Looking for a Model Combining the Goal-oriented Pedagogy and the Skill-based Approach in the Learning of Chemistry

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Abstract

The teaching of chemistry calls upon two opposing educational trends, which are the goal-oriented pedagogy and the skill-based approach. The objective of this article is to make a comparative analysis of these two pedagogical approaches. To do this, a theoretical method is used, using the works of previous authors on these two topics. On the one hand, goal-oriented pedagogy is based on hierarchical classification of pedagogical objectives and Bloom's taxonomy. Its aim is to achieve different levels of pedagogical objectives by focusing on the act of teaching. On the other hand, the skill-based approach seeks to develop the skills of the learner. This trend aims to fill the gaps in goal-oriented pedagogy by focusing the act of teaching on learning activities. However, these approaches appear to be complementary, both at the conceptual level and in their implementation, especially when they are applied to teach chemistry. While goal-oriented pedagogy allows obtaining a product which meets a precise set of instructions, and mobilizes clearly identified knowledge and know-how, skill-based approach allows developing disciplinary skills, insofar as the knowledge and skills are mobilized and integrated to solve a contextualized problem-situation. Thus, a model combining these two pedagogical approaches could serve as a steering process contributing to the viability of a learning system designed by pedagogical development and pedagogical innovation.

1. Introduction

Because of their differences, students require different types of help depending on local conditions: class size, available teaching materials, surrounding environment... Whatever the teacher's help, teaching would always be aimed at student's autonomy. Teaching methods play a fundamental role in any pedagogical differentiation. Each teacher would adapt these pedagogical methods according to the students and the learning situations, keeping in mind that the primary goal is to fight against school failure and to make each student progressing in his learning process. The grouping of the various methods implemented in the teaching of chemistry [1-3] through the approximation of their characteristics brings out two major educational trends from the literature.

On the one hand, goal-oriented pedagogy has its source in the behaviourist conception of teaching, considering the learning as an adoption of predetermined behaviours in relation to the implementation of a school activity to achieve the objectives of the proposed content; it proposes to plan school activities by carrying out a needs analysis beforehand in order to define the objectives to be reached at the end of the learning process, and then to choose the teaching methods to reach these objectives and the assessment of their achievement by the learner.

On the other hand, the skill-based approach seems to be a

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substitute to the behavioural idea of teaching. Indeed, this pedagogical tendency does not direct the learning process towards obtaining predictable effects by describing the pedagogical action which the teacher must carry out. It seeks to enable the learner to adapt to different types of situations, to give him / her ability to solve contextualized problems, and to give him / her necessary skills to set up projects which will be used to satisfy identified needs. The skill-based approach gives students the ability to act in relation to a situation they will face. However, it did not provide that mastery of disciplinary knowledge is essential for the efficient use of the skills which the student will acquire.

Despite apparent differences between the goal-oriented pedagogy and the skill-based approach, we will try to bring them together to form an applicable hybrid approach that should allow for the benefits of each of these two pedagogical approaches. From the review of the literature, we will identify the characteristics of the two approaches to allow us to combine their theoretical bases. Then, the comparison of these two pedagogical theories, as well as the studies which we carried out previously on their implementation within the framework of the teaching of chemistry [4, 5] will highlight their respective gaps, and allow to establish their complementarity.

2. Conceptual Landmarks

Many authors [6-20] were able to define the contours of contemporary teaching approaches. Therefore, we will describe the two major pedagogical approaches that coexist from the ideas established by our predecessors.

2.1. The Goal-oriented Pedagogy

The concept of pedagogical objectives developed to respond to the need to introduce more rigors into the training systems: the aim is stating clearly what learners have to learn [9]. The development of the concept of objectives and its operational applications was therefore closely associated with the idea of systematic planning of training activities, according to a systematic approach including a needs analysis, the determination of learning objectives, the choice of teaching methods, and the implementation of a learning assessment system designed to verify the achievement of objectives.

Goal-oriented pedagogy is a traditional method that divides the knowledge to be transmitted within the disciplines in as many objectives to be reached at each level of schooling. Indeed, goal-oriented pedagogy consists in answering the question: what must the learner know or do at the end of an activity? Through small evaluations, it allows to check if a specific objective is reached by the students.

2.1.1. Notion of Objective

A pedagogical objective is a statement of the effects expected in the more or less long term and with more or less certainty and interest by the trainers, the trainees, the prescribers or sponsors of training, and society [10].

According to Bloom (1971) [21], the pedagogical objective is a clear statement of what educational action should change the learner, and the primary purpose of his taxonomy of educational objectives is to categorize the levels of intellectual activity required by the objective. Indeed, a teaching objective must first describe a specific intellectual activity of the student.

From the perspective of behavioural psychology, a pedagogical objective must describe a set of observable behaviours, which are supposed to attest the control of learning by the student; the objective must describe the conditions for achieving the expected behaviour and specify the minimum performance to be achieved [8]. In this logic, the goal must therefore describe a desirable outcome at the end of a teaching process, not the learning process. In contrast, Gagné and Briggs (1974) [7] also emphasize the student's activities; it is not enough to predict what the teacher will do, but the teacher must also know clearly what the student will have the opportunity to learn, and therefore to do.

In short, the learning objectives specify sustainable and desirable changes in the student, which occur during or after a pedagogical situation, and infer, more or less explicitly, the activities which make it possible.

2.1.2. Taxonomy

The general and specific objectives can be classified by reference to the different types of behaviour according to the different domains and levels of the taxonomies of the educational objectives. Taxonomy categorizes human abilities into three domains, respectively cognitive, psychomotor and emotional. Each of these domains is then divided into different hierarchical levels.

Taxonomy is a tool which can help teachers become aware of the required level of skill of students, and build assessments which verify all levels of taxonomy. Indeed, taxonomies refer to a hierarchical classification of cognitive, affective and psychomotor behaviours. The most used taxonomies are those of Bloom (1956) [22], reformulated by de Landsheere (1984) [23], which propose a classification of cognitive behaviours in six levels:

level of knowledge: the student recognizes, memorizes and restores elements of information, as he learned;

level of comprehension: the student grasps the meaning of

the elements of the information, he translates and interprets information according to what he learned;

level of application: the student uses his knowledge in new situations, he solves problems by mobilizing the required skills, he chooses the means and methods to implement;

level of analysis: the student distinguishes the elements of the information and puts them in relation;

level of synthesis: the student uses the elements of information to make new ideas, he connects knowledge from several areas to arrive at a new proposal;

level of evaluation: the student compares ideas, determines their value and then makes well-founded choices, he makes a judgment on the structure of the information according to criteria which he defined.

The development of the evaluations should take account of the objectives actually defined in the programs, and respect both the vertical coherence between the general objectives, the specific objectives and the operational objectives, and the horizontal coherence between the objective, the corresponding content and the proposed evaluation. The assessment test should include questions of increasing difficulty corresponding to taxonomic levels.

2.1.3. Benefits of the Goal-oriented Pedagogy

Getting participation does not necessarily mean creating positive learning. Acting to act, speaking to speak, are activities devoid of purpose. Indeed, it is not enough to predict what the teacher will do (use the book, analyse the text, arrange the notes on the board, etc.), but also know clearly what the students will have the opportunity to learn and to do. A lesson is prepared according to the pursued objectives [9].

Goal-oriented pedagogy is the only valid method of rational pedagogical planning because it builds programming and progression around the learner's activity. As a result, it forces teachers, especially those in charge of curriculum development, to think and prepare activities in a specific and detailed manner. Indeed, it seems inconceivable that a teacher knowing what he wants to teach, and determined to check if he succeeds, do not choose his teaching method accordingly. Moreover, in the implementation of goal-oriented pedagogy, the choice of the means used by the teacher for his teaching sequences is subordinated to the learning objectives he wants to achieve for his students; in other words, the teacher has a freedom in his teaching.

Because of the unambiguous nature of the operational objectives, goal-oriented pedagogy encourages explicit values, desires and choices which are evacuated in the

"unspoken". Indeed, not only teachers should build their activities on clear goals, but they should also make these unambiguously and mysteriously known to their students [9].

Goal-oriented pedagogy also provides a rational basis for formative assessment and enables learner self-training by establishing individualized learning. In fact, knowing the objectives he should achieve and the means to achieve them, the learner can be in relation to the achievement of objectives, when these are formally stated. So, the learner knows what awaits him during his apprenticeship, and what results will be due to him at the end of his training.

In the goal-oriented pedagogy, the need to refer to taxonomy of learning objectives provides very structuring benchmarks for the planning of teaching, learning and evaluation activities; it facilitates communication between the different actors of the training system [19]. In fact, with goal-oriented pedagogy, communication between teacher and students is facilitated; as a result, a bilateral training contract is implicitly established, which the filling will be verified by a final assessment of learning and teaching. The evaluation of the achievement of the objectives assigned to a training system will allow constantly improving the implementation of the method, ensuring its mobility, and acquiring a certain internal circumstance, through the articulation of learners' tasks on the learning objectives.

The prior definition of pedagogical objectives also allows for clear communication with other education partners, parents, school administration, and possibly colleagues.

Since the objectives contain elements of analysis, needs and tasks, goal-oriented pedagogy allows passing on the aims of the education from the field of theory to the field of practical realization.

2.1.4. Critique of Goal-oriented Pedagogy

Goal-oriented pedagogy is about what students will be able to do after a learning session; the pedagogical objectives method provides a systematic and, to some extent, measurable response. But becoming an instrument of authoritarian prescription, it perverts the effects which were expected. Indeed, it undermines any room for manoeuvre in the actions of the teacher and prevents the student's fulfilment because the statement of objectives is often difficult to understand from a list of contents of knowledge [24].

It seems inconceivable that a teacher knowing what he wants to teach, and determined to check if he succeeds does not choose his method of teaching accordingly. However, from the moment when the aim is to achieve results defined beforehand, the pedagogical practice is no longer defined according to the contents of knowledge to be transmitted, but

in relation to objectives defined outside these contents. The contents are only worth as means to reach the objectives. Moreover, not only teachers should build their activity on clear goals, but they should also make them known to their students without ambiguity or mystery.

When the objectives are formulated at the outset, the action of the school will move away from the intentions of its organizers; unless the imprecision of the wording is an artifice permitting to pass for noble and humanitarian an authoritarian school policy, serving the interests of a minority, and realized systematically thanks to pedagogical frameworks alone in charge of defining the educational modalities, to impose and enforce them.

Paradoxically, the risk in the implementation of goal-oriented pedagogy is atomization when specifying the objectives, i.e. the distinction between aim, goals, general objectives and specific objectives, and their ranking; indeed, this specification leads to a concealment of ends. Finally, goal-oriented pedagogy produces an unfocused teaching on explicit objectives; students must then apply themselves to guessing what is important either by analysing the textbooks or the kinds of questions asked, or by gathering information from their elders.

Although goal-oriented pedagogy had the merit of putting the learner at the centre of school curriculum preoccupations, contrary to the old teaching methods, when curriculum contents were divided into multiple micro-objectives (primary objective, secondary objectives, operational objectives), the student learns pieces without understanding their meaning and without knowing how they relate to their everyday life. Indeed, goal-oriented pedagogy is based on a knowledge centre, considered as prerequisite to the activity and often discussed in a decontextualized way, stable knowledge in their disciplinary configuration, knowledge passed on in heritage without any logical progression any application framework and any questioning.

It is regularly criticized for teaching so-called "traditional" is to value too much knowledge in comparison to know-how. The entry by goal-oriented pedagogy consists in no longer asking oneself what is worth being transmitted, by looking only at what gives the assurance that something was transmitted, and considering only the pragmatic effects of education. So, these effects must be observed, because there can be education only beyond behaviour, whereas behaviourism is silent in repeating that only behaviours can be observed.

Finding its theoretical foundation in behaviourism, goal-oriented pedagogy considers education as an observable production of behaviour, rendering uninteresting what is not observable; learning methods, based on behaviourism, thus transform teaching into a society of enslavement. The teacher should therefore be able to observe in students the obvious and undeniable effects of his teaching, to say in advance what behaviour he intends to observe, and at what precise moment. However, the basic mechanism of this type of learning is the conditioned reflex, as studied by Pavlov (1927) [25]. To produce a behaviour is therefore to acquire a reflex, in other words to produce the stimulus which triggers the expected behavioural response.

2.2. The Skill-based Approach

Curriculum managers believe that the skill-based approach is one of the best known approaches to meeting society's social and educational demands and challenges, both economically and socially [20]. Indeed, the skill-based approach refers to a type of curriculum development which meets specific criteria according to a conception of the learning process; it calls for a complete reconstruction of training schemes and procedures. In this case, each curriculum is developed from a coherent body of skills, determined by the trainers and stakeholders, to meet the expectations of the work market and society. The idea of effective mobilization and combination makes each skill inseparable from the contexts in which it is implemented.

2.2.1. Characteristics of the Skill-based Approach

In the skill-based approach, education is based on results, performance and excellence, on what an individual should be able to achieve or accomplish, and benchmarks which allow to explain a standard of content with regard to a level of training [26].

From the analysis of the different formulations of definition, three elements constituting the concept of skill seem constant: a skill would be based on the mobilization and the coordination, by a person in situation, of a diversity of resources; a skill would only develop in a situation; a skill would only be acquired in the case of a completed treatment of the situation. In other words, we can only talk about skill in relation to a class of situations and in a context which gives it meaning [17].

A skill-based approach requires moving from the knowledge-to-learning model. The student should be able to develop skills from the activities which meet the requirements of the curriculum. In this case, the student is responsible for his learning and he is responsible for building his own knowledge; the aim is to emphasize the need to give the student the rightful place in the process of learning. So, he will have instruments which will be provided by the teacher, for which precise pedagogical actions should be implemented. Some are already validated, others will be

adopted to facilitate student learning.

The concept of skill denotes the desire to initiate at school the development of complex skills which will be essential for the individual's subsequent adaptation to a changing environment; it supposes the development of flexible intellectual tools which can adjust to transformations and thus favour the acquisition of new knowledge. The skill-based approach therefore considers that the student's knowledge is dynamically constructed, permanently recombined by himself through the activities the teacher proposes to him. As a result, knowledge is expressed through the production of practical results after the activities; the student must demonstrate a know-how which translates the passage from knowledge to competence.

The skill-based approach helps students develop a personal culture which will enable them to know how to act in all situations of life; they will be able to proceed in a methodical way by learning that to realize a task, to understand it and to select the essential one are necessary, then they must plan, regulate and check the execution. Students will develop the conviction that they can succeed, a necessary condition for motivation and involvement in the performance of the task, provided that they put the necessary effort into it and take it appropriately.

The evaluation on which it is coherent to rely on curricula based on the skill-based approach aims to remove the traditional distinction between formative and summative assessment [18]. The use of information and tools of a very qualitative nature, as the skill-based approach suggests, undermines the assessment of validity and fidelity criteria, and makes it necessary to rethink the very nature of the criteria [15, 16]. Especially since the concept of credibility tends to replace that of validity, and those of reliability or transferability tend to replace that of fidelity [18]. For example, the very controversial debates about the legitimacy of using the portfolio for summative assessment purposes illustrate that the magnitude of cultural changes involved in the evolution of a training program towards the skill-based approach should not be underestimated [27].

2.2.2. Implementation of the Skill-based Approach

Pedagogical constructivism, the theoretical basis of the skill-based approach, asserts that concepts are learned more easily and efficiently when students build them themselves [28] [29].

Putting in situation of research and the contextualization of learning are more effective than a transmissive approach, on the one hand because it is a source of motivation, and on the other hand because all the questions, trial, errors, and

hypothesis that it generates allow real progress in understanding. The aim is to bring the student to go through a process identical or similar to that which gave rise to the knowledge he is studying. In fact, any scientific theory appears historically as a response to an interrogation, as the product of an approach based on hypothesis and verifications, but also on errors and conflicts; knowledge is, historically, social and cultural constructions, marked by the ideas, the contradictions peculiar to the era which saw them born.

A skill results from an adequate understanding of integrated and accessible knowledge, know-how and skills which can be mobilized efficiently because they have been used regularly and successfully in a wide variety of contexts and disciplines, both in school and in everyday life [30]. From this analytical definition of a skill, prior pedagogical acts arise:

the teacher is primarily concerned with the quality of the understanding of the learning which has been done; questioning the student is the preferred method to understand what the student understands;

during the process of learning, the teacher helps students to discern the elements they must understand and memorize, both in terms of knowledge and know-how;

after a first apprenticeship, the teacher introduces students to learning contexts where they use their new knowledge, which enables them to mobilize them in situations inspired by reality;

during these activities, the teacher continues the questioning to ensure the correct understanding of the task to be performed by students, and gives to each of them the relevant feedback on the process and the result.

During the implementation of the skill-based approach, teachers should not only help students to develop skills, but mostly be able to show these students their talents and thus contribute to their knowledge of themselves. In this case, each situation of skills' development or skills' assessment must be "unpublished" for the student [31].

The teacher should start each class by proposing activities to the students. The teacher should first mention the title of the task, the theme, the macro-skill and the corresponding task family. Then, he should state the learning objects (knowledge and know-how), as well as the questioning to which the resolution of the task will answer. The situation proposed to the student must imperatively break down into four parts: the context, the expected production, the aids and constraints, and the instructions. From this perspective, the teacher no longer has to teach; he becomes the "coach", the animator and the accompanist of students who will advance at their own pace.

The student is led by the teacher to recognize the situations in which his knowledge and his steps are relevant. Parameters such as familiarity, evidence, quantity and quality facilitate or complicate this recognition. In fact, each new context requires new learning. A skill is acquired when the transfer is possible, when the student acquires the ability to mobilize the cognitive dimension in different contexts, different situations. Knowledge and know-how should be mobilized in many learning situations in which student is involved [31].

De Meerler (2006) [32] also explains that concepts of diversity and flexibility are at the centre of skill-based teaching. Students build their learning path by highlighting individual goals. New tools, such as personal development plans, portfolios, action plans and operational interviews, serve as tools to frame this evolution.

2.2.3. Contributions of the Skill-based Approach

The skill-based approach developed alongside other converging concepts such as contextualized teaching and learning, authentic assessment and professional expertise; it was able to provide interesting elements for developing curricula dedicated to the development of professional expertise, by encouraging upstream planning in a contextualized way and with an integrative vision of teaching and learning activities, and evaluation [19].

In order to develop an explicit model for learning a skill, this approach is also likely to facilitate teachers' feedback and their relevance; in the same way, this requirement is likely to facilitate the exploitation of the function of explicit role model as a modality of educational intervention, particularly in context of internships [34].

Skill-based professional training schemes are likely to stimulate and support students' motivation during their journey through the training system, notably by promoting their adequate perception of the value of the activities and the viability their internal resources [34]. With the skill-based approach, the school gives meaning to learning, the student is not considered as a container that the teacher has a mission to fill, but as a person who builds his knowledge, depending on what he is [36]. The knowledge that the student actually uses to perform a task is the most important.

The skill-based approach considers the teaching objectives no longer of the order of contents to be transferred but, as a capacity for action to be attained by the learner; knowledge, skills and behaviours are resources which the student must be able to mobilize for a specific task [36]. In this case, skill is showed as an original and effective response to a situation or a category of situations, requiring the mobilization and integration of a body of knowledge, know-how and know-

how; the competent student must be able to cope with new and unexpected situations [37].

2.2.4. Critique of the Skill-based Approach

Nowadays, the influence of the skill-based approach in the field of education and training cannot be denied, especially since curricula are written in terms of skills; these curricula emphasize the demonstration of knowledge rather than knowledge itself. This approach calls into question a number of critics who fear that knowledge will give way to skills, in other words, to see the acceleration of the advent of a society which focuses only or almost entirely on performance.

The skill-based approach is a conception of education fully dedicated to making school a docile instrument for economic profitability; indeed, there is a close relationship between the skill-based approach in the world of education and the search for skills in favour of economic competition in the world of business: the socio-economic world determined the notion because the school did not train individuals who were sufficiently qualified to enter professional life [36]-[38]. Behind the skill-based approach, there are essentially economic objectives related to the evolution of the labour market.

For Boutin & Julien (2000) [39], the public authorities use education in the service of an ideology of efficiency and effectiveness, to the detriment of culture and the development of people, and even of learning. They stigmatize a launch strategy that takes the form of a "marketing", and obscures the reductive aims, the paradoxical foundations and the hasty implementation of the skills-based approach.

The skill-based approach is an abandonment of knowledge. Indeed, it is most often criticized for the skill-based approach to relegate to the background and neglect the specific disciplinary content: knowledge and know-how. First, access to knowledge is no longer a teaching goal; knowledge is relegated to the rank of instruments for the development of skills; Perrenoud (1999) [40] even admits that teacher has to teach less knowledge if he really wants to develop skills. Second, the only knowledge which is relevant to the skill-based approach is those which can be mobilized in situations. In practice, the student no longer learns living languages and literature, he learns to communicate; in science, the student no longer tries to understand the natural world, he tries to acquire a little scientific culture; the student no longer studies history, he learns to read a historical document and summarize it or seduce the reader; in computer science, students are no longer being introduced to formal logic and procedural analysis, and now they are only taught to "fend for themselves" in the Microsoft environment.

The skill-based approach cannot claim to be pedagogical

constructivism, because it is the opposite of the founding ideas of progressive pedagogies such as the desire to put students to work on problem sites, in order to meaning to knowledge and learning, and the importance given to student activity as a driving force for building skills. Indeed, the skills-based approach considers knowledge as a tool to be mobilized in the accomplishment of a task, which contrasts with the consideration of knowledge as the goal of learning through constructivist approaches; from this perspective, Timant (2005) [41] explains that knowledge is not at the service of skills, rather skills are at the service of the appropriation of knowledge, using it and manipulating it.

For the constructivists, the type of activity is a way, but not the only one, to give meaning and to involve the student in the construction of knowledge. Constructivist pedagogy does not affirm that all knowledge could be reconstructed by or with the student; it absolutely does not exclude the direct transmission of knowledge and the "frontal" method when it is necessary. In the skill-based approach, there is no built or passed knowledge, but only developed skills that cannot be transmitted or taught; the teacher must seek to create problem situations which are both mobilizing and oriented towards specific learning [39].

In constructivist pedagogy, the student works alone, in groups or in interaction with the teacher, to discover the necessity of new concepts to be able to solve the problem, so that he formulates definitions or properties, to then discover a law, he may also be required to refute his hypotheses; so, a problem is a framework in which knowledge will be built. In the skill-based approach, problem solving is the ultimate objective and success criterion; knowledge only intervenes as a tool. Between the two approaches, the consideration of the error is totally opposed. In constructivist pedagogy, the most important thing is not that the student reaches the end of the task, but that he used his work, and possible mistakes, to progress in the discovery and mastery of knowledge. In the skill-based approach, progress in mastering knowledge is not an objective in itself; only the final result is important, and the error is sanctioned. In constructivist pedagogy, work can serve as a support for learning, but it remains the goal of the school work; giving up the mastery of complexity to obtain efficiency is contrary to a process of access to knowledge and access to the understanding of the world [42].

The skill-based approach often conveys the idea that there would be no single answer, but that every motion for resolution must be considered intrinsically, and the different solutions simply derive from different opinions, are ideas, thus despising the knowledge; knowledge should no longer be learning objectives. In most skill-based training programs, and for most targeted skills, there is no cognitive model of learning. This situation leads to a complete denaturing of the

conceptual orientations that underlie the meaning of the skill-based approach: formulation of skills in the form of a long list of behaviourist nature, evaluation of resources for themselves, sustainability of evaluative procedures essentially starting from quantitative data, irrelevance and scarcity of feedback activities from teachers, etc. [18].

In addition, the skill-based approach reinforces the social inequality of the education system [17]. Indeed, the curricula resulting from the reform by skills are characterized by their lack of precision in terms of cognitive content, because their relief is part of the central recommendations of the promoters of this approach. Perrenoud (1999) [40] denounces the lightening of notional curricula, and the restriction on the part of the knowledge taught to favour their mobilization in a complex situation, whereas paradoxically, to make students carry out complex tasks without mastering knowledge and know-how is impossible. Consequently, the teachers cannot do otherwise than to transmit the knowledge.

Another problem is the nature and level of knowledge to be mobilized, where curricula leave teachers free to decide this question. However, they may be influenced differently in this choice by the type of students that everyone will have to face, especially by anticipating the levels of difficulty they may encounter. Children who attended different schools may thus receive a wealth of knowledge, and therefore training on tasks, whose level of complexity and difficulty will be very different, depending on their learning environment. The degrees of integration, complexity and novelty introduced in the assessment of skills differ to the point that for some students, the problem resolutions boil down to the application of disguised or partial routines and for others, they engage the relevant combination of complex and original procedures by students [42].

In the Netherlands, Peter Teune (2004) [43] sees the skill-based approach as a way of countering a levelling-oriented culture; he regrets that teachers do not make many differences between students and do not value ambition; rather, they seek to set up an education in which each student will be appreciated, and judged on his abilities and means, requiring individualization of teaching.

3. Comparison of the Two Pedagogical Approaches

The skill-based approach is built on advances in goal-oriented pedagogy [44]. Like goal-oriented pedagogy, the skill-based approach is based on action lists completed by experts. In other words, learning means acting in the light of expected behaviours, so based on objectives set in advance; the students must know the usefulness of the skill to acquire

in a given field, and how they will be able to carry out its transfer in another field, according to the principle of transversality. Nguyen and Blais (2007) [19] point out that the common intention of these two approaches is to make teaching and learning effective, by providing a structuring framework for the appropriate planning of pedagogical interventions and assessment activities, in accordance with explicitly identified goals of the training.

3.1. Conceptual Difference

The skill-based approach is a way of designing and implementing teaching/learning which fills the gaps in a goal-oriented pedagogy. The skill-based approach develops the idea that the student learns better in the action, when he is put in meaningful production situation, involving integrative tasks which require the mobilization and integration of the acquired skills, and give a global vision of the capacities to be mobilized; the goal-oriented pedagogy is centered on the acquisition of knowledge and know-how which neglects the acquisition of intellectual processes [45].

The relationship between the elements of a skill and the specific disciplinary knowledge represents a major change brought about by the skill-based approach. While with curricula based on goal-oriented pedagogy, learning activities are usually organized according to the disciplinary content, in the skill-based approach, learning activities and integrative tasks are planned according to skills. Thus, skill becomes a tool for appropriating the disciplinary content in order to carry out tasks; moreover, know-how will be learned in an integrated way in a skill. The aim is therefore to learn not only disciplinary content, but also know-how to effectively use this declarative knowledge related to the content.

In the goal-oriented pedagogy strategies, learning is fragmented during the implementation. By giving to these strategies a tangible goal, while maintaining the objectives of mastery of fundamental knowledge, the skill-based approach gives meaning to the knowledge taught at school, increasing their reach beyond the horizon of the only success in school tests, and placing at the forefront of school missions the formation of autonomous thought. The aims are to focus on learning processes, the way students learn and use their knowledge, and to reflect on the cognitive functioning of individuals.

3.2. Progress of a Session

In the goal-oriented pedagogy, the teacher introduces the activity by ensuring that the instruction is understood; he begins the session with a preparatory phase by recalling what was already seen, and starts the activity. Each student knows exactly what he has to do, he solves the activity individually, referring to the necessary tools of help that the learning situations suggest to use; the teacher calls out when he notices errors, corrects some statements, and responds to students' requests. At the end of the activity, the individual productions are read, commented and corrected by the teacher, then returned to the students for preservation in the notebook. If the whole class passes the exercise, the teacher sets other goals for the next session; if a large number of students fail the exercise, the teacher plans a review session.

In a skill-based approach, students first respond individually to questions previously asked by the teacher. Then, they think together and propose activities, on which they will discuss the originality, the feasibility, the possible difficulties, the necessary resources, etc. They choose among the propositions, depending on which please them, which are accessible, and justify their choice; it is the stage of the pooling during which they also define the knowledge to be mobilized. Finally, they set up working groups to carry out the selected activities, with the collaboration of the teacher. During the realization phase, the teacher supervises the smooth running and the progress of the works, and provides tools of help and guidance; in case of conflict in a group, he intervenes to carry out an internal mediation; he manages working time, and immediately remediates the shortcomings he observes, which will be targeted and adapted according to the level of difficulty encountered by the students. At the end of the activity, the works are presented by their authors, then commented and corrected by the other groups; the authors then make a final draft after the session, which will be returned after a period set by the teacher, to be presented in class, posted or published in the school newspaper, for example.

In order to learn a procedure or knowledge according to the skill-based approach, the student must be aware of the use which can be made of this procedure or knowledge. So, the teacher has to confront the students with a task which they can only perform with the knowledge or the procedure which they want to acquire; then, the teacher will bring the complementary knowledge. In this case, the students, thinking about the problem by themselves, will assimilate this knowledge better than if the teacher had brought it from the beginning.

3.3. Findings

Goal-oriented learning allows obtaining a product which responds to a precise set of instructions and mobilizes predetermined knowledge and know-how. Therefore, during an activity, all students do the same thing in the same conditions, according to a single instruction set by the teacher. The situation is exclusively academic, aiming only a very sharp disciplinary knowledge, not guaranteeing the control of a real communication skill; the knowledge taught is disconnected from reality, and is only a simplified presentation of scholarly knowledge. In addition, certain

essential transversal skills cannot be developed in individual activities and learning situations.

Skill-based learning helps develop disciplinary skills, as knowledge and skills are mobilized and integrated to solve a contextualized problem. This learning strategy also contributes to the development of transversal skills such as group work, methodology and critical thinking; the aim is to encourage an approach which introduces learning contents based on real-life questions, which gives meaning to learning, which makes teaching more attractive. Students are fully involved and motivated to do the work; at the end of each session, they provide original productions. Indeed, the skill-based approach promotes the mobilization of cognitive resources in problem solving situations; however, this requirement to subject students to unprecedented and complex situations is criticized by Crahay [31].

A fundamental difference between the two approaches is also found in the student assessment method. In fact, assessment by skills requires a high level of general knowledge and language proficiency, because of the mobilization of transversal skills, in problem solving often extended beyond disciplinary issues, while the evaluation by objectives only aims at restoring knowledge [42].

The studies we conducted as part of the implementation of the two approaches in chemistry teaching [4] [5] support the above claims. Goal-oriented pedagogy seeks the assimilation of disciplinary concepts in order to allow the student to engage in the exercises. The conditioning of the student to achieve the specific objectives of the program allows the student to know what exactly is expected from him, what he should learn, and the exercises he should be able to solve. In this method, the teacher does not encourage the student to take initiatives. In addition, goal-oriented pedagogy does not care about the contextualization of learning concepts.

The skill-based learning of chemistry enables students to design and conduct a scientific approach to solve a problem, and to formulate scientific explanations. With this approach, students demonstrate initiative, critical thinking, curiosity and creativity; they feel empowered, and more involved in the work they are asked to do and in their learning. However, mastery of the content prescribed in the curriculum is not required, because the mobilization of skills does not require the acquisition of disciplinary concepts.

4. Conclusion

The goal-oriented pedagogy and the skill-based approach were historically two pedagogical approaches aimed at clarifying the purposes of training programs and at structuring educational planning activities. Because of their

links with other theories on education, contemporaneous with the periods in which they developed respectively and which concerned the conceptions of learning, teaching and evaluation, they have relatively contrasting educational implications, even if we must recognize that they developed both in continuity and in rupture with each other.

Indeed, the conceptual and operational developments of the skill-based approach have emerged mainly to overcome the limits attributed to the goal-oriented pedagogy; the skill-based approach is therefore a continuous work of adaptation of the goal-oriented pedagogy, which does not require a radical break with it. The aim is to reformulate the objectives by now explicitly referring to skills [19].

On the one hand, goal-oriented pedagogy allows the student to acquire disciplinary knowledge, but does not provide for their investment in terms of know-how and capacity for action. On the other hand, the capacity for action sought by the skill-based approach presupposes knowledge and certain behaviours, as advocated by goal-oriented pedagogy.

The conceptual differences which exist between goal-oriented pedagogy and the skill-based approach allow establishing a complementarity between these two pedagogical trends. Indeed, the mastery of knowledge and the adoption of behaviours cannot be dissociated from the intellectual processes which will allow the learner to act while having a global and integrated vision of the situations he will face. The appropriation of disciplinary contents requires that the student can mobilize them through scenarios proposed by the teacher, serving as a springboard to develop the skills related to it.

However, we must recognize that similarities have been established between, on the one hand, the goal-oriented pedagogy, the behaviourist conception of learning, the docimological perspective of evaluation, and the pedagogical logic centred on teaching, and on the other hand, the skill-based approach, the socio-constructivist conception of learning, the perspective of authentic evaluation and the pedagogical logic centred on learning.

The identification of the benefits and shortcomings of the application of goal-oriented pedagogy and skill-based approach in the teaching of chemistry in the 5th grade allowed us to reinforce the idea of complementarity between both approaches. Indeed, it appears in our studies that 1° the mobilization of skills requires prior knowledge acquisition [4], 2° and the appropriation of knowledge cannot be effective without a capacity of the student to use and adapt it, depending on the situation he will face [5]; in other words, the construction of knowledge by the student must go hand in hand with the development of both disciplinary and cross-curricular skills.

The combination of the two approaches should allow to adapt teaching according to the needs of the learner and to make him benefit from the teacher's contribution to knowledge and know-how while giving him the opportunity to assert his autonomy during the learning process. A new pedagogical model is needed, in which the teacher should be able to empower students to become more active, and to improve the effectiveness of learning. In addition, the use of information and communication technologies for education could serve as a support for pedagogical development and innovation to improve the quality of learning.

References

[1] Flamerion, L. (2004). Les différentes méthodes d'enseignement en science physique au lycée. Mémoire IUFM de Bourgogne.

[2] Tabailloux, A., & Gilbert, B. (2008). Comment enseigne-t-on les sciences aux Etats-Unis? Comparaison entre les méthodes d'enseignement aux Etats-Unis et en France. (Mémoire professionnel). Académie de Montpellier (France).

[3] Rakotoarimanana, L. M. (2016). Les enseignants de sciences physiques face à l'hétérogénéité des élèves de classe de seconde: Etude menée dans deux lycées privés et public d'Antsirabe. Mémoire de CAPEN n°410/PC. Université d'Antananarivo.

[4] Ratsimbatoha, Z. A. (2017). Implementation of the Skill-Based Approach in the Teaching of Chemistry in the 5th Grade of the French Education System.Open Access Library Journal, 4: e3984. https://doi.org/10.4236/oalib.1103984.

[5] Ratsimbatoha, Z. A. (2017). Implementation of the Goal-Oriented Pedagogy in the Teaching of Chemistry in the 5th Grade of the Malagasy Education System.Open Access Library Journal, 4: e3984. https://doi.org/10.4236/oalib.1103985.

[6] Bloom, B. S., Hastings, J. T., & Madaus, G. F. (1971). Handbook on formative and summative evaluation of student learning. New-York (U.S.A.): Mc Graw-Hill.

[7] Gagné, R. M., & Briggs, L. J. (1974). Principles of instructional design. New-York (U.S.A.): Holt, Rinelhart & Winston.

[8] Mager, R. F. (1975). Preparing objectives for instruction. Belmont (U.S.A.): Fearon.

[9] De Landsherre, G., & de Landsherre, V. (1976). Définir les objectifs de l'éducation. Paris (France): P.U.F.

[10] Hameline, D. (1979). Les objectifs pédagogiques en formation initiale et continue. Paris (France): Editions Sans Frontière.

[11] D'Hainaut, L. (1988). Des fins aux objectifs de l'éducation. Un cadre conceptuel et une méthode générale pour établir les résultats attendus d'une formation. Bruxelles (Belgique): Labor.

[12] Meirieu, P., (1991). Apprendre… oui mais comment?. Paris (France): Editions Sans Frontière.

[13] Jonnaert, P., Lauwaers, A. et Pesenti, M. (1990). Capacités, compétences, situations et fonctionnement cognitif. Cadre conceptuel de la recherche: «Radioscopie de l'étudiant arrivé au terme du cycle supérieur des études secondaires générales dans l'enseignement francophone». Louvain-la-Neuve (Belgique): Université catholique de Louvain.

[14] Romainville, M., & al. (1998). Réformes: à ceux qui s'interrogent sur les compétences et leur évaluation. Forum pédagogie, 21-27.

[15] Wiggins, G. (1998). Educative assessment. Designing assessments to inform and improve student performance. San Francisco (U.S.A.): Jossey-Bass.

[16] Kane, M. (1999).Validating measures of performance. Educational measurement; issues & practice, vol. 18, 5-17.

[17] Boufrahi, S., & al. (2004). Contribution critique au développement des programmes d'études: compétences, constructivisme et interdisciplinarité. Revue des sciences de l'éducation, vol. 30, n°3, 667–696.

[18] Tardif, J., (2006). «L'évaluation des compétences: de la nécessité de documenter un parcours de formation ». Montréal (Québec): Chenelière Education.

[19] Nguyen, D.-Q., & Blais, J.-G. (2007). Approche par objectifs ou approche par compétences? Repères conceptuels et implications pour les activités d'enseignement, d'apprentissage et d'évaluation au cours de la formation clinique. Pédagogie médicale, 8 (4), 232-251.

[20] Mansour, A. (2012). Approche par compétences. Repères-IREM, n°88.

[21] Bloom, B. S. (1971). Mastery learning.In J. H. Block (Ed.).Mastery learning: Theory and practice. New York (U.S.A.): Holt, Rinehart & Winston.

[22] Bloom, B. S. & al. (1956). Taxonomy of educational objectives: the classification of educational goals. New-York (U.S.A.): McKay.

[23] De Landsherre, G. (1984). Empirical research in education. Paris (France): B.I.E.-U.N.E.S.C.O.

[24] Hameline, D. (2000). Courants et contre-courants dans la pédagogie contemporaine. Paris (France): Editions Sans Frontière.

[25] Pavlov (1927). Conditionned reflexes.London (U.K): Routledge and Kegan Paul.

[26] U.S. Department of Education (1983). A Nation at Risk: The Imperative for Educational Reform: A Report to the Nation and the Secretary of Education. Washington (U.S.A.): National Commission on Excellence in Education.

[27] Roberts, C., Newble, D. I., & O'Rourke, A. (2002). Portfolio-based assessment in medical education: are they valid and reliable for summative purposes? Med Educ, n°36, 899-900.

[28] Piaget, J. (1937). La construction du réel chez l'enfant. Paris (France): Delachaux et Niestlé.

[29] Vygotsky, L. S. (1978). Mind in society. Cambridge (U.S.A.): Harvard University Press.

[30] Bissonnette, S., & Richard, M., (2001). Comment construire des compétences en classe. Des outils pour la réforme. Montréal (Canada): Chenelière / MC Graw-Hill.

[31] Crahay, M. (2006). Dangers, incertitudes et incomplétude de la logique de la compétence en éducation. Revue française de pédagogie, n°154, 97-110.

[32] De Meerler, C. (2006). Competenties in balans. Zoekennaarafstemmingtussencompetentieontwikkeling in school enbedrijf. Bruxelles (Belgique): Koning Boudewijnstichting.

[33] Chamberland, M, & Hivon, R. (2005). Les compétences de l'enseignant clinicien et le modèle de rôle en formation clinique. Pédagogie médicale, vol. 6, n°2, 98-111.

[34] Tardif, J. (1992). Pour un enseignement stratégique. L'apport de la psychologie cognitive. Montréal (Québec): Les Editions Logiques.

[35] Denyer, M. & al. (2004). Les compétences: où en est-on? L'application du décret «Missions» en Communauté française de Belgique. Bruxelles (Belgique): De Boeck Education.

[36] Hirtt, N. (2009). L'approche par compétences: une mystification pédagogique. L'école démocratique, n°39.

[37] Bosman, C., Gérard, F., & Roegiers, X. (2000).Quel avenir pour les compétences? Bruxelles (Belgique): De Boeck Université.

[38] Jadoulle, J., & Bouhon, M. (2001). Développer des compétences en classe d'histoire. (coll. Apprendre l'histoire ?, tome III). Louvain-la-Neuve (Belgique): Université Catholique de Louvain.

[39] Boutin, G. & Julien, L. (2000). L'obsession des compétences. Son impact sur l'école et la formation des enseignants. Montréal (Québec): Editions Nouvelles.

[40] Perrenoud, P., (1999). Construire des compétences dès l'école. Paris (France): Editions Sans Frontières.

[41] Timant, F. (2005). Les compétences: concepts et enjeux. Cahier des Sciences de l'Education, n°21 et 22.

[42] Letor, C., &Vandenberghe, V., (2003). L'accès aux compétences est-il plus (in)équitable que l'accès aux savoirs traditionnels ? Cahier de recherche du GIRSEF, n°25.

[43] Teune, P.J. (2004). Op wegnaarcompetentiegerichtopleiden. Apeldoorn (Pays-Bas): Garant.

[44] Lasnier, F., (2000). Réussir la formation par compétences. Montréal (Québec): Guérin.

[45] De Ketele, J-M., & Gérard, F-M., (2005).La validation des épreuves d'évaluation selon l'approche par les compétences. Mesure et évaluation en éducation, vol. 28, n°3, UCL – BIEF.