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ESD in Agricultural Schools
Results of the French-Austrian Project NECTAR

Abstract

This article relates the findings of the NECTAR project, an ERASMUS+ project between France and Austria about education for sustainable development in the two countries in agricultural schools: how it was implemented, to what extent, using the pedagogical frameworks of "Green Pedagogy - GP" and "Grounded Pedagogy for Transition - GPT". The project studied three topics: soil fertility (the focus of this article); local food autonomy; complexity in professional situations. Two pedagogical activities were observed for each topic, one in each country, and were then discussed and compared through the lens of the two frameworks. These two theoretical frameworks are complementary for the purposes of analysis: GP is focused on systemic constructivism, while GPT has a more cognitivist approach. Differences were mostly seen in the pedagogical sequences' preparation by the teachers, and the conceptualization of sustainability.

Keywords: ESD - Education for Sustainable Development, Green Pedagogy, Grounded Pedagogy for Transition, agricultural education, ERASMUS+

Zusammenfassung

Dieser Beitrag widmet sich den Ergebnissen des NECTAR-Projekts, einem ERASMUS+-Projekt zwischen Frankreich und Österreich zu Bildung für nachhaltige Entwicklung in den beiden Ländern im agrarischen Schulsystem: wie und in welchem Umfang sie unter Verwendung der pädagogischen Rahmenwerke „Grüne Pädagogik - GP" und „Grounded Pedagogy for Transition - GPT" umgesetzt wurde. Das Projekt untersuchte drei Themen: Bodenfruchtbarkeit (der Schwerpunkt dieses Artikels), lokale Lebensmittelautonomie und Komplexität in beruflichen Situationen. Zu jedem Thema wurden zwei pädagogische Aktivitäten beobachtet, eine in jedem Land, und dann durch die analytische Brille der beiden Rahmenwerke diskutiert und verglichen. Diese beiden theoretischen Rahmen ergänzen sich für die Zwecke der Analyse: GP orientiert sich an systemischen Konstruktivismus, während GPT einen eher kognitivistischen Ansatz verfolgt. Unterschiede wurden vor allem bei der Vorbereitung der pädagogischen Sequenzen durch die Lehrkräfte und bei der Konzeptualisierung von Nachhaltigkeit festgestellt.

Schlagworte: BNE - Bildung für nachhaltige Entwicklung, Grüne Pädagogik, Grounded Pedagogy for Transition, Fachdidaktik Agrarwissenschaften, ERASMUS+

1. Introduction

Education in agricultural schools asked to support the transition into a more sustainable future in food production with many other societal demands like combatting biodiversity loss, carbon capture in soils and other climate crisis adaptations like water retention and agroforestry. Therefore, innovative teaching with concepts of education for sustainable development (ESD) is important for educating the next generation of professional farmers and farmworkers worldwide (e.g. Alrawashdeh *et al.*, 2023).

NECTAR[1] (**N**ew **E**du**C**ation **T**ransition in **A**groecology and **R**urality), an ERASMUS+ partnership project between France and Austria, sets out to improve and compare actual teaching in agricultural middle and high schools in both countries with a focus on education for sustainable development. Therefore, three agricultural schools from each country were invited and constituted tandems with a shared teaching topic (see table 1).

Tandems & Teaching Topic	**School in France**	**School in Austria**	**Shared pedagogical setting**
Soil fertility	Alfalfa: an asset for a livestock farm like Cibeins?	Humus accumulation in different horticultural soils	Group work on conceptual development
Complexity and responsibility in professional situations	Plan, organize and conduct vegetable growing in the green house	Diploma thesis as final examination work	Project based learning
Local food autonomy	Creation of an innovative product with legume	Circular economy in school	Improving sustainability with creative solutions

Table 1: Overview of the visiting activities

The schools were accompanied by two tertiary educational institutions in both countries: CEZ-Bergerie nationale in France and the University College for Agricultural and Environmental Education (HAUP) in Austria, that constituted the organizational and pedagogical-didactical framework for the school visits.

NECTAR as a whole wanted to achieve these objectives:

- Elaborate courses for agricultural students to share in both countries, collected in a so-called Action Sheet.
- Confront students with the complexity of the future demands and get them engaged in critical or controversial discourse before making decisions.
- Implement individual and pedagogical objectives: cognitive learning and mental management. Students have to deal with different situations, with mixed groups,

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testing their communication skills; they have to act responsibly and autonomously and to follow their plans; they have to engage in systemic thinking processes.
- Analyse how pedagogical teams of teachers deal with teaching agroecology in agricultural high schools and what students have actually learnt.
- Cross case analysis on the pedagogical and didactical practices in agricultural schools in the field of ESD in these two countries.

Overall, this developmental project fostered professional exchange on the levels of researchers, teachers and students. This contribution aims at a closer look at the following aspects:

Research question 1: To what extent can topics of sustainable agroecology be implemented with the constructivist concepts of the HAUP and the CEZ-Bergerie Nationale?

Research Question 2: How can aspects of the theoretical didactical concepts "Green Pedagogy - GP" and "Grounded Pedagogy for Transition - GPT" be compared for planning and reflecting school practice?

2. Theoretical background

ESD in general should support the common political goal of making further steps in reaching the Sustainable Development Goals (SDGs;United Nations, 2020). Many educational programmes therefore foster the development of competencies (Saadvandi et al., 2023) instead of defining limited content-based learning goals; this is also true for agricultural schools in Austria (Faistauer et al., 2014; Scheuch, Michenthaler & Haselberger, 2017) and in France (Gaborieau, Rossand & Gilly, 2022; Mayen, Gaborieau & Dégrange, 2022). Therefore, pedagogical and didactic ESD programmes aiming at the development of capabilities and competencies related to taking action for sustainable development were developed in both countries independently in the last decade.

Green Pedagogy (GP), developed in Austria at the HAUP (Wogowitsch, 2013), is based on a systemic-constructivist concept of didactics (Arnold, 2012; Reich, 2006), which is characterized by the insight that cognitive-emotional systems are self-referentially closed. Learning is seen as an active, internally controlled construction process, which always takes place situationally, in multiple dimensions and embedded systemically in a specific context. In this sense, competence-oriented learning depends on the ability in picking up the diversity of the learners' appropriation logics. Learning processes are focused; these are based on previous experiences and emotions of learners. Therefore, the social and situational framing of learning settings are seen as particularly essential for the handling of dilemmas and contradictions as well as applied methods for developing systemic thinking and reflecting.

Grounded pedagogy for transitions (GPT), developed in France at the CEZ-Bergerie nationale, is based on learning through authentic social situations. It incorporates the contribution of professional didactics (Pastré, Mayen & Vergnaud, 2006),

which analyses work for training purposes; professional didactics considers that professionals combine both scientific and practical knowledge, in action, and that this knowledge forms the basis for training future professionals and citizens. It incorporates the idea that we learn from problematic questions that require us to think about the "why" and the "how" in order to problematize (Fabre, 2011) and conceptualize (Barth, 2013; Astolfi, 2010) possible solutions to the problem. It places the question of sustainability as a grid for reading human activities in a context of finite resources that need to be managed (Peltier & Mayen, 2017). Finally, it uses social and scientific enquiry (Dewey, 2006; Bachelard, 2004) as a pedagogical means of engaging learners in learning.

The two pedagogies with their backgrounds and associated philosophy should therefore be two possible ways of making a contribution to learning about sustainability and its associated concepts. A more detailed sketch of the project and the theoretical background was published last year in this journal (Forstner-Ebhart, Peltier & Scheuch, 2023).

3. Methods & Materials

By the means of a cross case analysis (Yin, 2018), we compared with the help of categories derived from Grounded Pedagogy for Transition and Green Pedagogy likewise one selected case: soil fertility. The most important categories for this paper are: task for the students; context of task; social setting for learning; learning products; transfer of learnt content and acquired competencies; evaluation of learning process; conceptualization by teachers and students; representations of content.

As material for analysis we used the description of the presented lesson plans of the teachers, the visits of the enactment of teaching, the reflection afterwards, and the more general follow up discussions to compare the underlying pedagogy, the teachers' preparation and/or teacher education as a whole. The products of the school partnerships, the so-called Action Sheets, were used as a condensed material for analysis too. The comparison works out the commonalities and differences of the teachings and the pedagogical concepts. Overall, this research is conducted in the philosophy of Action Research (Altrichter & Posch, 2007) with all subjects and objects of research involved with a pragmatic approach (Biesta & Burbule, 2003).

4. Results

The case of soil fertility is representative for the whole project, therefore we decided to focus on this school tandem. This school partnership shows many aspects, which could have been seen in the other partnerships as well. For an overview on all projects and the resulting Action Sheets, a Padlet can be visited[2].

2 https://padlet.com/Bergerienationale/nectar-911xbytr06baob8k

4.1 The Case of Soil Fertility

In this partnership, the schools of Cibeins in France and GBS Langenlois in Austria were involved. Their shared interest was the topic of soil fertility. We use this case to compare the teaching and to reflect on the two different pedagogical concepts.

4.1.1 Teaching Sequence in France

In a Bac technologique class, with students from 16 to 18 years old (Education Level 4), the aim was to evaluate the amount of change in the school farming system according to the decision to grow more alfalfa (*Medicago sativa*, a perennial nitrogen fixing plant) for increasing fertility of the fields, permanent landcover and nitrogen-rich fodder for the school cows. Thus, the pupils had to identify the agronomical, zootechnical and environmental arguments of alfalfa to improve fertility and sustainably at the farm.

The class (31 students) was divided into 9 working groups: 2 groups worked on the agronomical arguments (2X3 pupils), 2 groups on the zootechnical arguments (2X3 pupils), 2 groups on the cycle of nitrogen (2X3 pupils), 2 groups on externalities (2X4 pupils) and finally 1 group (5 pupils) on the sustainability of alfalfa in polyculture breeding farms. The activity was conducted with the aid of prepared texts and the purpose for each group was to present their arguments to the farm manager with the help of a poster.

The groups of students are used to working in those conditions. They must read, understand and get familiar with the notions introduced in the texts. Then, thanks to their interactions, they must explain them and deliver them orally with the help of a prepared support, in this case self-made posters.

Both groups working on the cycle of nitrogen had difficulties to schematize on the poster. Indeed, the representation in the form of an open cycle in the case of mineral nitrogen was too complicated for them to extract from the texts, especially volatilization and loss (regarding a cycle as reference).

The bigger group working on sustainability also had difficulties to identify the arguments, because there were too many documents to read and synthesize. In fact, this group had to use all the texts of the other groups to present the three sustainability levels with their arguments: no alfalfa = no sustainability; low crop proportion of alfalfa in the system = low sustainability; and high crop proportion of alfalfa = high sustainability. The task was too complicated for them.

4.1.2 Teaching sequence in Austria

The teaching sequence took place in a first year of a vocational middle school for landscape gardening, the students' ages ranged from 15 to 16 years old (Education level 3).

The context of the learning settings was about solving complex real-life tasks for landscape gardeners by using acquired knowledge (and additional information in given text) with the goal of enabling students to apply, transfer and combine their knowledge in different professional situations. Previously, the students had about 20 lessons on soil sciences, working separately on different topics. This was the first time for them to combine the knowledge (soil type, humus accumulation, soil life, composting…). In the first part, ideas from the students about soil fertility were collected in a word cloud in order to make the following tasks easier, to facilitate notions and elicit their knowledge. Students were very active in their participation and giving lots of concepts, also in explaining their reasoning and ideas and therefore activating the previously learned concepts.

Afterwards, the 11 students were separated into three groups. The groups were composed by the teacher, according to the students' interests and capabilities. Different case studies of soils (private garden, fruit orchard, vegetable garden) were prepared (each on a different table), which represented familiar situations on a similar topic. In all three case studies, tasks were linked to a problem of porosity, so humus levels in the soil had to be considered. It was important to see how the students organized themselves. In each group there was a leader, who came up naturally, but intended by the teachers' group composition in advance. The students worked with guiding questions for finding solutions to the tasks and created a poster. They highlighted important words in the text and discussed among them, whether the information was important or not, then they linked it to their script with the previously taught topics. They had to deduce links to the soil's attributes, find characteristics and indicators of the soil's structure quality (e.g. puddle as an indicator, connecting to the attributes of compacted soil). One difficulty the students had was in identifying which attributes to write down to solve the problem (for two groups, one was very autonomous). After preparing the cases, all the groups had to work on all three topics, by moving from table to table in a world café. A host, staying at the table to introduce the case study to the other groups, was chosen officially.

During the group work, the teacher helped and gave hints to the different groups for a cognitive scaffolding of their concepts. The students presented and discussed their work with the support of the created posters in a world café afterwards. In the final part, they evaluated themselves and their group members by reflecting on their cooperation and organization to realize the posters and prepare the presentations in the world café. After the lesson, the individual contributions were evaluated by the teacher.

4.2 Comparison

The pedagogical situations observed in both countries are more or less similar. Students work in groups about a case study and have to prepare posters to present it to other students. The aim of these activities between the two schools, the teachers' reasoning, and the explanations made in class were very similar. There are several

shared elements, such as the importance of explanations, transferring of the learning activities onto posters, the learning situations during group work and in the final plenum.

The main difference resides in the way to prepare the activities. French teachers think about the concepts that they need to teach and before the beginning of the activity, they inform the students on the topic (with resources: documents, articles, videos…) to lead them to a problematization of the case study mobilizing the concepts of the course. At the end of the activity, the concepts are institutionalized: they are written down explicitly in the learners' notebooks or digitally. This step can take several forms: a scheme, a mind map or written texts.

For Austrian teachers, the use of the concepts is more implicit, they do not focus on them before in their preparation. The focus is more on the learners and their thinking. At the beginning of the lesson, a word cloud was made. The students gave words to the teacher and the teacher structured them on the blackboard, but neither the teacher nor the pupils came back to this work again. The role was to bring in the students' thinking, to repeat the already learned topics and concepts, so that they can be applied in the following group work.

The topic of sustainability was anchored in Cibeins within a group work, but this group was overwhelmed by the number of texts to synthesize. In the reflection, the teacher stated that it would have been better to make a sustainability synthesis in the plenum afterwards for two reasons: first, not only one group deals with this aspect but all can bring in their perspective, second, the imbalance of texts between the groups would not happen.

In Langenlois, sustainability was built in only implicitly. For the teachers, it is clear that working with humus and enriching soils with different problems is a contribution to soil fertility and other sustainability aspects as well. However, this was not made transparent to the students, since conceptualization took place in the beginning with the word cloud only about soil fertility. Sustainability as a concept and the links of soil fertility to sustainability were not made.

These differences can partly be explained by differences in the curricula: while it is more regional in Austria, where curricula for the agricultural middle schools are planned by the federal states, it is a national curriculum in France, following guidance from a national agenda.

Therefore, we could see those patterns of teaching also in the other participating schools and use only one case - soil fertility - as an illustrative example.

5. Discussion and Outlook

Both concepts share a constructivist basis (Gerstenmaier & Mandl, 1994), while GP is more anchored in discourse within the students and taking their thoughts into consideration, taking their emotions seriously and enhancing exchange between their own ideas; therefore, learning is enacted more from a social constructivist side.

GPT on the other hand has a strong focus on conceptualizing and problematizing the professional situation and has therefore a more cognitivist approach. Therefore,

they both have the same background in constructivism, but differ in their approach of planning and enacting in the classroom.

This difference could be a consequence of the genesis of the two concepts, since GP was developed as a generic pedagogical concept for many teaching situations in various subjects and many circumstances and mainly for pre-service teacher education. On the other hand, GPT works closely with subject teachers in vocational education as a coaching tool in in-service teacher education (see also below). This difference can also be seen in the role of sustainability between the two models. While GPT is very explicit with a conceptual framework for applying on a given problematic situation (no – weak – strong sustainability), GP has sustainability implemented with the generic Brundtland definition, the three pillars with their interactions only and not a normative or directional conceptualization. In planning the teaching about a topic, this central idea gets lost, as it is often not the core of fulfilment of the state curriculum. Instead, the much narrower content topics are conceptualized, and the social settings, the handling of dilemmas and contradictions as well as the applied methods for developing systemic thinking and reflecting are much more in focus. Through the observations and the analysis, these differences became visible.

Another point in the educational biographies for teachers may be influencing: the training of teachers differs: in Austria, young teachers are not trained a lot in subject didactics but with a far more global and methodological approach, as they might teach any subject in vocational middle schools. In France, young teachers receive training for their own discipline, with (some) didactics integrated in it. Therefore, the learning of the teachers may have an influence about their way of approaching complex sustainability contexts; in France focusing more on conceptualizing the content, in Austria more on creating a pedagogical setting.

Since GP is implemented in pre-service teacher education only and GPT mainly used as a tool to develop actual teaching sequences with in-service teachers, it could be observed that the latter concept is far more visible in the classroom and more tangible for the reflection of the teachers themselves. Schools in France cooperated with the Bergerie nationale for several years to implement GPT, this was not the case for Austrian examples with GP. This could be one aspect of a possible transfer, that GP could be better implemented in Austrian schools while working directly with in-service teachers as well.

GPT on the other hand could profit from having a closer look at the students' ideas in France, their pre-concepts and considering these as equally important as the conceptualisation to reach a closer match during learning between the students' ideas and the curricular demands.

Overall, it was interesting to compare the theoretical concepts in practice and with the inventors discussing their views!

6. Conclusion

The NECTAR project, through the analysis of its three topics, brought elements to answer the two research questions.

On the first question: To what extent can topics of sustainable agroecology be implemented with the constructivist concepts of the HAUP and the CEZ-Bergerie Nationale?

- Agroecology is a concept integrating value. The two pedagogies (GP & GPT) proposed in the project are fit to teach agroecology, as they both take into consideration the values associated to the concept, along with the values of the learners.
- In GP and GPT, there is a real interest in situational problems. The transition to agroecology constitutes a real situational problem, making the use of GP or GPT relevant to teach in a class, especially for subjects around ESD.

On the second research question: How can aspects of the theoretical didactical concepts "Green Pedagogy - GP" and "Grounded Pedagogy for Transition GPT" be compared for planning and reflecting school practice?

- On collecting learners' representations, the work is not done in the same way: it is more implicit in GPT, and it is attempted to be explicit in GP.
- The process of problematizing and conceptualising could be more closely observed in GPT, in which teachers are frequently observed and questioned on their sequences and practices, than in GP. So, for a permanent improvement of teaching in schools, it is a crucial point to accompany pedagogical teams in their practice.
- GPT aims for more conceptual knowledge, while GP targets more knowledge for action or how to put things into action (which is more implicit in GPT). These two approaches are therefore complementary, seeing that these two kinds of knowledge are necessary. It can be said that the two theoretical frameworks enrich each other.

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