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Assessment of cross-cutting competences in education for sustainable development

Example of the Swiss research project *transformations*

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ABSTRACT

The current context, with the many changes occurring in both local and distant environments, raises ethical questions that challenge our emotions, our relationships, and our vision of the world and our place in it. These changes require us to be capable of apprehending a complex set of problems so as to understand and analyse them, grasp the individual and societal challenges they present, and, with full awareness of the issues, decide how to behave. This aim of enabling every citizen to be capable of making informed choices and acting responsibly is found in the curricula of many countries, including Switzerland. Education about changes, for systemic and forward-looking vision and for action is rooted in particular in the Education for Sustainable Development (ESD) approach. Our study aims to better define what is conducive in compulsory schooling to the development of cross-cutting competences and their assessment.

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Introduction

In 1987, in the 'Brundtland Report', the idea of Sustainable Development (SD) appeared and was defined for the first time as a mode of development 'that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland 1987, p. 16). This definition is a very general one and it has continuing relevance at the present time; its application can be adapted to specific and varied situations and contexts. However, the best known and most widely used definition of SD is the three spheres model (e.g., *éducation21*, the Swiss national centre for promoting Education for Sustainable Development (ESD) in the education system): economic, social and environmental. In this representation, SD seems to be a consensus, or a search for balance, between these three poles. This modelling, although it has made it possible to open up channels of communication between different actors with sometimes very divergent interests, underlies a major weakness: the three domains seem to have the same weight. Indeed, this approach overlooks the fact that the environment, unlike the economy, has finite limits. As Theys and Guimont (2018) reminds us, the planet boundaries define and impose limits

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on both economic and social development: ‘The limits imposed by nature are absolute, not relative: economic and social systems are one of the components of the biosphere, on which they depend and whose rules of operation they must integrate’ (p. 5). Therefore, for a stronger vision of sustainability, it is important to anchor the economy in the society, and likewise, the society in the biosphere. This way of defining SD corresponds to a strong vision of sustainability, as opposed to the three spheres model which represents a weak vision (e.g., *éducation21*).

To create this ‘model of society respectful of ecological limits’ (Curnier 2017, p. 2), it is important to question our relationship to the world, to others and to the environment. This paradigm shift (Curnier), which is necessary to face the challenges of the Anthropocene (Curnier; Lange 2020), requires ‘an ability to master complex thinking and to decide collectively in situations of uncertainty’ (Lange, p. 3) to define a desirable common future and the means to achieve it. To succeed in this societal transformation, schools have an essential role to play.

But this raises some questions: Is it possible to have a strong education of SD in class? And if so, how can teachers be helped to achieve this? What are the levers and obstacles?

In the framework of the European Conference on Educational Research (ECER 2021), an overview of Swiss ESD research has been proposed. It is in this context that we present below the current state of our present research, on the competences that students should possess at the end of their compulsory schooling to face the challenges of the 21st century. Thus, we propose an example, in Switzerland, of ESD pedagogical practice that responds to the needs of a strong vision of SD, in the form of a project-based pedagogy that makes it possible to develop and assess cross-cutting competences in class. The created pedagogical resources¹ are now tested in classes. The results of this work will be published in further papers.

I. Reading framework for cross-cutting competences and their assessment for a strong SD education

1. From weak to strong SD education in schools: the power of competences

In the field of education, ESD is now well established in the curriculum of many countries (e.g., in Switzerland, France, Quebec, ...). In particular, in the *Plan d'Études Romand* (PER) - the curriculum for French speaking Switzerland - we can find that the ESD ‘has above all a civic and intellectual purpose: it contributes to the formation of a critical mind by developing the ability to think and understand complexity’. ESD is not defined as a new discipline but as another way of approaching the content of each discipline, at each level of schooling (French Ministry of Education 2021; *éducation21*). It is thus a form of interdisciplinary teaching, in which several disciplines collaborate to achieve a common objective (Darbellay and Perrig-Chiello 2002).

Moreover, the most common way of talking about SD, also in schools, is the weak vision with the three spheres model. Then, how can we provide teachers with avenues to move towards the emancipatory and reflective citizenship (Curnier 2017) goals of the school programmes and the strong vision of SD, including interdisciplinary practices?

First of all, ESD involves the personal development of students. Therefore, in ESD, the teacher must develop his or her students’ modes of reasoning that will enable them to have a complex vision of situations and attitudes that are favourable to carrying out thoughtful actions (Morin 1999; Pellaud 2013). ESD also means ‘instilling a change of mindset to see further, anticipate the future and act accordingly’ (Pellaud 2013, p. 3), to be able to understand the complexity of interactions (*éducation21*), to ‘make informed decisions and take individual and collective action to change society and care for the planet’ (UNESCO, paragraph 1). Thus, one of the main purposes of ESD is to enable students to take action. We believe, as do some authors (e.g. FECODD 2019; Le Boterf 1998), that processes involving action are dependent on competences. It is therefore necessary, in ESD, to ‘give learners of all ages the knowledge, skills, values and agency to address interconnected global challenges’ (UNESCO).

In this respect, we agree with Perrenoud (1997) that there is a need to change the school paradigm from a school that focuses only on knowledge to a school that also aims to transmit citizenship competences and attitudes. Therefore, we explored the literature in order to define characteristics and mechanisms of competence, and then to precise ESD competences.

2. Competences: characteristics and discussions

a) General definition

The notion of competence is polysemic and varies according to the milieu, the context and the author. The term has been much used in the professional world for many years: competences are seen as a lever favouring employability and focusing more on the individual than on the context (Parlier 1994). For Le Boterf (1998), the important thing in processes involving competences is not so much to have competences as to be competent. This amounts to distinguishing between simply superimposing elements ('having competences') and being capable of mobilising and using them so as to act competently ('being competent'). This 'acting competently' corresponds to the capacity to combine and mobilise a set of pertinent resources (knowledge, know-how, qualities, networks of resources, etc.) in order to perform activities, in a particular context, according to certain modes of procedure so as to produce results (products) meeting certain performance criteria for a user (Le Boterf 2008). To be competent one therefore has to 'know how to mobilise'. Finally, another important characteristic regarding competences is that they are always contextualised, in other words they always depend on 'the activity through which they are manifested' (Le Boterf 1994, p. 57), their 'implementation' (Tardif and Dubois 2013, p. 31).

A very common way of defining competence is to see it as a 'knowing what to do' associated with knowledge, know-how and 'knowing how to be' (Bissonnette and Richard 2001). However, some authors point out a limit of this application: simply knowing what to do is not sufficient to produce action. Thus, for FECODD (2019) and Le Boterf (1998), 'being-able-to-act' and 'wanting-to-act' are two other components also required. Knowing what to do 'presupposes knowing how to combine and mobilise pertinent resources' (Le Boterf 2005, p. 60); wanting-to-act relates to the student's motivation and commitment; and being-able-to-act implies 'the existence of a context, a work organisation, social conditions that make individual responsibility and risk-taking possible and legitimate' (Le Boterf, p.60).

It could also be added that competence is what differentiates an expert from a novice (Bissonnette and Richard 2001), inasmuch as, according to Le Boterf (2002), the professional or the 'expert' will be capable not only of performing the action competently but above all also be able to explain how to succeed in the task or perform it competently. Thus, having a reflexive view of one's own practice makes it possible to become more competent and to identify one's own learning mechanisms.

Despite some divergences, the specificities of some domains and a substantial number of definitions, it is possible to derive from them some common characteristics, which we have used as a basis for a definition that could apply to our research. In the last twenty years, competences have also made their entry into the world of education. This seems logical since, as Deltour and Mangez (2015) point out, schools respond to the needs of society. If the professional world changes (in particular in its way of recruiting), schools must enable young people, when their schooling is finished, to integrate as well as possible into society (in particular by finding a job).

b) Some characteristics and critical discussions

We find the synthesis made by Hadji (2015) relevant and agree on the same characteristics to define competence.

Situation. First, the notion of situation is found in the definitions of numerous authors, such as Gillet (1991), Bissonnette and Richard (2001), Allal (2002), Tardif (2006) and many others. They

all refer to a 'family of situations' to which a competence applies. This means that a competence is expressed in a set of similar situations that share the same goal. According to Scallon (2007, p. 6) 'one cannot rely on one situation to infer a competence'. In other words, to master a competence, one has to have exercised it several times in several different situations. Gillet (1991) recommends first practising a competence regularly in a specific context. Bissonnette and Richard add that, in a second stage, generalise it to different but similar situations (a family of situations).

This characteristic aspect of competence and the reflections of Allal (2002), led us to prefer the term 'competence' rather than 'ability', in our study. Indeed, Allal uses competence to designate a more complex system referring to an understanding and a frequent and adapted use with a form of automation and generalisation to a family of situations. Conversely, if a capacity also requires an understanding and use of resources, it appears in a more specific context, for example for the school environment, linked to a particular discipline or task. Thus, a 'capability', although often used by some authors as a synonym for competence, is, in our approach, a component of competence. Therefore, certain 'transversal capacities' (*capacités transversales*, CT) of the PER will ultimately be competences for us.

Complexity. 'Complex' is generally confused with 'complicated', which leads to situations that are meaningless for the class. It is not a question of presenting the student with a situation that is impossible to resolve, since it is known that, for a student to invest in a task, it should be neither too hard (in order to seem feasible) nor too simple (so that he/she finds some interest in solving it) (see e.g. Silvia 2006). Thus, the notion of complexity refers to the implementation of a combination of different processes to perform a task (Bissonnette and Richard 2001). Finally, the complexity is inherent not only to the situation but also to the age of the students and their potential.

Performance. For Chomsky (1971), competence corresponds to a set of rules that enable the production of performance, and in the same way Perrenoud (2002) sees competence as what lies behind performance. There is thus the idea that, if a person is competent, they can perform, or, as Gillet (1991) puts it, competence is a system that makes it possible to solve a task-problem by an 'effective action'.

Resources. The resources that the individual will mobilise may be internal or external (Hadji 2015; Tardif 2006), and may refer to different types of objects. For example, Gillet (1991, p. 69) speaks of 'conceptual and procedural knowledge', Allal (2002, p. 81) of 'cognitive, affective, social and sensorimotor components'; and Coulet (2011, p. 9) defines these resources as types of knowledge and know-how.

For us, it is therefore important to unite knowledge and skills in an inseparable complementarity. As argued by the French project for a Common Core of Knowledge, Competences and Culture (*Conseil supérieur des programmes, Projet de Socle commun*, 2015), we believe that without a base of knowledge no competence can be constructed and that, as Le Boterf (2018) argues, it is fruitless to superimpose knowledge without knowing how to mobilise it. According to Hadji (2015, p. 45), subject learning (*connaissances*), often assimilated to knowledge (*savoirs*), is 'specific to the ideas of the syllabus, in a given discipline' and results from a cognitive action requiring 'an effort of understanding and modelling of the real' (p. 46). We could add to this definition that an effort of memorisation is also very present. In this regard, it is opposed to competences, which are defined, as we have seen, in operationalisation, and where knowledge only appears in its mobilisation.

This distinction is important in the field of compulsory schooling because it shows that the same competence can be exercised and achieved through the mobilisation of knowledge from very different disciplinary fields. Therefore, we talk about transversal competences.

Integration. The notion of integration is very closely linked to that of resources, since it is a matter of the learner's integration of the previously defined resources. In Allal's definition (2002, p. 81), resources, which she calls 'components', are set in an 'integrated and functional network'. Coulet (2011, p. 9) speaks of an 'organisation of varied elements'. The general idea emerging from these different approaches is therefore that resources, in order to be mobilised, must be integrated by the learner, i.e. learned, understood (Bissonnette and Richard 2001), and the student must have appropriated them in such a way that they can be considered internal.

Mobilisation. Mobilisation is common to all the definitions found in the literature review. So, mobilisation goes further than a simple reuse or transfer of operational knowledge, enabling a readjustment of the acquired resources according to the situation (Pellaud 2000). Mobilisation thus induces a personal adaptation of resources to the new situation.

Putting together these different notions, it can be seen that a competence corresponds to the integration and mobilisation, for a complex task, of a set of resources in a family of situations so as to produce an effective action.

In order to define the notion of competence adapted to the Swiss school environment and ESD, we turned to the prescriptions of the CIIP (Conférence intercantonale de l'instruction publique de la Suisse romande et du Tessin), which we compared to those of the ministries of education for France, Belgium and Quebec, in order to extract the information that French-speaking teachers face.

Thus, for the CIIP (*Présentation générale du PER*, CIIP 2010), competence is 'the possibility, for an individual, of mobilising an integrated set of resources with a view to effectively performing an activity regarded as complex'. The notion of mobilisation is also found in the curricula of France and Quebec. In France, the curricula are more concerned with the mobilisation of the students' acquired resources in different tasks and complex situations (*Socle commun des connaissances et compétences* 2006). In Quebec, the website of the Ministry of Education and Ministry of Higher Education (2021) refers to 'the acquisition and mobilisation by students of resources that include a body of established and shared knowledge'. For Bissonnette and Richard (2001), these resources can include knowledge, competences and capacities. In French-speaking Belgium, the *Décret Missions* (1997) states that all the resources that are to be implemented must be organised.

c) our definition of competence in ESD

On the basis of these findings and with a view to assessing students' competences in school, we have emphasised in our definition the aspect of the expression of competence, i.e. stressing what can be observed in concrete situations. We thus give the following definition: 'A competence is demonstrated at the moment when an individual mobilises an integrated, interdependent, interlocking and functional network of cognitive, emotional, social and sensorimotor resources in order to effectively perform a complex task for him/her, within a family of identified situations' (Pellaud et al. 2021, p. 7). As stated in Pellaud et al. (2021) we abandon the idea of action within the school. Indeed, the latter cannot be totally spontaneous, nor can it emanate solely from a personal choice of the student. 'However, we place action as a fundamental objective, like ESD'.

3. ESD competences: cross-cutting competences

a) Definition

In order to define which competences to work on in ESD, we based ourselves on the previous reflections on competences and ESD and it seemed to us that the competences needed by students to face the challenges of the 20th century should be cross-cutting. In the sense that these cross-cutting competences are opposed to disciplinary competences in the sense that they have no disciplinary anchorage and apply in various contexts (Tardif and Dubois 2013; Bissonnette and Richard 2001). They are thus 'common to several fields' (Hadji 2015, p. 50) and are described by

Tardif and Dubois as general competences. These competences must also offer students the possibility of realising, in the classroom, the complexity of the situations of everyday life, by making connections between what they learn in school and their daily life, so that they are able to act judiciously and responsibly in everyday life (Tardif & Dubois; Bissonnette & Richard). They should ideally prepare students for their future lives while giving new meaning to what they have learned (precisely by making this link between school learning and everyday life) (Dutr  vis and Rastoldo 2020).

Dutr  vis and Rastoldo (2020) put forward a taxonomy of cross-cutting competences in which one finds: (1) motivational and metacognitive competences, (2) relational competences, and (3) emotional competences. On the other hand, and in contrast to our approach, they oppose these cross-cutting competences to cognitive competences. This seems to us inappropriate since some cognitive competences can perfectly well express themselves in various disciplines (Pellaud et al. 2021), such as complex or critical thinking; and good capacities of memory and attention are needed in order to self-motivate and self-regulate, form relationships and identify emotions, etc. (see e.g., Dukes et al. 2021). We too have thus defined three types of cross-cutting competences (Pellaud et al. 2021): metacognitive, cognitive, and socio-emotional competences.

b) Metacognitive competences

Following Flavell (1977, 1985), many authors have been interested in metacognition, defining it as awareness and knowledge of one's own knowledge and learning processes, and the mechanisms to control, regulate and adjust this learning (Flavell, 1979). Metacognition enables 'analysis of one's own intellectual functioning' (Danvers 2003, p. 383). It must also give rise to an internalisation of the steps taken to solve a problem, which gradually allows the evaluating gaze to be shifted from an external critique (the teacher) to self-critique (Grangeat & Meirieu 1997), i.e. the development of a metacognitive student (Portelance 1998).

c) Cognitive competences

Cognitive competences are manifested in the proper use of a 'range of mechanisms (e.g. perception, attention, memory, language, decision-making, reasoning, etc.) which are responsible for processing information or, more precisely, for acquiring, developing, and transforming knowledge (e.g. Seron and Van der Linden 2014)' (Pellaud et al. 2021, p. 4).

d) Socio-emotional competences

These are the social and emotional competences (a term to be understood as relating to 'affective mechanisms in the widest sense of the term' (Pellaud et al. 2021, p. 7) that make it possible in particular to identify, understand, use and regulate one's own emotions and those of others (Brasseur et al. 2013; Mikolajczak et al. 2020).

Like Dutr  vis and Rastoldo (2020, p. 12), we think that 'all competences influence... one another'. Metacognitive competences are closely linked to the student's motivation and emotions since they play an essential role in self-image, knowledge of one's strengths and weaknesses and the possible levers. Emotions and cognition are also interdependent (see e.g. Dukes et al. 2021) such as for example 'emotions play an important role in the regulation of cognitive action' (Lafortune and Saint-Pierre 1996, as cited in Danvers 2003, p. 384) and vice versa (e.g. cognitive mechanisms constitute important characteristics of emotions). In the context of teaching, fear or sadness could tend to paralyse a student in his/her learning whereas interest or joy could help sustained attention and perseverance in an activity.

e) Our selection of cross-cutting competences

In a previous work (Pellaud et al. 2019), we aimed to select the cross-cutting competences needed by 21st-century students to respond to the challenges of SD. We compared these

competences with the reports and recommendations of various international bodies (World Economic Forum [WEF], OECD and UNESCO [Education 2030]) so as to be sure that they corresponded to our expectations. In a second stage we had to verify that they were also adapted to the Swiss context. To do so, we compared our competences with the objectives of the PER and the ESD competences of *éducation21*. The idea was again to bring out points of convergence between the different formulations proposed in these two texts.

We have therefore taken up the same analytic table as in the previous work (Pellaud et al. 2021), completing it with the data from the PER and the ESD competences of *éducation21* (Table 1).

4. Assessment of cross-cutting competences in ESD work

Competences develop in complex situations. Asking questions to elicit recall of knowledge will therefore not necessarily bring out the student's competence, as Perrenoud (1999) notes. If one would develop competence, it is therefore preferable to offer teachers and students other means of assessment than those habitually used to test knowledge. The characteristics introduced above highlight some points that we believe are important in an evaluative practice of competences.

First, main objectives of work through competence are to enable the student to be more involved and autonomous, through the capacity to think reflexively about his/her own cognitive processes, so as to be able to improve, be more responsible and be capable of acting by and for him/herself. We therefore decided to use an evaluative process that places the student at the heart of his/her learning: self-assessment (Scallan 2007; Hadji 2015). However, for students to carry out a self-assessment, it is essential to teach them how to self-assess (Scallan). To do this, we examined what Hadji calls co-assessment, i.e. an evaluative process in which 'a student compares his/her self-assessment with the assessment made by the teacher' (p. 64). We therefore aimed to combine with most of the self-assessments an assessment based on the same competences and/or capacities so that the teacher can also assess his/her students. Finally, a period of dialogue between student and teacher is organised so as to compare their viewpoints and to make it possible to assess the accuracy of the students' self-assessments with regard to the objectives defined, the successes and gains, the difficulties to be overcome and the means to be applied in order to progress (Allal 1999).

This idea of progression is also found in the characteristics of the notion of competence. Le Boterf (1998) and Perrenoud (1999) mention that competences evolve and vary depending on the individual and the context. Thus, testing the same capacity at different moments and in different contexts, in order to observe a potential evolution of the level of mastery of the competence to which it relates, seems to be an interesting avenue to develop in this study. To determine the level of mastery and its evolution, it is therefore desirable to set degrees of acquisition of capacities based on criteria and indicators established for each situation (Tardif and Dubois 2013). According to Gerard (2009), a criterion is general and abstract. Criterion should be used in different contexts without modification but opens up the risk of being interpreted differently by different users. By contrast, an indicator is contextualised and concrete. Indicators are important because they refer to a precise situation and corresponds to an observable. The generality of criteria makes it impossible to assess a student's production. They have to be complemented with observable indicators. Research (Gerard) indicates that it is through indicators that the examiner can find information as to the level of mastery of a capacity. Tardif (1992, as quoted in Beckers, 2002) even goes so far as to propose to question students on the criteria of success for work with them. It seems to us desirable to leave some freedom to teachers and their students to define how success is measured. We therefore chose to propose some (general) criteria and to leave teachers and their classes to choose the indicators (which will be more precise and specific to the exercise). Competences can be worked on cyclically (Perrenoud), always seeking to go a little further, to move beyond previous acquisitions, and this is what is regularly found in school curricula (the PER in Switzerland, the common core of knowledge, competences and culture in France).

Table 1. Comparison of cross-cutting competences with the objectives of national bodies.

Types of competences	Cross-cutting competences and capacities	National bodies	
		ESD competences of <i>éducation21</i>	Competences and capacities of the PER (CT + General Education (GE))
Cognitive competences	Complex thinking <ul style="list-style-type: none"> • Systemic approaches (connections) • Managing uncertainty • Managing paradoxes • Spirit of synthesis Reflexivity <ul style="list-style-type: none"> • Reflexive approach • Scientific / critical spirit Prospective <ul style="list-style-type: none"> • Creative thinking • Anticipation, projection • Change • Flexibility, adaptability 	Systems: Think in systems Relation to knowledge: Construct interdisciplinary knowledge taking account of different perspectives Anticipation: Think and act with foresight Creative thinking: Thinking critically and constructively Perspectives: Changing perspective Responsibility: Develop a sense of belonging to the world	‘Become aware of complexity and interdependences’ (GE) ‘Envisage, problematize and model situations and solve problems’ (Maths dans Natural Sciences, MSN) Develop a reflexive approach (CT) Apply creative thinking (CT) Develop learning strategies (CT) Develop responsibility as a citizen (CT) ‘Develop a responsible and active attitude with a view to sustainable development’ (GE)
Metacognitive	Motivational and metacognitive competences <ul style="list-style-type: none"> • Learning strategies (as described in PER) • Autonomy • Responsibility • Taking initiative 		
Socio-emotional	Relational competences <ul style="list-style-type: none"> • Communication • Collaboration, cooperation • Participation • Respect • Empathy Self-knowledge <ul style="list-style-type: none"> • Self-esteem • Self-confidence • Values • Ethics 	Collaboration: Jointly addressing sustainability issues Participation: Contributing to collective processes Values: Reflecting on own values and other people's	Communicate (CT) Collaborate (CT) ‘Become aware of diverse communities and develop openness toward others’ (GE) ‘Develop self-knowledge in physical, intellectual, affective and social terms to act and make personal choices’ (GE)

In order to visualise students' progression, we turned to formative assessment (Beckers 2002; Mottier Lopez 2016) and assessment for learning (Broadfoot et al. 2002; Allal and Laveault 2009; Stobart 2011) to complement summative assessments of knowledge. One of the objectives pursued in this approach is to valorise the student (his/her work and commitment) by placing him/her at the heart of the regulation of his/her learning (Stobart 2011). To do so, we draw on positive psychology (Chodkiewicz and Boyle 2017; Shankland and Rosset 2017). For, it should be recalled, the pressure and the negative connotation given to evaluation (Hadji 2012) are often experienced as a hindrance for students. But ‘what counts in school is not that students are assessed, but that they learn’ (Gerard 2009, p. 14). In this regard, positive psychology (Shankland et al. 2018) and the solution-focused approach (Murphy and Duncan 1997) provide some very concrete pathways for, in particular, the formulation of (self-)assessments.

II. Toward of proposition of research methodology

1. Objectives and methodology of our proposal

The objective of the research we are conducting with *éducation21* is to see to what extent it is possible to create generic grids for the assessment of cross-cutting competences, and more

specifically in ESD. The context of the study is that of twelve classes (level 1 and 2 ISCED, students aged 9 to 16) in French-speaking Switzerland, with the active participation of volunteer teachers whose role is to use these assessment grids after certain activities suggested in the *Transformations* resources. The framework thus supplied should facilitate the use of the assessment grids, by freeing the teachers from the design of interdisciplinary teaching sequences integrating a competence-based approach. The experimental phase will last for one school year (2021–2022), without direct intervention by researchers with students.

2. Presentation of resources and their specificities

Based on project-based teaching (Beckers 2002; Pellaud 2014; Pellaud et al. 2019) through an inquiry-based learning, the *Transformations* resources offer 'ready-to-use' activities on 'socially live questions' (Legardez 2003) arising from SD issues. They are based on disciplinary content corresponding to the requirements of the PER so as to assist teachers in their practices.

The activities offered in these resources are intended to lead the students to reflect on a complex contemporary problem, in a first stage in a context remote from Switzerland (on an international scale), and then, in a second stage, to relate this problem to the national or even regional scale. The first phase thus enables the pupil to discover, practise and assimilate new knowledge and capacities. All these aspects, acquired or being acquired, then reappear in the second phase of the project. This is structured around a class project in which each student mobilises everything he/she has previously practised. Added to this is a creative process, since the project leads to the presentation of all the work done by the students. This can take the form of a presentation to other classes, to parents, an exhibition, a blog, a journal, etc. This makes it possible to valorise the work done by the students, to make it more concrete and to sensitise other actors to the issues. In this way, the students themselves become mediators, which contributes to the mobilisation of a number of the competences developed throughout the project.

The resources consist of:

a) Student cards, with the activities and self-assessment

Each card starts with the explicit presentation of the objectives aimed at by the performance of the work. These objectives are formulated at the start of the activity, explicitly, with reference to the competences they should make it possible to attain. This is done to enable the student to know what is expected of him/her and what he/she will be doing. The students are thus aware of what they are working on, or reworking, and this favours the capacity to make connections between tasks arising from different disciplines. These objectives also correspond, in part or fully, to the self-assessments offered to the students. Here is an example of the presentation of objectives at the top of the page (Image 1):

And, at the end of the activity, a self-assessment is proposed to the pupils to take stock of what they have done (Image 2):

It is these self-assessments that serve as the basis for the dialogue between student and teacher during the co-assessments.

b) Additional cards

With which, depending on the students' level, teachers can go further or explore a subject in greater depth,

c) A teacher's guide

This guide, designed to help the teacher in this procedure, details the use of the student cards and justifies and explains the pedagogic choices. It is presented in two parts: on the left, the detail of the activity, step by step, with advice for getting students started, a description of

the tasks set and the answers to the questions. On the right are the links with the objectives of the PER and the official pedagogic materials (MER). Although this is not obligatory (nothing is obligatory, it is all simply made available to the teacher), the guide suggests moments of assessment and co-assessment at various times and for different capacities (the grids for assessing cross-cutting competences will be provided as a supplement). Thus, multiple moments of assessment will enable both the teacher and the student to draw up a profile of the degree of acquisition and mastery of cross-cutting competences in the context of ESD.

d) Assessment grids to measure attainment of the cross-cutting competences (see next section)

Teaching by project, based on inquiry, enables us to work in an interdisciplinary way on the various objectives of the PER by confronting the students with complex situations so as to develop cross-cutting competences. The *Transformations* activities have been conceived so that students can practise the same competences several times throughout the project. Associated with the generic grids for assessment of cross-cutting competences, the *Transformations* resources will thus enable teachers to go further in this approach by valorising all the students' work, without focusing solely on their knowledge.

3. Competence assessment grid

a) Cognitive competences assessment grid: An example

We were initially interested in constructing the grid for the assessment of cognitive competences. To do so we made use of the pyramid of Anderson and Krathwohl (2001), based on that of Bloom (1956), with which we associated the verbs of action from the national and international bodies (Figure 1).

This taxonomy differs from that of its original authors through the addition of the first level, which is exploration. It seemed to us inappropriate to retain a first level which refers to the restitution of knowledge, since, although it is indispensable for constructing competences, in

Imagination, creativity and the capacity to recognise differences and similarities can be practiced and developed. That's what you will do here.

Image 1. Presentation of objectives.

How many ideas did you find? And when discussing with others?

Did you find it interesting to share your ideas with others?    

Why?

Was it easy to group them?    

What helped you to group them?

Do you need to practice grouping other things?

Image 2. Example of self-assessment corresponding to objectives.

this particular case we do not want to evaluate the memorisation of knowledge. We therefore replaced it with the exploration level since it is not uncommon in the classroom that students test, suggest and imagine without necessarily invoking knowledge or resources that they have previously learned and understood. For example, when young students suggest hypotheses for the disappearance of the Aral Sea, for the activity 'Who does water belong to?', they will set to work their creativity, their imagination, which may be extensive without being 'thought through'. In science, this refers to naïve ideas or theories about everyday phenomena, which it is important to bring out since they may be barriers to future learning (Giordan and De Vecchi, 1987; De Vecchi and Giordan 1988; Giordan 1998; Giordan and Pellaud 2008). We have also removed the level 'apply', which refers to the use of disciplinary tools, like applying a calculation rule in mathematics or a conjugation rule in language. This level thus seemed closer to the notion of knowledge than to that of competence. Furthermore, the key idea was not the application itself, but the effectiveness of this application.

To this vision, which may appear linear and suggest an evolution running from the base to the top of the pyramid, we have added a large arrow which creates a feedback loop, to show that the process can endlessly recommence. The small arrows on the sides are also there as a reminder that these are not stages to be gone through to reach the top level. It is possible to 'skip' levels or go back, without this necessarily implying progress or regression.

On the basis of this taxonomy, we looked for the verbs of action, corresponding to the application of a competence, in the texts of the international bodies previously presented (Pellaud et al. 2021), bringing together the WEF, the OECD and Horizon 2030, and also the national centre for ESD, *éducation21*, and the PER. We thus obtained the following list (Figure 2):

These verbs of action, grouped according to a logic based on the degree of complexity of the student's cognitive activity, served as criteria for the assessment grid that will be offered to teachers.

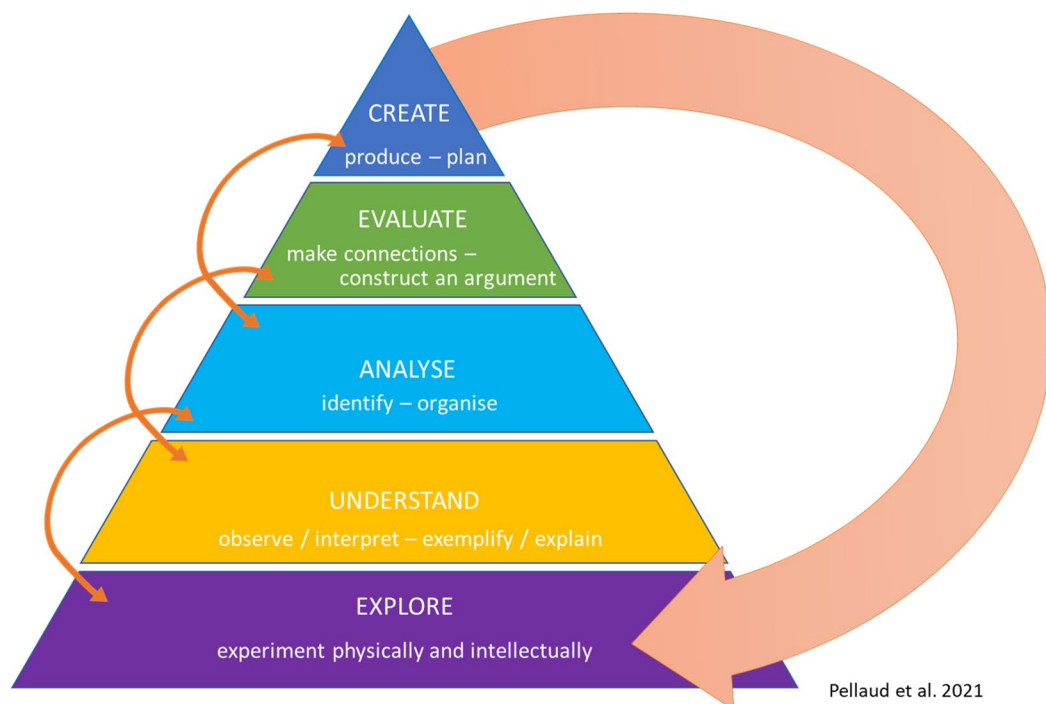


Figure 1. Taxonomy of levels of acquisition and mastery of cognitive competences.

Verbs from the PER	Verbs from the objectives of é21	Verbs from international organisations
Generate, conceive, catalogue, set in new contexts, change perspective, vary sources of inspiration, put in perspective, think prospectively.	Think and act with foresight.	Capacity for innovation, flexibility, taking advantage of changes, anticipating, shaping visions of the future.
Interrelate, deduce, synthesise, summarise, explain issues and interactions, choose, estimate, formulate arguments, reconsider one's point of view.	Develop a systemic approach, take account of different perspectives.	Take account of uncertainty, act in the global context, develop critical and constructive thinking.
Demonstrate, explore, differentiate, compare, sort, select, compare.	Identify gaps, incoherences, essential knowledge, distinguish interest groups.	Analyse complex system, interdependences, deal with complex problems.
Recognise, find information, locate, decode, extract, distinguish, identify, explain in own words, qualify, formulate.	Construct interdisciplinary knowledge.	
Imagine, formulate (naïve) hypotheses.		Creativity, originality, flexibility, openness.

Pellaud et al. 2021

Figure 2. Verbs of action from official texts of national and international bodies.

b) Metacognitive and socio-emotional competences assessment grid

We are also working on developing grids for assessing socio-emotional and metacognitive competences, based on the work done on grids for assessing cognitive competences. Analysis of the development of mastery of socio-emotional competences will take as its base for taxonomic reflection the works of Mikolajczak et al. (2020). As regards metacognitive competences, they will mostly be worked on with the *Transformations* resources; autonomy and initiative will be essentially worked on through the self-assessments.

4. Mixt methodology

The methodology used will be mixed. The quantitative part, based on a questionnaire for the students in different classes, should yield sufficient amount of data to allow a possible generalisation of the results. The qualitative part will be the opportunity for a deeper and more specific study of certain cases of use of the assessment grid and the co-assessment process. The opinions of the teachers will give us a personalised and contextualised view of our tool. The two methodologies thus converge and fill in each other's lacunae; they are complementary (Amyotte and Pépin 2017). The methodology will unfold in several phases, through interviews, questionnaires, exercises, (self-)assessments and student-teacher dialogues.

a) Quantitative methodology

A questionnaire dealing more precisely with socio-emotional competences, the subjective feeling of competence (self efficacy), and awareness of one's responsibility and capacity to act will be filled out at the beginning and end of the work (just after and a few months later) by the whole cohort of students.

In order to be able to examine the results as objectively as possible, we first envisaged measurement by means of a questionnaire based partly on questions inspired by existing tools (whose psychometric qualities have been validated) and partly on dimensions that we added according to the objectives of the study. These ad hoc items thus made it possible to flesh out the measures in an appropriate manner by targeting them more specifically on the expected effects of these interventions.

The questionnaire is divided into two parts. The first part consists of two open-ended questions: one to investigate the social representations (Abric, 2014) of the students regarding the notion of SD and the other to question their creativity and prospective vision. The second part

of the questionnaire is based on questions to be answered on a four-item scale ('completely agree', 'somewhat agree', 'do not really agree' and 'do not agree at all'). Some of the questions were constructed based on existing tools (Ntamakiliro, Monnard, and Gurtner 2000; Guimard, et al. 2015; Auzoult 2010; Navarro, Olivos, and Fleury-Bahi 2017). The others were created specifically for the study to assess specific dimensions related to the present project, i.e. the feeling of competence, motivation to act, awareness of empowerment or responsibility, etc.

In the first version of a questionnaire, adaptations should be necessary. In this context, we will address the psychometric properties of these instruments through principal component and factor analyses. These statistical analyses aim in particular to determine the structure of the instrument (e.g. the number of dimensions and their organisation). Finally, after descriptive statistics (e.g. distributions and variance) and an inspection of the validity of the measures, we will determine which tests (e.g. parametric and/or non-parametric) will be appropriate to compare progression in different groups and classes.

b) Qualitative methodology

In order to refine the quantitative measures, we will opt for a dual approach of collecting qualitative information through teacher-student interviews and semi-structured interviews with teachers. The recording of all interviews will allow multiple listening and will reduce potential expectation or selection bias on the part of the researchers. They will then be transcribed.

For the analyses, we will opt for a thematic analysis approach in order to 'identify the semantic units that constitute the discursive universe of the statement' (Negura 2006, p. 4). The different statements collected will therefore be dissected through different analytical prisms in order to categorise the elements of the discourse into already defined themes. In particular the teachers' feelings and some aspects more specifically linked to their pedagogic approaches (representations, habits, expectations, etc.) for the interviews with teachers. And the ability of students to self-assess accurately and whether they demonstrate progress in mastering certain competences for the co-assessment part. Other objectives will also be defined more precisely after the quantitative results (Albarelllo 2007).

III. Perspectives

In order to develop a generic tool that can be used to assessed cross-cutting competences, we are currently proposing three prototype co-assessment grids (one for each type of competence). These differ in their structure: some grids propose lists of criteria and/or indicators that are more or less long, already established and detailed or, on the contrary, only tracks to leave the teachers the possibility of designing more specific means. This choice, of proposing different grids, should allow us to address the complexity of creating a generic tool that is neither too general and abstract nor too precise and conceptualised, for our audience: the teachers of compulsory schools in French-speaking Switzerland. Indeed, the results obtained will allow us first of all to know the needs and preferences of teachers, the functionality of these prototypes, and then to rework this tool with regard to a more specific framework of reading tools, and in particular those relating to the evaluation of transversal competences, as with the Triple-T model (Brockwell 2019).

The creation of a generic tool for the assessment of competences thus raises the question of its feasibility and its implementation in the classroom: Is this possible? Can cross-cutting competences really be assessed (Rey 1996)? If so, how and under what conditions? There is also the question of repercussions on learning; do students acquire the competences that are worked on better, or more easily?

Beyond the possibility of creating a generic tool for assessing ESD competences, this project seems important to us in the current context (Anthropocene) because it offers teachers other ways of considering ESD sessions. Indeed, if we wish to mobilise teachers for a stronger

education on SD, we must give them ways to put their students more at the heart of the learning process to help them gain more confidence in themselves and develop a sense of power to act on the evolution of things. This is how we hope to approach the changes needed for societal transformation.

Conclusion

Following a review of the literature that enabled us to highlight the characteristics of a competence, particularly for the school environment, we selected the points that seemed to us to be essential for working by competence in ESD. We then defined what these cross-cutting competences are for students in the 21st century. Then we made sure that these were consistent with the objectives of the international bodies and corresponded to the expectations of the PER (*Plan d'Études Romand* - the curriculum for French speaking Switzerland).

In order to give weight and meaning to this process, which we believe to be important in the personal development of students in the Anthropocene, we looked for a way to value and assess this competences development.

It is in co-assessment that we found a way to combine student awareness and confidence, by including them in the learning and assessment processes, with teacher expertise to support them. Project-based teaching, proposed in the *Transformations* activities, and formative assessment make it possible to favour the student's progression rather than sanction an activity at a given moment. In order for all this to be capable of being operationalised, appropriate levels, criteria and indicators will be offered to guide teachers in this innovative pedagogic process. Finally, these pedagogic strategies aim to focus on the student and his/her investment to foster his/her self-confidence; they draw on the findings of research in positive psychology and the solution-centred approach, essentially in the formulation of the self-assessments.

We are therefore going to propose a first version of the assessment grids, and self-assessment, of students' cross-cutting competences to volunteer teachers at the start of the 2021 school year for an experimental phase. The feedback on the different types of grids (one type of grid per category of cross-cutting competences) will enable us to validate, or not, the proposed prototypes, and also to adapt those that have not worked so well.

Note

1. Resources Transformations: <https://blog.hepfr.ch/transformations/ressources/>

Disclosure statement

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