed in the workshop: “Experiments on the subject of the sun”; “Outdoor area of the preschool”; “Sun protection corner”; “Get parents involved”; and “Wall poster for preschool's entry area.”

Step 3: Preparing, implementing, and reflecting on the engagement

In the weeks that followed, the schoolchildren prepared for their engagement. The teacher used time from technology and geography class, freeing up a total of three hours per week for the service-learning project. During their time together in class, the students deepened their knowledge of sun protection, energy, and energy conversion. In biology class, they learned about the skin as a sensory organ. The small groups also prepared for their engagement and met regularly to coordinate their preparations among the groups. Then came the kickoff: The students worked two hours a week for four weeks at the preschool. They experimented with the children, built a sun sail in the yard, designed the sun protection corner with UV measurement equipment and a weather map, organized an evening presentation for the parents, and painted a wall mural with solar themes in the hallway. In addition to the two hours a week of civic engagement, they students also had one hour a week of reflection in the classroom. They shared their experiences, gave one another feedback, planned the next steps, and acquired additional knowledge about their engagement.

Step 4: Sharing appreciation and wrapping things up

The students achieved a lot during the engagement, but their actual goal still remained undone: getting the Sun Pass for the preschool. On a sunny afternoon, the ninth-graders, preschoolers, preschool teachers, and parents gathered to show their appreciation for what the students had achieved. The students outlined what they had done to the parents and local press, and a representative of German Cancer Aid ceremoniously presented the Sun Pass to the preschool.

Value formation and reflection as a recurring theme throughout project

How do we behave with the young children? What does sun protection have to do with us? Why is our engagement important to society? This is a sampling of the questions taken up by the teacher during the reflection phase. The students learned the importance of sun protection for the skin and how to take care of their own bodies.

"Our educational nature trail"

AT A GLANCE

Seventh-graders in their interdisciplinary "natural sciences" class familiarize themselves with how the forest and local ecosystems work and get involved by reforesting a neglected educational nature trail so that the community can once again enjoy it.

- Service-learning as a year-long project for seventh-graders
- Educational objective: giving students another way to relate to nature
- Teaching content:
 - Biology: The forest: Stratifications, use, protection of trees and animals
 - German: Preparing profiles, giving brief presentations
 - Ethics: Relationship between humans and the environment, civic engagement
- Values in focus:
 - Sustainability: Recognizing the importance of nature for people, animals, and plants
 - Environmental awareness: Becoming aware of the preservation of our natural environment

The school is already implementing service-learning projects in its German and ethics classes. Now, the idea is to extend service-learning to the interdisciplinary "natural sciences" course to help generate more interest in science among the students. The idea for the civic engagement itself was developed before the class started: Some years ago, the teacher was involved in creating the educational nature trail, which had long since fallen into disrepair.

Step 1: Getting the students involved and narrowing down the project idea

At the start of the school year, the teacher introduced her class to the year's subject: the forest. Who lives in the forest? How is the forest important – for people and the environment? To get things started, they visited the educational nature trail, which had fallen into disrepair in recent years, and the teacher proposed a service-learning project idea: Let's reforest the trail. The students were generally open to the idea of such a project and began gathering ideas: What exactly might our engagement be? Who can support us? In the weeks that followed, the students won the support of the city and of the forest service, who was responsible for the trail. The neighboring primary school also wanted to be involved, since learning about the forest is part of their general science class.

Step 2: Planning and implementing the civic engagement and linking it to the learning process in school

The students made sure that they were well prepared for their engagement: In the classroom they deepened their understanding of the forest, created profiles of the various plant types, learned about the "tree of the year" concept, and discovered the hallmarks of an educational nature trail. Their knowledge helped them in their engagement in the community: They visited the educational nature trail, spoke with the forestry service, and zeroed in on their idea: reforesting the "tree of the year" and replacing the descriptive stone markers. Thanks to their engagement, the seventh-graders succeeded in restoring part of the educational nature trail, replanting the littleleaf linden and sessile oak trees, and replacing the stone markers.

Step 3: Completing the engagement and sharing appreciation

To wrap things up, the students invited everyone involved in the project to a celebration of the renovated nature trail and the new trees and stone markers. The students resolved to present their work to next year's class and ask them whether they would carry on their engagement for the nature trail.

Value formation and reflection as a recurring theme throughout project

The schoolchildren had many occasions during this project to develop a sense of values: The engagement afforded the opportunity to actively think about environmental awareness and sustainability, look for links to their own lifestyles, and consider what their contribution to preserving the natural environment might be.

"What do we do if there's a fire?"

AT A GLANCE

Second-graders learn about the fire triangle and its significance as part of their general science studies class. They also learn how to prevent fire and work with the fire department to pass this knowledge onto children in a local refugee housing facility.

- Service-learning as a half-year project for second-graders
- Educational objective: Giving children the opportunity to participate through their own engagement
- Teaching content:
 - General science studies: Fire and related subjects
 - German: Speak clearly and listen attentively, practice reading aloud, use handwriting
 - Ethics: Understand and accommodate cultural differences and similarities
- Values in focus:
 - Solidarity: Help address the concerns of refugee children
 - Environmental awareness: Understand the risks of fire and the consequences of burns

In this rural primary school, projects are a regular part of the school day. The teaching staff saw service-learning as an opportunity to generate interest in STEM subjects early on and make values tangible.

Step 1: Involving the students and working together to develop the initial ideas for the civic engagement

It was important to the school to get the kids involved early on, so the second grade began its service-learning project with an open discussion of what project they should devote themselves to. And what does it mean to be engaged? Helping, supporting others, doing something good – that's what the students determined. And whom can we help? An animal shelter, preschool, fire department, refugees: The children considered a broad spectrum of ideas. In the end, the children decided to do something for refugees. The subject of migration was very current in Germany and Europa at this point of time, and there was much discussion of it both at home and in the media.

Step 2: Narrowing down the idea and partner for civic engagement and determining the classroom content

To turn the children's idea into reality, the teacher first met alone with the regional commissioner for refugees and the volunteer fire department. The desire of the class to do something on behalf of refugees led to the following idea for the engagement: The second-graders would team up with the fire department to share their knowledge of fire safety with the children in the nearby refugee housing facility. To get the students involved and win them over, the teacher had an idea: The next time the class was talking about the project, the school fire alarm went off. That's it, said the kids: the topic of fire! We'll show the kids how to respond when fire breaks out.

Step 3: Preparing for the project: linking classroom content to the engagement

In German class, the kids wrote a letter to the fire department asking for help with their project. In general science studies, they learned about the phenomenon of fire and the consequences of burns. During a visit to the fire department, they learned about how to behave in the event of a fire. And their preparations didn't end there: In ethics class, they discussed their feelings about their engagement and their knowledge of refugees. That helped them to speak about their fears and learn more about the living situation of the refugee children. Before the engagement began, the students practiced their presentation with the first graders at their school, then talked about their experience: The first-graders didn't always respond to their questions in the way they expected, for example. The second-graders responded by incorporating more non-verbal elements in their engagement to minimize language barriers.

Step 4: The big day: the engagement takes place

On the day of the project, the second-graders met the refugee children outside the fire department. They quickly broke the ice with a bit of English and some questions they had prepared, then things got started: The students gave their presentation on the subject of fire safety and worked with the fire department to show the kids how to respond in the event of a fire. The highlight of the day was the collaboration on extinguishing a fire. The morning was instructive on the subject of fire safety and offered basic scientific information in an easy-to-understand form. What's more, it led to valuable contacts among the children and the desire to meet again.

Step 5: Sharing appreciation and wrapping things up

The second-graders met for a wrap-up session with the teacher in which they reflected on the day: How did the engagement go? What in particular did we like or dislike? How was the encounter with the refugee children? The school demonstrated its appreciation for the engagement of the students with a ceremony and medals for the "fire safety experts."

Value formation and reflection as a recurring theme throughout project

Above all, the project promoted solidarity and sustainability. The teacher helped the children become aware of this through reflection again and again during the project by asking questions and drawing a connection to classroom content. She made it possible for the children to form their own opinions and assess matters independently: What is the significance of fire for the environment? How can we all help to prevent fire and protect our environment?

“A carbon footprint for our neighborhood – sign us up!”

AT A GLANCE

Eighth-graders in physics and technology class learn about the principles of thermodynamics and methods of energy production and work with a residential construction company to develop a strategy for energy-saving upgrades in a local neighborhood. The students help calculate the neighborhood’s carbon footprint and process the data in a model that they present to the residents.

- Service-learning as a half-year project for eighth-graders at a comprehensive school
- Educational objective: Teach practical, real-world physics and technology
- Teaching content:
 - Physics: Thermodynamics, combustion engines, heat insulation
 - Technology: Drawing images and facades, constructing models
- Values in focus:
 - Sustainability: Questioning our own behavior with a view toward the next generations
 - Environmental awareness: Adopt environmentally friendly habits

Two teachers at a comprehensive school learned from the media of plans for energy-saving upgrades in a nearby neighborhood and felt this was a great opportunity for a service-learning project. They contacted the relevant authorities and offered the support of the students. The chair of the building cooperative and project manager for the energy upgrade strategy were open to the idea and agreed.

Step 1: Involving the students, developing the service-learning project together

In the weeks that followed, representatives from the building cooperative visited the eighth-graders, reported on the planned energy infrastructure upgrades, and talked with the class how they could be of assistance. Plans were being made to measure traffic volumes in order to determine the neighborhood’s CO₂ emissions. The strategy also included getting the residents more involved in the planning, and the students could lend a hand here as well. This gave rise to the idea that the children could get involved in measuring the neighborhood’s CO₂ emissions, analyze the results, and then organize them in a clear model to present to the residents.

Step 2: Preparing the engagement and linking it to course content

To kick off the service-learning project, the students conducted several on-site visits to the neighborhood: They took stock of the green spaces and looked for good places for measuring traffic. In the classroom, they acquired the knowledge they needed for their civic engagement: They learned about thermodynamics and how gasoline and diesel engines worked, and they conducted experiments involving heat insulation and energy conservation. In their technology studies, they photographed building facades, which they then drew and used as a basis for their model.

Step 3: Conducting and assessing the engagement

Students took their places at important intersections in the neighborhood to document traffic and count the number of cars, trucks, buses, and bicycles that passed by at three times on a single day. Using their knowledge of CO₂ emissions, they calculated the neighborhood’s annual CO₂ emissions and plugged their findings into a model that they built as part of their technology studies. The model used yellow to designate streets with annual emissions exceeding one metric ton of CO₂, orange for those exceeding 10 metric tons, and red for those exceeding 100. They also enhanced their model with houses and trees that they built themselves. In a follow-up classroom session, they joined their teachers in evaluating their service-learning project and prepared a presentation of the findings. The students presented their detailed model to the public in the technology museum, where it will provide residents and visitors with information about local CO₂ emissions from now on.

Value formation and reflection as a recurring theme throughout project

The students who participated in the engagement studied the issue of sustainability in depth and made their own contribution to environmental protection and intergenerational justice. They learned that their actions have a real impact on sensitizing neighborhood residents to climate protection.

"Using energy consciously – including at our school"

AT A GLANCE

Eighth-graders in physics class study energy, energy consumption, and energy conservation and volunteer at a neighboring school to work for the responsible use of energy. They develop an energy conservation strategy and proposals for "bodily energy" based on conscious nutrition.

- Service-learning as a four-month project at a secondary school
- Educational objective: get young students excited about science
- Teaching content:
 - Physics: Thermodynamics and principles of electricity
 - Biology: Basic energy metabolism in the human body, nutrients
 - Ethics: Relationship of people to their environment, responsible stewardship of nature
- Values in focus:
 - Environmental awareness: Becoming aware of the importance of the environment and its conservation
 - Sustainability: Using resources efficiently

To make science subjects in grades 5 to 8 more relevant to real-world experience, a school launched a service-learning project for eighth-graders. Students in physics class drew on the topics of thermodynamics and the principles of electricity to ask themselves: What could our engagement be? Whom could we support? The class settled on the subject of energy conservation by combing through local media and decided to conduct interviews with neighborhood institutions to find out whether a need existed. They learned that a neighboring school was concerned with energy conservation and that an energy-saving strategy for heat and electricity would be a helpful means of support. In the months that followed, the eighth-graders learned about the various forms of energy and about methods for measuring and saving energy. They then applied this knowledge to develop a precise energy conservation plan for the nearby school. They devoted two hours of physics class each week to this task. In German class, they also developed flyers and posters to sensitize the students to energy conservation. The biology teacher also participated by introducing the subjects of bodily energy and mindful nutrition. The students learned that they could play an important role in sustainable behavior and resolved to use energy more conservatively in the future themselves. Their engagement was set to continue in the following school year: The neighboring school would like to have the students' support again for the actual implementation of the energy conservation strategy.

“Awakening a love of science through research-based learning”

AT A GLANCE

Eighth-graders in physics class learn interesting facts about water, energy, and heat and run an academy for kids in the community consisting of five afternoons of experimentation that provide young schoolchildren with an attractive outing in the local countryside.

- Service-learning as a four-month project for eighth-graders at a secondary school
- Educational objective: Learning through teaching and explaining
- Teaching content:
 - Physics: Principle of heat, energy, planning and implementation of experiments
 - German: Creating flyers and letters, communications training
- Values in focus:
 - Acceptance of responsibility: Caring for younger students
 - Social justice: Creating a high-quality educational program in rural areas

Students at a rural secondary school created the “community kids’ academy” to give other children from surrounding cities the opportunity for hands-on access to science through research-based learning. The students planned and implemented a total of five afternoons in which they joined the children in experimenting and explaining what’s behind scientific phenomena such as how wax in a pot melts when the temperature rises. The eighth-graders got involved in the community through their civic engagement, they took responsibility for themselves and others, and lent a hand in shaping the future of their region.

“We’re bringing science to primary schools”

AT A GLANCE

Seventh- and eighth-graders in physics and chemistry class learn about various natural phenomena and offer age-appropriate learning units on soil, water, energy, light, and shadow to students at the local primary school.

- Service-learning as a year-long project for seventh- and eighth-graders
- Educational objective: Learning through teaching and explaining
- Teaching content:
 - Physics: (Renewable) energy, light and shadow, water
 - Chemistry: States of aggregation
- Values in focus:
 - Acceptance of responsibility: Taking an interest in primary school students
 - Social justice: Sharing knowledge to give other children better educational opportunities

The idea is to make general science studies in the neighboring primary school more exciting. Seventh- and eighth-graders from the secondary school got involved in service-learning by offering kid-friendly learning units for third- and fourth-graders in the primary school. They began by familiarizing themselves with phenomena relating to water, energy, traffic, and other subjects in physics and chemistry class, then adapting this knowledge to their younger audience: They combed through the primary school curricula, looked for appropriate experiments – which they prepared and implemented – and developed worksheets. The secondary school students explored science with the younger kids in separate sessions spread out over several months. In the process, they learned not only that a good education is important from the very beginning, but that through their engagement they could share their own knowledge and help promote educational justice.

"A healthy breakfast for our neighborhood"

AT A GLANCE

First-, second-, and third-graders learn about healthy eating habits in their general science studies and get involved with a healthy breakfast to promote conscious nutrition in neighborhood preschools.

- Service-learning as a months-long primary school project
- Educational objective: Making the subject of "healthy eating" exciting
- Teaching content:
 - General science studies: Healthy eating, sight, smell, taste
- Values in focus:
 - Social justice: Sensitizing kids early on to their health
 - Assuming responsibility: Taking care of our own bodies

A primary school would like to introduce its students to concepts of a healthy lifestyle through a "Healthy Nutrition in Preschool" service-learning project. First- through third-graders learned about "healthy nutrition" in class, created food pyramids, studied the composition of different types of food, and looked more closely at their own eating habits. They took what they learned and passed it along in their engagement at local preschools by preparing healthy breakfasts for the kids and giving brief presentations on food and the importance of a balanced diet. The students learned not only that it is important to take care of our own bodies but also that it's important to be mindful of what we eat.

"Herb spiral for people with disabilities"

AT A GLANCE

Third-graders learn about herbs and their use during their general science studies and gardening sessions, and they build an herb spiral in a home for the disabled to sensitize them to fresh, healthy nutrition.

- Service-learning as a half-year project for third-graders
- Educational objective : Experiencing for oneself a sense of good nutrition
- Teaching content:
 - General science studies: Plants, soil, cycle of nature, healthy eating
 - Ethics: Getting to know charitable institutions, discovering opportunities for action
- Values in focus:
 - Solidarity: Getting involved on behalf of people with disabilities
 - Environmental awareness: Making conscious use of materials when building an herb spiral

The subject of plants and soil was part of the third-grade curriculum in this school year. The teacher learned through a personal acquaintance that the cook in a housing cooperative for people with impairments were looking for more fresh herbs to use in preparing the residents' meals. She told her students about it, and together, they talked about how they could help out. In the classroom, they learned about various options for creating herb gardens and visited the housing cooperative to report on their ideas. The idea of an herb spiral in the outside area was a hit. In their service-learning project, the students learned everything about herbs and the properties of soil, then designed an herb spiral from sustainable materials. During their engagement, they worked alongside the residents to build the herb spiral in their outdoor area. The herb garden was inaugurated at a celebration at the housing cooperative. In their civic engagement, the students learned that people with disabilities are a valuable part of society and that it is enriching to spend time with them.

“Water days for preschoolers”

AT A GLANCE

Sixth-graders in physics, chemistry, and biology class work on the larger topic of water and get involved in a preschool by organizing daylong seminars on water-related issues, leading a creekside walk, and planning the construction of a water playground for the preschool.

- Service-learning as a half-year project for sixth-graders at a middle school
- Educational objective: Make students feel empowered
- Teaching content:
 - Physics, chemistry, biology: Biosphere and water as an essential resource
- Values in focus:
 - Sustainability: Using water consciously
 - Acceptance of responsibility: Caring for preschoolers

A middle school set out to rethink how it teaches physics, chemistry, and biology: The idea was that the students, most of them from at-risk environments, would have the opportunity to experience the application of scientific content for themselves early on. The subject of “water” was on the lesson plan for sixth grade, and the teacher had already contacted a local preschool. The students talked in class about what they could do for the preschool and decided to offer “water afternoons,” since their research showed that the preschools were already teaching basic science. In the classroom, the sixth-graders learned all about water and meticulously prepared their engagement. The students spent several mornings with the little ones, conducting experiments and leading an interactive walk along a creek to give them a fun way to learn about water. Their engagement motivated them to plan for the construction of a sustainable water playground for the preschool during the next school year. The students learned that water is an important resource, so they wanted to design the playground accordingly – using rainwater, for example.

“Let’s help adolescents with a history of addiction”

AT A GLANCE

Eighth-graders in biology class grapple with the topic of drugs and addiction and volunteer at a local streetwork walk-up center, assisting with day-to-day work such as cooking for the young clientele.

- Service-learning as a half-year project for eighth-graders at a middle school
- Educational objective: Make students feel more empowered
- Teaching content:
 - Physics, chemistry, biology: Healthy lifestyle, drugs, addiction prevention
- Values in focus:
 - Acceptance of responsibility: Becoming aware of the importance of a healthy lifestyle
 - Solidarity: Helping adolescents going through difficult times

A middle school wanted to implement a service-learning project for eighth-graders to give the students, many of whom come from difficult living situations, a greater sense of empowerment. The teacher was completely open in asking her students to look through the lesson plans: What is on the plan in this school year? The students themselves picked the subject of drugs and stimulants and researched actual needs and potential community partners in their city. Helping a streetwork walk-up center and joining the adolescents to cook, eat, and organize clothing donations – that’s something where their engagement was truly needed. In the classroom, they learned a lot about the larger societal issues and reflected on their own living situations. Meeting the adolescents in the counseling center was not easy for them, but after

the first meeting, the students were very moved by their encounters. That's why they decided to continue the engagement: Starting in the next school year, cooking for the youth meetup would become a fixed component of home economics lessons. They learned how important healthy eating habits are for a good lifestyle and want to continue helping the adolescents to learn to take better care of their bodies.

Service-learning in STEM subjects in the upper grades

The pilot project itself had no service-learning project in grades 9–12. So we consulted experienced teachers and put together two examples based on real student projects. The purpose is to demonstrate what can be achieved through service-learning in STEM subjects with this age group.

"It can happen to anyone – HIV awareness campaign in a rural area"

AT A GLANCE

Eleventh-graders in biology class learn about the structure and functional interrelationships of the immune system and work with Deutsche AIDS-Hilfe to organize an awareness campaign in their region on the subject of HIV.

- Service-learning as a four-month project for eleventh-graders at a secondary school
- Educational objective: Eliminating fears and educating people
- Teaching content:
 - Biology: Preventing infectious diseases
 - Civics and politics: Analyzing social challenges
- Values in focus:
 - Solidarity: Sensitizing others to their health
 - Acceptance of responsibility: Using education as a tool to lower the risk of new HIV infections

A biology teacher read a recent state-wide statistical report showing that the number of new HIV infections is higher in rural areas than in big cities. She told her students about this, and together they talked about what the reasons for this might be and what might help reduce the number of new infections. The students studied the statistical report and found that HIV is still something that can happen to anyone. For this reason, the eleventh-graders decided, you need a general awareness campaign that reaches as many people as possible. They recruited the regional office of Deutsche AIDS-Hilfe as a partner to help them decide what such a campaign targeting rural areas might look like. They found out which events were planned for the coming months and worked out an idea for how to communicate an effective message about the subject of new HIV infections. With their "mobile awareness strategy," which they developed during class in close collaboration with Deutsche AIDS-Hilfe, the students visited several weekly markets in the area, spoke to passersby in pedestrian streets, and offered information at a local festival and the annual autumn festival about how HIV spreads and how you can protect yourself. In class afterward, they talked about the mixed responses they encountered. They agreed that regular campaigns were needed to raise public awareness of HIV and other sexually transmitted diseases. The students learned that it's important to advocate for the health of all people and to be persistent in speaking openly and taking a stand even about uncomfortable topics.

“A database for managing volunteers”

AT A GLANCE

Eleventh-graders in computer science class study software engineering and programming and develop a database and training program for a volunteer agency to manage its volunteers.

- Service-learning as a three-month project for eleventh-graders at a comprehensive school
- Educational objective: Facilitating the practical application of computer science
- Teaching content:
 - Computer science: Software programming
 - Commercial IT: Knowledge management
- Values in focus:
 - Acceptance of responsibility: Working responsibly with personal data
 - Solidarity: Working for the future of one's own region

During a civic engagement day, eleventh-graders got in touch with the local volunteer agency. From the conversation they learned that the agency used personal profiles and Excel spreadsheets to refer volunteers to potential partner institutions, a process that was cumbersome and error-prone. The students had the idea to develop a database for the volunteer agency, and they took their idea to the computer science teacher. They analyzed the precise requirements needed to refer volunteers and asked the agency workers which information they wanted to include. Next, they planned the process and designed a software solution for the volunteer agency. They also offered to host a workshop to help familiarize the employees with the new software. When the workshop was complete, the students received much recognition from the director of the volunteer agency and those active in the community. The young students made an important contribution to the future of the charity and provided lasting support to their region.

6 Standards of quality for service-learning in STEM subjects

The examples showed that service-learning can be carried out in many different ways: with students of all ages and from all types of schools, on various topics, in various classes or on an interdisciplinary level, and over a short period of time or across an entire year. The students can engage in the environmental, social, cultural, or political sphere – in small groups or with the entire class. They can research, develop, and plan their own engagement project or fine-tune a predefined template.

What are the standards of quality in "Service-Learning – Learning through Civic Engagement"?

Amid all the welcome diversity, service-learning projects also have shared attributes that guide the planning and educational implementation. Seifert, Zentner & Nagy (2012) have defined six "standards of quality" for learning through engagement in the German-speaking world based on research and years of practice: ([genuine community need](#), [connection to the curriculum](#), [reflection](#), [student voice and participation](#), [civic engagement outside the school](#), [appreciation and feedback](#)). The standards of quality are closely associated with the impact on how well the students develop skills. The effect of service-learning on classroom knowledge, for example, depends on how clearly the goals for the students' acquisition of skills were defined ahead of time, how closely linked they are to the practical engagement, and whether there is a conscious reflection with the students on the connection between learning and civic engagement (Ammon, Furco, Chi & Middaugh, 2002).

How are the standards of quality for service-learning in STEM subjects interrelated?

One of the standards of quality is already inherent in service-learning in STEM subjects: the project's [connection to the curriculum](#) in one or more of the STEM subjects. The exact planning of the subject matter content, the length of the project, and the nature of the interplay between learning and civic engagement are closely associated with all the other standards of quality for learning through engagement: What [genuine need](#) in the community or in society is your project responding to? How much time would the students need for their engagement? How much is already known; how much preliminary research does the project involve? How much student voice and [participation](#) would you like to admit? How should the [reflection](#) with the students unfold? How will you design the [collaboration with the community partner outside the school](#)? Which forms of [appreciation and feedback](#) do we use? All these questions have an impact on your planning and implementation of the various standards of quality and highlight that a service-learning project has many components that work together toward the desired success.

Facilitating the formation of values with service-learning in STEM subjects in light of the standards of quality

Service-learning give students the opportunity to put science and technology to practical use, reinforce what they learned in the classroom, and experience values directly while working on behalf of others. The quality of how the service-learning is implemented is critical. A genuine need in the community that the students can help fulfill with their engagement, knowledge of the relevant subject matter, active participation and student voice in all phases of the project, regular reflection on the project's larger societal context, and a good collaborative relationship with the community partner(s) – all these factors are equally important. It takes this kind of high-quality experience to motivate students to reflect on the relationship between the classroom content, the civic engagement, and their specific actions, then to see their experience in a larger societal context and actively develop their moral principles. So to actually succeed in helping students to explore and form their values through service-learning in STEM subjects, all six standards of quality must be implemented well.

6.1 Connection to curriculum – planning and designing service-learning in STEM subjects

With service-learning, schoolchildren combine civic engagement in society with their cognitive learning in school. The definition says it all: The students' engagement is not separate from or in addition to the school, it is part of the learning and closely tied to the content of the curricula.

What does “connection to the curriculum” mean in service-learning?

The case studies in the previous chapter showed that the connection to the curriculum in service-learning consists of two closely linked components:

Structural connection	Content connection
<ul style="list-style-type: none">▪ Service-learning is not a working group or a voluntary extra program.▪ Service-learning is intentionally integrated into the regular school day.▪ How exactly this is done is left up to each school or teacher to decide.	<ul style="list-style-type: none">▪ The objectives for the skills to be acquired by the students are defined based on the lesson plans and curricula.▪ The civic engagement allows the kids to apply what they learn into real contexts.▪ The students reflect on the engagement in the classroom and tie it to the subject matter.▪ Service-learning includes an evaluation of the students' learning progress.

- **Component 1: Structural connection:** All the service-learning projects introduced in this handout take place in STEM instructions – so they are a fixed component of the lesson plan. The precise nature of the structural connection varies and can be handled differently in practice:

- **Service-learning as a teaching model for a short-term project**

Short-term service-learning is uniquely suited to giving a hands-on approach to a certain learning unit. Such a project might last several weeks to a few months, depending on the lesson planning and number of hours. The time horizon shouldn't be less than 6 weeks, however. Otherwise, there is not enough time for preparation, reflection, learning, and the civic engagement itself. You can also bring other colleagues on board for support to take on or expand certain parts of the project in their classes:

B Example: “Using energy consciously”

The example “Using energy consciously” (page 16) involved the learning units of thermodynamics and the principles of electricity. Over the course of four months, the teacher devoted two hours per week from his eighth-grade physics class for letting the students prepare for the engagement, discussing the subject matter, reflection, and the civic engagement activities itself. In their project, students had the opportunity to reinforce what they learned in the classroom and apply it in practice by measuring the energy use of a neighboring school and offering suggestions for saving energy. Since the time in class was limited, the teacher elicited the support of his colleagues: His colleague in the German department allowed her classroom time to be used for developing the written materials such as flyers and informational pamphlets. The biology teacher participated by integrating the subject of bodily energy into the project. For the reflection, the ethics teacher joined the project to address the importance of taking on responsibility in society through civic engagement with the students.

- **Service-learning as a year-round approach**

To have more time for the project, you can also use service-learning in a STEM class for a half or full school year or use existing structures such as the elective subjects from which German secondary-school students must choose. This yields additional opportunities for interdisciplinary collaboration, more practical applications in the engagement, and more time for reflection and teaching values to the students.

B Example: "We're bringing science to primary schools"

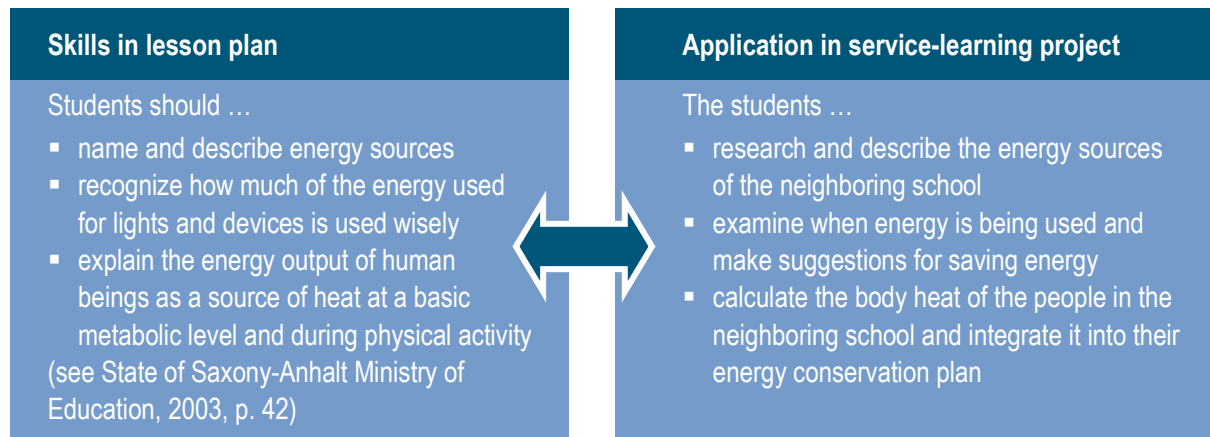
In our example "We're bringing science to primary schools" (page 17), service-learning continued throughout the year for two hours weekly in chemistry and physics class. The students' civic engagement provided many tie-ins to subjects from grades 7 and 8, including energy, light, shadow, soil, and water. The students worked throughout the school year on various subjects from the lesson plan, conducted experiments, and combed through the primary school curricula to prepare what they learned for their younger counterparts. Small groups prepared a total of 12 small learning units using experiments and worksheets, then applied their knowledge in experimentation sessions with primary school kids. The year-long structure made it possible to prepare thoroughly for the engagement and synchronize the class times of the primary and secondary schools, for example. Seventh- and eighth-grade teachers from German class participated in the project for the reflection parts, and biology teachers also helped with subjects such as the relationship between soil and water.

- **Component 2: Subject matter connection:** The STEM subject lesson plans and curricula, with their defined classroom topics and student skills, are the source of the subject matter and curricular connection for your service-learning projects. To facilitate a successful interplay between classroom learning and civic engagement, it's important to first define the students' learning goals in the lesson planning:

- What should my students learn?
- Which skills should they acquire and develop?
- Which classroom content, which learning activities, and – once the project is fleshed out – which engagement activities should drive this?
- How can I as a teacher support my students in this?
- Which methods do I want to apply?
- How should I assess or give feedback on the development of skills?

B

Example: “Using energy consciously” (page 16)



How can you make the curricular connection in a service-learning project succeed?

How the two components in your project interact and how long you want the project to run depends on your objectives and lesson planning. What's important is that you consciously plan the subject matter content and skill acquisition in advance. At the same time, they should remain flexible enough to respond to the civic engagement idea as it takes shape and the student activities that emerge. Planning and implementation will vary depending on how long you (and/or your students) want the service-learning project to run. A rather small engagement can be implemented in a shorter project, while a longer project offers both a more in-depth engagement with more insights and more time slots to reflect and form values and for the practical application of (more) subject matter content during the engagement. So if your goal is for your students to learn in a hands-on manner and see how the content relates to practice, a shorter project works well. If you also seek to boost motivation and participation and encourage value formation and interdisciplinary work, a longer service-learning project is better. Service-learning is not a fixed project or subject per se, it's a flexible teaching and learning approach. The case studies offer helpful suggestions for applying this in practice.

How can the students get involved in the curricular connection?

It's important that students participate and have a strong voice in the service-learning project. The curricular connection also offers many opportunities for the students to play an active role – for example, by researching on their own in the lesson plans for their subject and in so doing to actively support the lesson planning for service-learning: What should we learn in this school year? Which knowledge do we need for our civic engagement? You can adapt the defined target skills to your particular class – with the participation of the students, if you wish – and reflect regularly as the project unfolds: Where do we stand in the acquisition of skills? Where is there still room for improvement? And how? Seize the opportunity to have your students participate and make decisions on their own, because the more they actively participate, the more responsibility they can take in the project and their own learning processes, the higher their motivation and, ultimately, their success.

Side note: Interdisciplinary learning – recognizing interrelationships

Service-learning in the STEM subjects is also an excellent tool for interdisciplinary learning. It allows students to view STEM subjects from various perspectives by how they are put to practical use in the civic engagement – with all the complexity and contradictions that real life entails – and to see how science and technology subjects interrelate. Beyond the interdisciplinary work within the STEM subjects, the connection to subjects such as German and ethics offers the potential to help the students form values, discover values-related themes in their civic engagement, and delve deeper into those themes. Advance planning is helpful for every type of interdisciplinary collaboration: Which subjects can furnish content for your project? Which colleagues could you ask for support? What might practical collaboration look like?

Side note: Performance feedback in service-learning

Service-learning offers as many opportunities for formative and summative assessment of student performance as any other teaching and learning approach. Class tests, written papers, and oral presentations on the subject matters, setting up experiments, group projects, etc. are all activities that allow students to build and show their skills and that you can evaluate. Opportunities for feedback present themselves in the civic engagement as well: How did the students carry out the project activities? Were they punctual, reliable, and prepared? All of this is an opportunity for performance feedback – but also for feedback on and for the appreciation of the students' personal development. Because even though performance evaluations are part of service-learning, it's important to give students feedback on their development beyond a simple grade. Regular (and non-judgmental) feedback is important for the students in developing their skills.

Material tip: Materials for working with your students – such as "Learning Network," "Objectives for Acquiring Skills," "Project Planning Tool," "Learning Map," and the "Before-After Comparison" reflection method – can be found at the Siemens Stiftung media portal. (These materials are only available in German.)

„*The service-learning project helped the students see the interrelationships between different school subjects.*“

„*Service-learning is more than social learning. It also gives me an alternative approach for teaching my subject.*“

„*It's important to map out the objectives in advance: What do I as a teacher want to achieve for my students? What should they learn? How can I teach that? And what is the result we seek?*“

6.2 Genuine community need – preparing and coordinating the civic engagement well

Service-learning combines classroom learning with a civic engagement for the community or the society as a whole. Society has many needs that can be addressed through STEM subjects, and students can use their knowledge to respond. How do they find this genuine community need? And how is contact with the community partner established?

What is the genuine community need in service-learning? Why is it important?

The civic engagement plays a special role in service-learning. It gives students the opportunity to apply their skills and what they learned in the classroom, combine theory and practice, and link it all to the world around them. Service-learning holds great potential, especially for the STEM subjects, which students often find difficult to see in a real-world context. All the more important that the students' engagement is truly needed, responds to a genuine community need in the school's environment, and is well prepared. Because only then

- can students truly get involved in meaningful activities using their classroom knowledge and make a qualified contribution to solving a genuine problem,
- do the students learn that their civic engagement makes an effective contribution and that they and their skills are needed,
- do the students gain valuable experience in the engagement that enriches their education,
- can the engagement be a source of motivation and positive feedback.

How is the genuine community need identified? How can the civic engagement be well planned?

Researching the genuine community need that can be addressed is one of the most important steps in service-learning: What ideas are in place for an engagement? What is needed, and where? Which engagement is needed? These questions need to be answered before service-learning can become a valuable educational experience for students (cf. Seifert et al., 2012). How you approach these questions depends on the situation before the project. There are two basic starting points that, along with the curricular basis, play a critical role:

- **Starting point A: Neither the engagement idea nor the community partner are known yet**

When looking for an engagement idea or honing your initial ideas, it's helpful if the students begin right in the research phase by exploring their neighborhood or community or asking potential community partners. They learn the research skills in the classroom and look around their immediate environment as part of ...

- **An open research with an assigned subject:** If you have not yet decided on an idea or a partner for your service-learning project, the students can research freely in their neighborhood or community. Given the connection to STEM subjects, the subject matter or larger issue is often pre-assigned.

B **Example: "Let's help adolescents with a history of addiction"**

In the example "Let's help adolescents with a history of addiction" (page 19 f.), the classroom subject "drugs and stimulants" was already established. Within these parameters, students carried out an open research into community needs and conducted interviews at various institutions in their area. Their conversation with Streetwork demonstrated to them: That's where our help is really needed.

- **Research with a rough project idea in mind:** If the STEM classroom subject is already assigned and you're talking with your class about a service-learning project on this subject, then the students may already have an initial idea for the civic engagement. Or maybe you have an idea that you can suggest to the students? In either scenario, the aim of the research is to find out *who* the students can support through their engagement and *how* exactly.

B Example: "Our educational nature trail"

In the example "Our educational nature trail" (page 12 f.), the teacher already had a rough idea for the engagement. The objective for the students in their research was therefore to find out whether this engagement was really needed, how exactly it should look, and who the partner might be. They spoke with the committee for social services in the city, conducted a quick poll in the school, and contacted the forest service. This led them to their detailed engagement idea. They then began planning the practical implementation.

- **Starting point B: Engagement idea and/or community partner(s) are known**

In this scenario, the engagement idea and/or the community partner(s) are already known – through a personal contact, a partnership that your school has, or a specific idea for an engagement from the students. The goal now is to clarify the following:

- **If there is a detailed engagement idea:** How can we find a partner for our idea? Who should our engagement benefit? Is there a genuine need for this?

B Example: "Sun Pass – sun protection for preschools"

In the example of "Sun Pass – sun protection for preschools" (pages 11 f.), German Cancer Aid approached the school with a specific engagement idea. The objective of the engagement – to get Sun Pass certifications for institutions – had been established. The job of the students was to find out whether the preschool needed this engagement and to sit down with the preschool to hash out how exactly the engagement should be structured.

- **If contact to the community partner is already in place:** How can the partner be supported? Through which engagement? How can we help out with our knowledge and skills?

B Example: "Water days for preschoolers"

In the example "Water days for preschoolers" (page 19), the teacher was in touch with a preschool that was interested in working with the sixth-graders. But what exactly should such a partnership look like? A delegation of students visited the preschool to find out how they might make a meaningful contribution. During the conversation, it came out that the preschoolers enjoyed playing with water and would like to have more opportunities to do so. This led to the detailed engagement idea.

- **If both the partner and the idea are already in place:** How can we plan our engagement so that it truly helps? What exactly does the partner need? What do we need to look out for?

B Example: "We're bringing science to primary schools"

In the example "We're bringing science to primary schools" (page 17), the idea and the engagement partner were already known. The students had to find out how to organize their engagement in detail, which issues to choose, how to plan their hours, and create a schedule so that everything fits for all participants.

The essence of service-learning is often summarized as "do something for others and learn something in the process." What's important here is that if we want to do something for others, we need to incorporate their opinions into our planning. Because the primary goal is not to implement a good idea but to make a difference with that idea. That's why the students should research the real need, even when the partner and/or the idea have already been decided.

Material tip: Materials to support needs research – such as "Forest of Leaves," "Potential Community Partners," and "Conducting an Interview" – can be found at the Siemens Stiftung media portal. (These materials are only available in German.)

6.3 Reflection – the key to value formation

It is not experience that makes us wise, said the American philosopher and educator John Dewey, but rather our reflection on the experience (Dewey, 1933). “The students need to make mistakes – then think about them and learn from them with our support,” concluded one of the teachers in our pilot project. A recent US study on service-learning showed that supplementing the civic engagement with classroom discussions on ethics made students more willing to get involved politically and work to help others (Kahne et al., 2013). What this means is that reflection plays a special role in service-learning, especially for the students’ formation of values.

What is reflection in service-learning?

Reflection is, put simply, thinking back on a matter. Reflection plays a critical role in service-learning: As the link between “service” and “learning,” reflection transforms the practical experience of the students into valuable learning experiences. The teacher guides the students in consciously reflecting on their own actions, helping them to cement their newly acquired skills and identify the relationship between what they learned and what they experienced in their engagement. For example: What do I know from physics class about the relationship between renewable energy sources and sustainability, and what does that mean for my future? In this way, reflection supports the emotional, social, and personal development of the students and inspires them to look beyond their own immediate environment and reflect on the significance of their actions for society as a whole.

Why is reflection important for students’ formation of values?

Reflection is the key to the processes of value formation. Because values cannot be imparted in the abstract. The formation of values is a process that unfolds as our personalities develop, and it works best when we experience and reflect on values. Service-learning offers precisely such opportunities to experience values and reflect on them based on genuine experiences in the engagement. But none of this happens automatically or by happenstance with service-learning. It needs to be consciously planned, organized, and triggered. Potential benefits of regular, high-quality reflection in a service-learning project:

- Visibility of successes, greater sense of empowerment and stronger sense of social responsibility among students (Waterman, 1993)
- Support in developing an identity (feeling of belonging, sense of purpose) and moral consciousness (Leming, 2001)
- Awareness of the perspectives of others
- Greater motivation to get actively involved in the school and society (Billig, Root & Jesse, 2005; Waterman, 1993)
- Greater willingness to get involved politically and engage on behalf of others, especially when the engagement is supplemented by discussions of ethics (Kahne et al., 2013)

Subjects for reflection in service-learning

To encourage the most diverse possible processes of reflection in service-learning, it’s important to address a diversity of issues with the students. For this reason, we refer to **four different levels of reflection** in service-learning:

Reflecting on oneself:
Understanding
one’s own attitudes
and development

What role does environmentalism play in your life?

*What did you think of people with disabilities before your engagement?
What do you think now?*

Are you careful about how you use energy at home?

**Reflecting on the societal context
of the engagement:**

Being aware of your own role in society,
looking at your experience in the larger
context, examining your own values

Why is it important to help others?

*How exactly did your engagement help sensitize people to the need to
protect our climate?*

What would've happened if you had not gotten involved?

Reflecting on the project:
Solving problems,
making success visible

What exactly do you hope to achieve with your engagement?

How did you solve problems that arose?

What was your contribution to the project's shared success?

**Reflecting on the relationship between
service and learning:**

Applying knowledge and skills,
understanding the point of classroom
learning, using experience to learn

Why is it important for us to know how an ecosystem works?

What did I learn in class this week that I could use in the engagement?

*Which specific skills from the educational plan was I able to improve thanks
to my engagement?*

The various levels all blend together in practice. The main reason for the distinction is to emphasize the diversity inherent in reflection. Take advantage of this diversity when reflecting with your students and empower them to explore a broad spectrum of perspectives in developing their moral concepts.

How should reflection be set up to enable the students' formation of values?

For reflection to succeed in practice, you need the diversity of content that can be achieved through the aforementioned four levels of reflection. What's equally important is that high-quality reflection should occur not only spontaneously but also by design and be well organized, so that the students' thought processes are consciously stimulated to allow for the formation of values, not left to random chance. Some helpful and necessary means to this end include good questions, sufficient depth in the reflection, varying perspectives, diverse methodology, and regular reflection sessions – at all four levels.

Reflection requires ... ideas and good questions

The main purpose of reflection in service-learning is to generate ideas and good questions that encourage young people to become aware of their learning processes and critically examine themselves and others. With service-learning, these ideas are often generated in the students' engagement outside the school. These ideas must then be taken up in class to enable guided reflection and turn the ideas into a conscious learning experience.

Many young people are not accustomed to expressing feelings and opinions. They must first learn to reflect and question things critically. This requires good ideas, especially at the outset, in order to glean new ideas and questions from the answers and coax the students into deeper and deeper reflection. You yourself will see new sides of your students and get to know them in a new way:

B Example: “Water days for preschoolers” (page 19)

When students were asked what they learned at the day’s engagement, the teacher often heard the answer: “Hmm, I don’t know. A lot, I guess.” So she began to **rephrase the questions more clearly and tie them in to the engagement more directly**: “What did you do with your primary school group today? Which experiment did you conduct? Did the kids do a good job?” – “Hmm, well, we ran ‘sinking tests’ in the water. The kids thought it was fun, but they found it difficult to take the objects one at a time. They always wanted to do everything all at once and also fought a lot. It was exhausting ...” The teacher was astounded at the capacity of the student to reflect. The next step was to encourage the student to think about what could be done to help the kids run an experiment well and work together as a group.

B Example: “Herb spiral for people with disabilities” (page 18)

In response to the question about what he thought of his engagement that day, one student responded: “It was good, because I was able to do something for the people with disabilities.” The student was not able to express his experiences and emotions more clearly than that.

The teacher made her question **more precise and specific**: “Use your senses. Close your eyes and describe to me what you heard today during your engagement.” – “An old lady hummed contentedly to herself while we planted the herb garden, and the birds were chirping. And one of the residents laughed out loud ...” The teacher noticed that it was especially important to their students to give them a precise and concrete trigger for the reflection – an emotional memory, a special experience from the engagement, a photo, a story.

Reflection requires ... depth

Good questions and ideas are important to make the children reflect. But questions or ideas alone do not guarantee deep reflection. Instead, the goal is to get the students to not only describe but also compare, and to question their normal patterns of thinking, analyze difficult situations, look for various solutions, etc. This depth of reflection is especially necessary in forming values and to reach the inner thoughts of young people and encourage them to question themselves and others and change their opinions or actions if necessary.

There are various ways to trigger these kinds of complex thought processes. One example is the question types outlined in the Bloom Taxonomy (1976). This helps you stimulate in-depth cognitive processes and challenge the students in various ways. Use this potential as well to give your students a varied perspective of themselves, their skills, and their environment (for more details, see also Seifert, 2016).

B Example: “Water days for preschoolers” project (page 19) (using Bloom Taxonomy):

- What is the composition of your preschool group? Describe the children that you observed. (Knowledge)
- How do the children in the group differ, and what do they have in common? (Comprehension)
- How might the differences within the group affect your planned experiment with the kids? (Application)
- Which steps of the experiment can be changed to allow all the children to benefit? (Analysis)
- Use this to determine how your approach needs to be adapted so that all the children can participate and understand the experiment. (Synthesis)
- Compare your experience in the engagement with what you expect and set out to achieve. Did the kids behave as you expected? Did your plan work? (Evaluation)

Reflection requires ... varying perspectives

The idea of reflection is to turn attention to everyone involved in service-learning: the students themselves, those with whom the students were in contact during the engagement (fellow students, teachers, project participants, community partners, etc.), and the society that benefits from the students' engagement. The idea is that the reflection looks equally at the perspectives of "I," "We," and "Others."

B Examples: "A healthy breakfast for our neighborhood" (page 18)

- I:** What does it mean to you to take on responsibility?
How did you take on responsibility for others in your project?
- WE:** How did you work together as a group? Who was responsible for what in your group?
What is the benefit of doing something together?
- OTHERS:** How did the preschoolers respond to your engagement? What kind of feedback did you get from the preschool teachers? If I were to ask the parents of a preschooler what changed for their child because of the responsibility you took on, what would they tell me?

Reflection requires ... diverse methodologies

Reflection should not be a "question-and-answer" game. The *how* of reflection can be colorful and diverse. There are no limits to the diversity of methodologies: From learning diaries to image reflections to theatrical plays or creative drawing – use different methods! This lets you accommodate the various ways in which your students learn. Alternate between writing (learning diary, letters, etc.), reading (literature, newspaper, etc.), doing (drawing, photographing, theatrical plays, etc.), and speaking (discussions, presentations). This lets all the kids find their own unique way to reflect and express themselves. A large collection of reflection methodologies for your service-learning project can be found in Seifert, Zentner & Nagy (2012, pp. 207 ff.).

Reflection requires ... regularity

Good reflection requires time and should be a part of every phase of every service-learning project. It's important that you consciously plan time for reflection. Make space in your lesson planning for reflection, not simply "if it happens." Just the opposite: To stimulate effective value-forming processes, reflection must take place during all phases of the project: **BEFORE**, **DURING** and **AFTER** the civic engagement.

B Case study: "Our educational nature trail" (page 12 f.)

It was important to the teacher that the students reflect consciously on the values of environmental awareness and responsibility. For that reason, she gave some thought **BEFORE the engagement** about how she would sensitize the students and developed the following questions: "Who lives in the forest? How is the forest important for people and the environment? How is the forest important in your life? What experiences do you associate with the forest?" Using the "head, heart, and hand" methodology, the students drew an outline of their bodies, and under "head" (thoughts), "heart" (feelings), and "hands" (actions), they wrote down what they associated with nature. One girl wrote "attachment to home" under heart, and one student wrote "taking a walk in the forest with the dog" for his hands. This **self-reflection** built up an emotional attachment to the engagement among the students, since most of them had positive childhood experiences with the forest. It was easy to segue to: "What needs to happen for children today to also have positive associations with the forest?" This question helped the teacher encourage the children to reflect on solidarity and responsibility – from the beginning.

B Example: “Let’s help adolescents with a history of addiction” (pages 19 f.)

To sensitize students to the values of social justice and solidarity, the teacher led the students in frequent reflection **DURING the engagement**. The classroom instruction focused on good lifestyle choices: “Which drugs are you familiar with?” “How do you need to live to stay healthy?” These questions allowed students to **reflect on the relationship between learning and engagement**. After their initial encounters with addicted adolescents, they reflected on their own behavior: Using the “Strong Moments” methodology, they thought about situations in which they had previously resisted temptations. A lot came together during this **self-reflection**. They then spoke with the adolescents in the institution and compared stories. It became clear that diseases of addiction often arose out of despair, from difficult life situations that seemed unsolvable. Which circumstances lead to addiction? Can people be convicted for their addiction? Why are most addictive substances illegal? This **reflection on the societal context** triggered empathy and showed that there are no simple answers to complex questions.

B Example: “A carbon footprint for our neighborhood – sign us up!” (pages 15 f.)

It was important to the teacher that her students become more environmentally aware and understand sustainability. To this end, the students used the “Timeline” methodology to evaluate their experiences **AFTER the engagement**. They shared their experiences and emotions from the carbon footprint project, reading aloud from the project diaries that they kept. This provided a clear vehicle for **reflecting on the project** and **self-reflection**. After this group reflection in class, students were told to make a before-and-after comparison of their skills. For this, they used the skills survey that they had conducted in class before the project to assess how, in their own assessment, they had used and further developed their skills during the engagement. This started the process of **reflecting on the relationship between engagement and learning**. **Reflecting on the societal context** of their engagement was also an important topic: “What is the long-term benefit from reduced CO₂ emissions?” “How will life in the neighborhood change after the energy upgrades?” The students learned about sustainability first-hand during their project, and through the varied reflection on their experiences, they learned what effect their actions today have on the quality of life of future generations. This also bolstered their environmental awareness: “We need electric cars,” demanded one student when the project was over.

Material tip: You can find methodologies to support your reflections with students in “Reflection Methodologies,” available at the Siemens Stiftung media portal. (These materials are only available in German.)

“ *In the project, the students took on responsibility for their fellow human beings. It was important to them to understand all of it.* ”

“ *Our project really helped the students become better at self-reflection.* ”

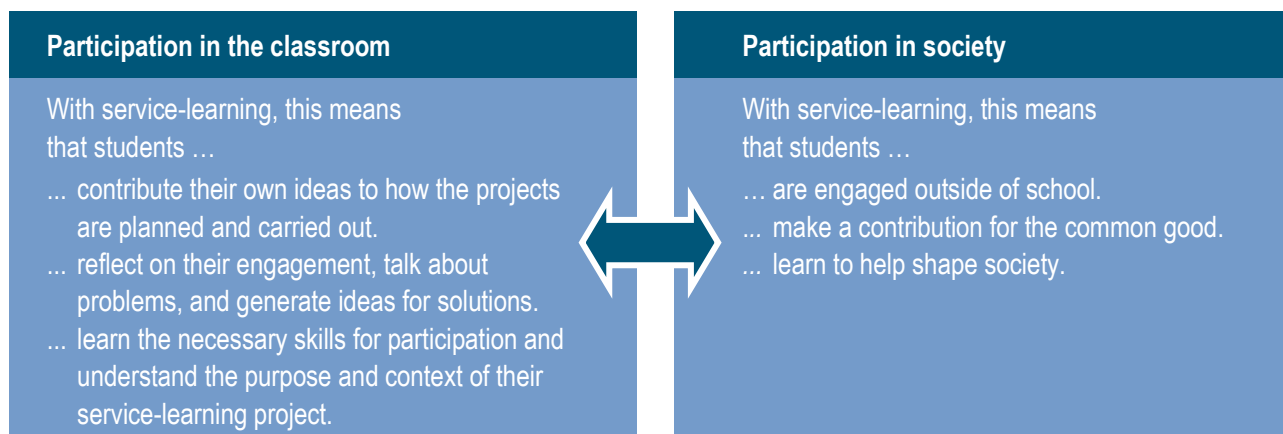
“ *The students wanted to be involved in shaping their own learning process. They wanted to participate, talk about it, take on new roles. It was great to see.* ”

6.4 Student voice and participation – enabling and supporting participation

Participation, ownership, cooperation, collaboration: All these terms are frequently associated with service-learning. What potential does service-learning offer for the active participation and collaboration of students? And how can you make the most of this potential with your students as well?

What does student voice and participation in service-learning mean?

Student participation in service-learning encompasses two inseparable elements: One is not conceivable without the other (Seifert et al., 2012):



With service-learning, participation is therefore about more than the engagement itself. It means that students can make decisions and take on responsibility – including in the classroom. Without this opportunity for participation, it's possible that the kids will not see their engagement as an opportunity to become stakeholders in society – and as a result, will not use the full potential the value-forming processes.

Why is student voice and participation in service-learning important for forming values?

Research has yielded interesting insights demonstrating a link between the degree of student voice and the value-forming processes. Young people who enjoyed greater opportunities for participation and autonomy in their service-learning project had

- more self-confidence, a greater sense of empowerment, and a more pronounced capacity for social communication and critical thinking (Bradley et al., 2007).
- less cynicism about political issues and more interest in becoming socially and politically active now and in the future (Billig et al., 2005; Morgan & Streb, 2003).

The **real-life experiences** of the teachers in our pilot project confirm the research findings and show how important student participation is for the success of value formation as part of service-learning:

“Our students must be able to experience values intellectually and tangibly – and service-learning offers precisely this opportunity. We need to trust our children with more responsibility and make fewer decisions for them.”

“I see a greater sense of responsibility: When the students are given responsibility, they do really want everything to go well.”

“The students want to shape their own learning process – I could see that clearly.”

“My students developed a different sense of social responsibility: They want to continue their project next year, because they consider it valuable and important.”

Research and practice shows that student voice and participation heighten the intrinsic motivation of the students. They identify more closely with their project and its associated themes. This in turn leads to more intense experiences with service-learning and allows them to think about values and experiences from their own self-interest.

How can you make student participation in a service-learning project succeed?

How much you as a teacher are able to plan in advance and to what extent the students are able to make their own decisions during their engagement and in the classroom depends on many factors. You need to decide how much participation you consider reasonable for your particular project and students. For purposes of motivation, it's a good idea to involve the students in your decision. The following two paragraphs show how participation in service-learning might look like:

Foundation: creating a trusting work environment

Having a trusting work environment in the classroom is essential so that your students can develop a team spirit, interact respectfully, and work well together to design the service-learning project. You as the teacher can establish important preconditions for this:

- **Establish rules for working together.** "We do not laugh at anyone for expressing an opinion." "Every idea is equally important and will be heard." Those are a couple of rules that you can establish together with your students. Involve them in the rule-making process: Children themselves often know best which circumstances they need to learn well.
- **Make the working atmosphere part of the reflection.** Talk regularly about how group collaboration and respect for rules works.
- **Launch the service-learning project with team-building activities** (*games, energizers, or collaborative learning methods*). That trains social skills, makes for a more relaxed atmosphere, and supports the work in small groups.

Throughout the project: involve students in planning and implementation

The extent to which students are involved in the planning and implementation depends on how many project components are already in place. Important: *Not everything can be pre-programmed*. At the same time, there are often many general parameters that are non-negotiable. Striking the right balance between direction and self-determination is not always easy. The better you know your students and the more honest your dialog with them, the easier it will be to strike the right balance. At the start of the service-learning project, the emphasis is more on creating motivation and getting the students to see the project as their own. During the implementation phase, however, the emphasis is on getting the students to take responsibility and cope on their own with questions and challenges. This is the only way they can participate in their own learning process and experience a sense of empowerment.

B Example: "Let's help adolescents with a history of addiction" (pages 19 f.)

The teacher held up the lesson plan for eighth-grade physics/chemistry/biology and suggested that the students choose their own topic for the service-learning project. The teacher's role was to moderate the students' selection process. After an appropriate period of dialog, discussion, and debate, the class decided together on the larger issue of "drugs and addiction." The teacher had actually had another subject in mind, but the students were very enthusiastic about "their" topic. Needless to say, they handled the next phase – narrowing down the engagement topic, looking for a partner – on their own.

B Example: "What do we do if there's a fire?" (pages 13 f.)

After the students had prepared their engagement, they did a dry run. While they presented on the subject of "fire safety" to one another, they learned that they understood everything well – since they had prepared so well in class. But how would the younger children in the refugee center do? One student had the idea of trying out the presentation on the first-graders in their own school. The other students thought that this was a great idea, and the teacher suggested asking the first-grade teacher themselves. A delegation did so, and they received an invitation to try out their presentations on the first-graders. They got a lot of helpful suggestions from the first-graders – and were visibly proud of their own good idea and that they themselves had been allowed to initiate it.

Where do you see yourself? An opportunity for self-reflection

The following self-reflection questions might be helpful in assessing how you as a teacher would like to shape the student participation in the service-learning (cf. Seifert et al., 2012):

- Do I know what my students think? How and when do I learn things about them?
- Do I take their opinion into account in my decisions?
- When/where can my students make decisions relevant to them on their own?
- Do they learn to take on responsibility in this process? And do they learn that they must own the consequences of their decisions and actions?
- What information do the students receive about my goals? Do they understand, for example, what civic engagement means and why it is part of service-learning?
- How and where do I consciously exclude them from participating in decisions? Why?

Material tip: Materials to support the participation of your students – such as "Curriculum Detectives" – can be found at the Siemens Stiftung media portal. (These materials are only available in German.)

“ *We teachers do not need to control everything. We should just let things flow. And above all, trust our students to handle something on their own. They are often capable of more than we suspect.* ”

“ *In service-learning, it's important for the teacher to pass on responsibility to the students and trust them to handle something. Often, we are surprised – because we underestimated them.* ”

“ *The school needs to establish a link to the children's own lives – and service-learning makes that possible.* ”

6.5 Civic engagement outside of school: working with community partners

The two basic goals of service-learning are changing the teaching approaches and learning culture in school, and strengthening democracy and civil society. For both to succeed, the civic engagement takes place outside the school and in collaboration with partners in the neighborhood or community. This benefits not only the students, who discover new learning venues. It also benefits the schools, which open themselves up. It benefits society, which gains engaged young citizens. And it benefits the community partners themselves, who get hands-on support for their causes from the students (cf. Seifert et al., 2012).

Why is it important to collaborate with community partners to facilitate the formation of values among students?

Values are formed in grappling with new circumstances. Only when the civic engagement happens outside the school and in interaction with community partners do the students apply their knowledge to real-world situations, help address genuine societal needs, and gain the ability to feel empowered and capable. The engagement outside the school is needed to open up the students to new kinds of experiences that are sometimes unexpected and contradictory and that lead them to tackle societal issues and elaborate their own values. It provides valuable input that is critical for reflection and the formation of values: *How important is nature to me? What is my role in protecting the environment? What impact does my behavior have on others?*

How do we find a community partner for our service-learning project?

The right community partner – a social or cultural institution, environmental or conservationist organization, local political office, etc. – depends on the subject matter and the type of engagement. Another variable is whether you wish to work with one community partner or more. There are many paths to finding the right partner:

- *Let students conduct an open research:* They find potential community partners and ideas for their project by conducting interviews, studying newspaper articles, searching online, etc.
- *Leverage existing contacts:* Who is your school already working with in another context? Who might be able to also serve as a service-learning partner?
- *Have a personal conversation:* You or your students can speak to institutions associated with the school, drawing on contacts from your circle of acquaintances or the students' parents.

How do we work well together?

Whether you find the community partner together with your students or are already in contact: The partnership should always be carefully planned and nurtured.

- **Start off on the right foot: get to know one another, clarify goals and expectations.** Getting your partnership off on the right foot is particularly important. Take the time to organize your partnership well right from the outset. Invite your partner to your school or take your students to visit the partner's offices to get to know one another and explain the educational concept of service-learning and the skills you hope to impart to your students. Agree on your mutual expectations for the partnership and the goals that each side has for the engagement. It's especially helpful if you put this down in a written agreement.
- **Stay on track: keep a close eye on the partnership.** Talk with your students during the regular reflections: How is the engagement going? Have there been problems or disagreements? This allows your students to help you in taking countermeasures before it's too late, so that small problems do not escalate. To keep a close eye on the partnership, it's important to talk regularly with the partner in addition to your regular reflection with the students. That helps the service-learning project succeed and the students learn how to manage good partnerships and see them as a beneficial, empowering experience.

- **Cross the line together: analyze, acknowledge, wrap up.** At the end of the students' civic engagement, celebrate what you have achieved together and acknowledge the individual contributions of all parties. This often takes the form of a joint closing ceremony in which parents, colleagues, and fellow students can take part. In addition, take the time for a joint closing reflection and feedback round with your students and the community partner. Talk about the extent to which you achieved your goals and how happy you were with the partnership – and whether you wish to continue the partnership in a future service-learning project or bring it to a close.

B Example: Good partnership right from the start: "Water days for preschoolers" (page 19)
After the teacher set up the partnership, a delegation of sixth-graders visited the preschool team. During a well-prepared meeting, the students presented their idea and the service-learning concept and discussed their engagement. The partnership continued just as it had started: There was a joint inaugural event, an event for all the parents in the preschool, and a series of small meetings to coordinate the follow-up steps and assign roles. The result was a genuine partnership as peers among all the participants. This proved to be a valuable experience for everyone, not just the students.

Material tip: Materials to support the collaboration with the community partner – such as "Forest of Leaves," "Potential Community Partners," and "Conducting an Interview" – can be found at the Siemens Stiftung media portal. (These materials are only available in German.)

6.6 Appreciation and feedback

Service-learning lives from a good partnership among all parties: students, teachers, and engagement partners. The help the service-learning succeed and contribute so that everyone can benefit from the shared experience. This requires a supporting culture of mutual appreciation. That's why part of service-learning is to consciously appreciate the contributions of everyone right from the outset and celebrate them at the conclusion.

Recognition and appreciation – from the start to the group completion

People feel recognized when, because of their work, they are personally appreciated, feel socially attached, and are taken seriously. Making service-learning work requires more than a one-time appreciation at the end of the project. It's about a culture of recognition and an appreciative attitude that accompanies the entire project (cf. Seifert et al., 2012):

- **Recognition through a collaborative learning environment:** A trusting work environment and collaborative learning climate in the classroom are the foundation for mutual respect and appreciation. This is essential to ensuring that problems are identified, feelings expressed, ideas contributed, and everyone is treated respectfully. As the teacher, you can make a big contribution by working with your students to establish rules for the partnership, running team-building activities, and having the group reflect on the partnership.
- **Recognition through feedback and reflection:** Regular feedback is important for a culture of recognition. Feedback can be given by fellow students, teachers, community partners, in reflection sessions, or in personal meetings. This helps bring visibility to successes and progress – along with problems or stumbling blocks. It helps overcome difficulties and lets students achieve more learning successes.
- **Recognition from the public:** For students, public perception of their civic engagement demonstrates to them that they can make a difference. This is also a nice show of appreciation for your work as the teacher and for your school. Work with your students to plan how you can publicize your work: Which opportunities are available? Whom would you like to notify or invite? The press? The parents?
- **Recognition through a conscious closing and a joint assessment:** The students' engagement should not simply come to an end. The service-learning project involves relationships that are cultivated among all the participants, and this deserves a formal closing event. Take the time for a joint wrap-up with all involved parties: What worked well? What should we have done differently? What did we like about the partnership? How should things continue now?
- **Recognition through mutual feedback and certification of skills:** Students especially appreciate recognition for their service-learning efforts in the form of feedback on their skills. One good way to do this is by issuing individual certificates. These not only show personal appreciation, they can also be helpful down the road when the students are applying for college, vocational training, or jobs. The certificates should include a thank-you and a description of the engagement project, the role of the student, and the skills acquired.
- **Recognition through a joint closing ceremony:** A closing ceremony offers an opportunity to show appreciation for the involvement of all parties. Use the closing ceremony to involve the students in the planning and organization (have them host), present certificates, express personal thanks to the community partners and other helpers (colleagues, school administration, parents, etc.), and generate publicity. One essential element of any service-learning ceremony is to have the students present and celebrate their successes. This is especially important for their sense of empowerment and pride in their own achievements.

Material tip: A sample certificate can be found in "Certificate" at the Siemens Stiftung media portal.
(These materials are only available in German.)

7 Frequently asked questions

Why facilitate students' value formation in schools? Isn't that the job of parents?

Values are formed when dealing with cultural, individual, and societal contexts – wherever young people congregate and interact with others. Any reason to examine one's own values and talk about them with others is important for the value-forming process. In addition to parents, families, and friends, the school as an institution with a mandate to educate plays a critical role in supporting the formation of values and empowering students to refine and critically examine their values. That's why facilitating value formation is part of the law governing schools in every German state.

Why facilitate students' value formation in STEM subjects?

Children today are confronted early on with scientific and technological issues. Such issues have become an inevitable part of our daily lives. Part of these issues is always the consequences and changes that they bring for our society. If we hope to empower young people to respond thoughtfully and productively to such issues, teaching and learning in the STEM subjects should help students look beyond the technical side of scientific and technological phenomena to see the societal relevance and the consequences for our coexistence. The subject of energy, for example, should always include the question of the limited availability of (fossil fuel) resources on our planet and how we can use them sustainably. When students in STEM classes reflect on and critically examine this interaction of science, technology, and society in all its complexity, they refine their values and learn to act and think accordingly when dealing with these topics.

Is service-learning appropriate for all types of schools and all ages?

Yes! Service-learning can be used in all types of schools and students of all age groups. The school examples presented here provide ideas and suggestions applicable from second grade through to university-track secondary school students focusing on their chosen specializations.

How long does a service-learning project last?

The amount of time you assign for service-learning projects depends on your educational context and objectives. It should last at least 6 weeks, however, to ensure that the students have time to really acquire the intended skills and the civic engagement has the appropriate intensity and outcome. For suggestions about the various options for integrating service-learning into the curricular timeline and content, see the case studies from the model project on pages 11–21.

Will my students learn enough?

They have every reason to, since service-learning is a fixed component of the curriculum, not an extra activity. In their civic engagement, students are applying their skills and knowledge to real-world situations. The content of the engagement is well prepared, the students regularly talk about their experiences during the service-learning project in the classroom, and everything is consciously tied into the content of the curriculum.

What are the prerequisites for service-learning in STEM subjects?

First of all, you need to be open to trying new things and shaking up your teaching approach – for example, because you want to generate enthusiasm for STEM subjects, or because you find it important for young people to help others and play an active role in shaping society. It can be helpful if you convince colleagues to support you and share their experiences. It's especially important that your school administration supports you – for example, by letting you be flexible in reorganizing classroom times and topics.

8 Where do I get support when I want to begin service-learning?

Siemens Stiftung media portal

The Siemens Stiftung media portal is an online portal offering quality-controlled, curriculum-oriented teaching and learning materials. It now offers teachers access to some 5,500 media in English, German, and Spanish on topics relating to science and technology. This handout is also available for free download from the media portal. Here you will also find all other materials mentioned in the handout, including methodology suggestions and worksheets for your students. All media relating to service-learning are among the 1,400 open educational resources (OER) now at the media portal and available to all users under the open license CC BY-SA 4.0 international. That means you can download them without first registering, change them to suit your needs, and share them with others.

To access the media portal, please visit: <https://medienportal.siemens-stiftung.org/>

Network and Foundation for Learning through Civic Engagement – Service-Learning in Germany

The nationwide Network for Learning through Civic Engagement – Service-Learning in Germany, which is coordinated by the non-profit Foundation for Learning through Civic Engagement and sponsored by the Freudenberg Foundation (among others), is a coalition of schools using service-learning and regional partners, so-called centers of excellence for service-learning. These are typically civil society institutions like volunteer agencies, public foundations, non-profits, educational development agencies, etc. with qualified trainers that advise, support, and partner with schools in implementing service-learning programs. The goal of the network is for members to share real-world experience, learn from one another, work together on the quality implementation and continuous improvement of service-learning, and advocate for more service-learning and to establish service-learning in educational policies. The network does this by also working with educational ministries and teacher training institutions at the state level. For more information, and to see publications and materials, please visit www.servicelearning.de.

The Practical Guide to Service-Learning for schools

The *Praxisbuch Service-Learning (Practical Guide to Service-Learning)* uses examples from various types of schools to illustrate how civic engagement can be combined with classroom learning – for all subjects. The book offers many tips for your work, from organizing a service-learning project to its educational implementation. The book draws on the collected experience of schools and partners from the German Service-Learning-Network called Network for Learning through Civic Engagement and contains extensive materials and methodologies by and for users (the book is only available in German):

Seifert, A., Zentner, S. & Nagy, F. (2012). *Praxisbuch Service-Learning. "Lernen durch Engagement" an Schulen* (Pädagogik Praxis). Weinheim: Beltz.

At the Beltz Verlag website, you'll find an extensive free library of resources to use in your school. (The materials are only available in German.)

9 Service-learning in STEM subjects – a collection of ideas

Learning games for Alzheimer's patients

Students learn about various symptoms of old age in **biology** and simple circuits in **physics** and offer the service of developing learning games for Alzheimer's patients that involve recognizing combinations and training coordination.

Bicycle repair shop for refugees

Students learn about the design and function of bicycles in **physics** and about the importance of bicycles in other cultures in **geography** and offer the service of getting people in their community to donate old bicycles, which they work with a bicycle repair shop to get up and running again so that they can be used by refugees.

Path of senses for people with disabilities

Students learn about sense perception and the transmission of nerve signals from stimuli in **biology** and work with disabled individuals to design a "path of senses" that trains their perceptions.

New media for seniors

Students work with digital media in **computer science** class and study the brain in **biology**, and they develop senior-friendly workshops to show senior citizens how to use modern devices to explore digital media.

Youth without alcohol

Students learn about the fermentation of alcohol and the effects of alcohol on the human body in **biology** and get involved with the drug counseling center in local youth organizations to plan alcohol-free cocktail evenings and raise awareness of the consequences of alcohol consumption.

Vertical gardens

Students learn all about the characteristics of a healthy diet in **biology** and start vertical gardens at various social institutions, working with partners to plant vegetables and flowers.

Math fair for primary schools

Students learn to make creative use of basic mathematics and explain it to others in **math** and design an entertaining math quiz on the playground of the neighboring primary school to give the young kids another way of relating to math.

Healthy diet in old age

Students discuss a healthy diet in old age in **biology** and familiarize themselves with compiling and analyzing statistics in **math** and survey seniors in a retirement home about their eating preferences, because the administration would like to modify the meal plan on holidays.

Good nutrition for animal shelter

Students learn about the metabolism of animals in **biology** and about the ingredients of food in **chemistry** and work with the local animal shelter to develop a strategy for providing affordable food that is appropriate for each species.

LED lighting for our community

Students learn in **physics** how LED lights work and about their energy-saving potential and independently develop a campaign to encourage the city to upgrade to LED lighting in public spaces.

Rainwater is for all of us

Students learn about the natural cycle of water in **geography** and about how storage and pump facilities work in **technology** and build an irrigation system for a family services center to operate its own garden. They also develop a campaign to raise local awareness about collecting and using rainwater.

Let's keep our lake clean for swimming

Students learn about the biotope of water in **biology** and about the attributes of polymers in **chemistry** and work with a local environmental organization to collect plastic waste from the local lake, which is then used to make signs that are placed along the path to the lake to make passersby aware of the need to reduce throwaway products.

Let's keep our soil clean

Students learn about the biotope of water in **biology** and about the chemical analysis and attributes of various oils in **chemistry** and work with a local environmental organization on initiatives in the community to clean up the soil in the nearby industrial area in order to prevent that heavy fuel oil and mineral oil products seep into the groundwater.

Parcourse for our community

Students learn about basic mechanics in **physics** and about designing and building objects in **technology class** and work with the city and an athletic club to design a parcourse in the city park.

Let's protect the earth and our climate

Students learn about home energy use and consumption in **physics** and design the "Earth Day" exhibit to raise awareness of the connection between climate protection and opportunities for saving energy in private households.

Solar-powered toys for a refugee housing facility

Ninth-graders learn how a solar cell is constructed in **physics** and work with kids in a neighboring refugee shelter to build solar-powered toys.

Drinking water educational trail

Students learn about various functional models for drinking water educational trails in **physics and crafts class** and work with the city to build a drinking water educational trail with various experimentation stations.

Working together for clean drinking water

Students study the link between the growth of plants and nutrients in the soil in **biology and chemistry** and work with government offices to organize soil samples of private gardens. They then notify the owners about how they can protect the groundwater and fertilize wisely.

Recycling

Students study the composition of recyclable materials in our garbage and develop procedures for separating waste in **chemistry** and work with the residents of a local workshop employing the disabled to develop useful products from recycled plastic. They then sell the products at an open-air market and donate the proceeds to the workshop.

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