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Contribution to the development of a modular approach to the cross-disciplinary integration of environmental skills training modules in initial training at secondary school level and in higher education

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ABSTRACT: This article proposes a curricular engineering approach to the identification of competency modules with a view to their integration into university and secondary vocational training. The curricular theory based on the choice of a recommended curriculum and a possible curriculum dictated by the axiological and epistemological dimensions served as a framework for this research. Methodologically, a corpus of environmental skills modules was analysed and their potential for integration into existing VET curricula was examined. As a result, a set of three modules respecting the conditions of transversality was identified and proposed for integration into vocational and university training in the field of industry within the framework of a didactic programme to be carried out.

KEYWORDS: curriculum, cross-disciplinary skills, cross-disciplinary integration, environment.

1 THEORETICAL FRAMEWORK

1.1 THE CONCEPT OF CURRICULUM

This research is a part of the curricular theory (Mœglin & Chaptal, 2016) developed by Franklin Bobbit (1919). This approach provides a fertile ground for revising and developing curriculum content. The axiological and epistemological dimensions of curriculum theory are relevant to this research. The axiological dimension places the human being and society as the goal, and the *curriculum* is based on values and goals. The epistemological dimension bases the curriculum on knowledge of content and processes. Barthes (2022) proposed methodologies for analysing curricular systems based on the epistemologies of the sociology of the *curriculum* developed by Forquin (2008). The concept of *curriculum* includes:

- The *formal curriculum* refers to the hierarchical set of content, tasks and procedures to be taught and learned within the framework of a teaching programme (class, school, year, etc.). The *curriculum* also conveys "typical sets of socially approved questions, procedures and answers" (ibid., 1989). The formal curriculum may be prescribed (official programme and instructions) but it may also be recommended, taking into account the axiological dimension of curriculum theory;
- The real, observable curriculum, which refers to what is actually taught and practiced;
- The produced curriculum: this is the curriculum experienced by pupils. We could say that the curriculum produced is what pupils retain at the end of their learning;
- The hidden curriculum, which represents what is hidden by the learner or by the involuntary action of the teacher, depending on his or her culture;
- The possible curriculum concerns the researcher's work of exploration and prospecting, justified by a reference system with the aim of pushing back the limits of what already exists. In this respect, this "possible curriculum remains virtual (in potential), as long as the conditions for its implementation have not been identified" (lange, 2014).

1.2 THE CONCEPT OF TRANSVERSAL SKILLS IN EDUCATION

The concept of competence

The concept of competence has been the subject of a large number of studies. There are several definitional approaches, among which Tardif's (2006) seems to be the most widely accepted, and it is in line with the development proposed in this document.

According to Tardif:

A competence is an ability to act based on the effective mobilization and combination of a variety of internal resources (knowledge, cognitive ability, metacognitive ability, relational know-how, procedural know-how, physiological resources, emotional resources, etc.) and external resources (networks, software, databases, documentary resources, members of the team, resources in the professional environment, etc.) within a given situation and context.

CROSS-CURRICULAR SKILLS

According to Tardif and Dubois (2013) *"a compétence is said to be cross-curricular because it has no disciplinary or professional anchor. In this sense, it is general in relation to disciplinary, specific or professional skills".* Cross-curricular skills relate to personal skills (personal effectiveness, relationships and services, impact and influence, performance, cognitive skills) and generic professional skills (knowledge of legislation and regulations, economic knowledge, basic scientific and technological skills, understanding of the environment, information and communication technology skills, foreign language skills). Cross-disciplinary skills should therefore be seen as skills that can be used in a variety of professional situations. For this reason, a cross-disciplinary skill is non-disciplinary and is not anchored in a given profession.

THE CROSS-CUTTING INTEGRATION OF A TRAINING MODULE AND THE CONTEXT OF PROJECT

Cross-cutting integration or the integration of cross-cutting skills into existing training courses is defined as a concept which aims to take account of cross-cutting dimensions (such as gender, the environment, protection, etc.) in the training activities of an organization or a project. Following Tardif and Dubois (Ibid), we believe that the implementation of a competency, whether transversal or specific, is always highly contextualized; the characteristics and constraints of the context can never be ignored in the deployment of a competency.

Integration must take account of:

- The sector (trade, profession, module, etc.);
- The school curriculum (within the framework of a didactic program);
- The prescribed curriculum (program and study program guide, timetable, etc.).

Cross-disciplinary integration into an existing curriculum is done by substitution or by extension. In the first case, elements of the existing curriculum which are no longer relevant to the profession, for example because of technological and societal developments in the profession, are identified and replaced by a module identified for this purpose, taking into account the balance of the curriculum from the thematic and temporal points of view. In the second case, the cross-disciplinary skills module is added to the existing curriculum, taking into account the contextual factors mentioned above. In this case, the corollary is a heavier curriculum.

Two approaches to implementing cross-curricular integration:

The cross-curricular integration of subject content involves two approaches*: the approach based on the content of the profession* and *the modular approach.*

APPROACH BASED ON THE CONTENT OF THE PROFESSION

In this approach, the steering chain for a given field starts with demand engineering, which is updated by observing the market and conducting sector studies that highlight training needs. A list of occupations is then proposed. This is followed by supply engineering. For each trade, a description of the occupation and the work involved is provided, including the work process, the tasks and operations, the conditions under which they are carried out and the performance criteria associated

with the trade. On the basis of these descriptions, a comparative analysis of the tasks and operations involved in practicing the various trades will identify the tasks and operations that cut across the various trades. By combining the tasks and operations of the different professions, we can create a profession that meets the needs of the market and integrates the different professions. It is in this sense that one talk about *cross-disciplinary integration or the art of combining knowledge in the service of the general interest*.

THE MODULAR APPROACH

This approach focuses on modules. A module refers to three essential dimensions. Firstly, the term "module" essentially refers to the dimension of units, sequences or parts of content that form an autonomous whole. To this first dimension is added that of the organization of the content, which must be planned and logical (Legendre, 1988). Thirdly, the term 'module' highlights the dimension of independence and autonomy from the point of view of content, which means that a module, depending on the theme developed and the level of the learners for whom it is intended, is complete in itself. Once they have completed one module, learners can move on to another. In this approach, a module can be identified and developed by a scholarly community in a fully responsible manner so that it can find its place in existing or developing teaching and training objects.

1.3 THE RESEARCH PROBLEM

The cross-disciplinary integration of training content is a current issue in vocational training. Indeed, the development of new professional skills dictated by the economy tends to overshadow the need to take account of cross-disciplinary skills and disseminate them across different training courses in order to optimize them. Based on the axiological and epistemological dimensions of curriculum theory, we have analyzed the environmental skills modules that exist in the school and university curriculum in Côte d'Ivoire. The environmental theme is justified by a contextual requirement (the 2023 Dubai Conference on climate change, the Kyoto agreements, COP 21 to 28, etc.) and an institutional requirement (National Determined Contributions (NDCs) concern the reduction or prevention of GHG emissions). The aim is therefore to propose a possible curriculum dictated by a recommended curriculum for listing values (social values) and general principles to be respected (environmental protection, climate change), with the formalization remaining to be carried out locally in a situated manner. This research looks at the integration of environmental skills modules into existing vocational training courses. The aim is to propose training modules in environmental skills with a view to integrating them into the existing curriculum at CAP/BT and Bachelor/Master levels.

2 METHODS

The methodology initially consisted of analyzing the environmental skills modules. With a view to analyzing existing environmental training modules, an analysis grid was drawn up. It includes (1) the categories or criteria to be taken into account during the analysis and (2) the rating or evaluation levels which correspond to the values assigned to each category to indicate the degree of presence or importance of this characteristic in the element analyzed. It was decided to give priority to the categories of environmental skills modules with a close link to climate change, in view of recent developments in this area, as part of the proposal for a possible curriculum and a recommended curriculum. The rating or assessment levels for the category considered are: relevant, not very relevant and not relevant.

The corpus analyzed consists of a set of training modules in the field of the environment or training in the field of the environment available in the training offers of the universities and big schools (INP-HB, UNA, UFHB). These modules were supplemented by other module titles collected from the Department of Higher Education and Planning (DESP) from vocational training schools and private universities in Côte d'Ivoire. Around fifty environment-related topics were compiled and analyzed.

The modular approach was chosen to integrate environmental skills modules into existing vocational training. This required an examination of the potential for integrating the modules into existing training courses, taking into account three aspects: the non-disciplinary nature of the skill linked to this module, the absence of a focus on a given profession or trade, and the moderate genericity of the module being integrated. The competency or elements of competency in a module should not be integrated with a disciplinary competency describing an occupation or profession.

3 RESULTS

3.1 RESULTS OF THE ANALYSIS OF EXISTING ENVIRONMENTAL TRAINING MODULES

At higher education level, the analysis shows that there are around fifty environment-related subjects, and combining them makes it possible to propose around ten dealing with content closely related to climate change (Table 1).

Table 1. List of modules relating to climate change

N°	Module title	Module code
1	Environmental concepts and theories	CTE
2	Physical foundations of the environment	FP
3	Environmental management tools in ESIA[1]	OGE
4	Shared natural resources	RNP
5	Environmental analysis tools in ESIA	OAE
6	Integrated management of natural resources	GIRN
7	Technical methods in ESIA	MTE
8	Environment and society	ES
9	Environmental assessment and stakeholders	EEA
10	Environmental Development Project	
11	Climate change education	ECC

This list was submitted to a panel of around twenty teacher-researchers with expertise in energy, climate and the environment for their opinion, not only on the appropriateness of implementing the modules, but also on the appropriate school and/or university level for their development and integration.

TECHNICAL AND VOCATIONAL EDUCATION

Environmental skills modules have not been developed in existing technical education and vocational training curricula. However, some curricula, such as that for the “Refrigeration and air conditioning training stream” (BT level), do include environmental standards requirements. For example, Competency 2, entitled "*Integration into the social environment*", refers to the correlation between individual health, environmental protection and well-being. Skill 6 entitled « *Measures relating to health, safety at work and environmental protection »* briefly presents *judicious identification of ways of storing hazardous products and materials in compliance with environmental protection measures.*
It is also interesting to note that the analyses of the trade’s situation systematically mention the trade’s impact on the environment. For example, the revised CAP in refrigeration and air conditioning addresses the "environmental impact" of refrigerants. It goes without saying that there are opportunities for taking environmental skills into account in training courses, at least in the industrial sector, and the potential for integrating them needs to be explored.

3.2 RESULTS OF INTEGRATING ENVIRONMENTAL SKILLS MODULES INTO INITIAL TRAINING AT CAP/BT/LICENCE/MASTER’S LEVEL

Cross-disciplinary environmental skills modules identified for integration into existing training courses.

The following graph shows the results of the survey on the identification of environmental skills modules to be integrated into initial training courses.

[1] Environmental and social impact assessment

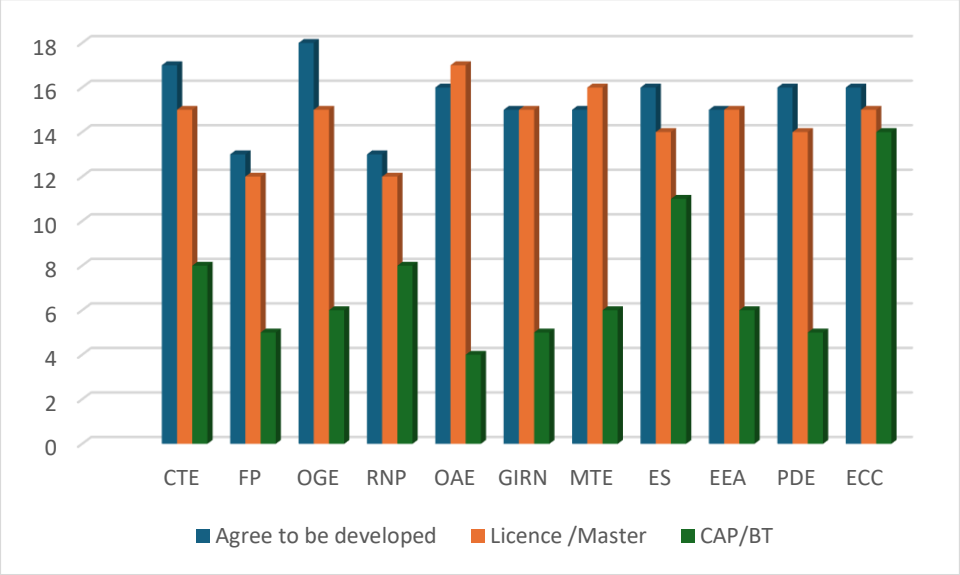

Fig. 1. Results of the survey on the identification of cross-disciplinary environmental skills modules

These results show a trend in favor of developing the "Environmental management tools in ESIA" and "Environmental analysis tools in ESIA" modules at bachelor's and master's level for higher education, followed by the "Climate change education" module at CAP and BT level for vocational high schools.

On the basis of these results, and in the light of the modular approach to integrating modules transversally into a training course, the modules were proposed for integration into vocational training courses at CAP and BT level in the industry sector and at Bachelor's and Master's level in the energy sector (see table 2).

Table 2. Potential modules to be integrated into initial and/or continuing training at CAP/BT/licence/Master's level

Cross-disciplinary modules offered for integration into initial training courses	**CAP**	**BT and BTS**	**Licence**	**Master**
Environmental management tools in ESIA			Licence BE Licence EE Licence PV	Master BE Master EE Master Energie et environnement
Environmental analysis tools in ESIA			Licence BE Licence EE Licence PV	Master BE Master EE Master Energy and Environment
Climate change education	IMPV Building electricity Equipment electricity General mechanics Steel construction	Electrotechnics Electricity Building Metal construction Electromechanical maintenance Mechanical maintenance Vehicle and machinery maintenance Boilermaking and welding Production systems maintenance (BTS)	Licence BE Licence EE Licence PV	

BE Biomass energy
EE: Energy efficiency
PV: Photovoltaic
IMPV: PV Systems Installer and Maintainer

4 CONCLUSION

Analysis of the environmental skills modules has enabled us to identify those that can be integrated into existing initial training courses. Based on the concept of cross-disciplinary integration, modules were identified that could be proposed for dissemination in existing vocational training courses at both university and vocational high school level. The next step is to develop the modules identified, specifying the associated skill, the context in which it is to be performed, the general performance criteria, the skill elements and the specific performance criteria associated with each of them.

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