



A Comparative Analysis of the Organization and Presentation of Middle School Science Curricula: Physical Sciences and Technology in Algeria and Science in the United States as a Model

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Abstract:

The study aims to analyze and compare how the chemistry content is organized and presented in the physical sciences and technology curriculum for the middle school level in Algeria and the science curricula for the equivalent educational level in the United States of America. We followed the descriptive method in this study, adopting analytical and comparative approaches in the way the contents of the chemistry subject are presented and organized in both curricula. We used a standard grid that includes several criteria specific to the organization and application of the content in the curriculum.

The study concluded that there is a difference in the organization and presentation of the chemistry education content in the physical sciences and technology curriculum at the middle school level in Algeria compared to the science curriculum in the United States of America. This is due to each country's educational perspective and policy in general, and science education policy in particular, and the differences in the educational philosophies guiding each educational system.

In light of the findings of this study, the physical sciences and technology curriculum at the middle school level in Algeria can be developed to adopt modern teaching practices, reinforce practical and experimental aspects in education, and adopt a comprehensive approach that integrates knowledge, skills, and scientific values.

Keywords: Curriculum, science, chemistry, teaching, middle school education, analysis, comparison.

Analyse comparative de l'organisation et de la présentation des programmes d'enseignement des sciences au collège : Les sciences physiques et la technologie en Algérie et les sciences aux États-Unis comme modèle

Résumé :

L'étude vise à analyser et à comparer la manière dont le contenu de la chimie est organisé et présenté dans le programme des sciences physiques et de la technologie pour le niveau intermédiaire en Algérie et dans les programmes de sciences pour le niveau éducatif équivalent aux États-Unis d'Amérique.

Nous avons suivi la méthode descriptive dans cette étude, en adoptant des approches analytiques et comparatives dans la manière dont les contenus de la matière chimie sont présentés et organisés dans les deux programmes. Nous avons utilisé une grille standard qui comprend plusieurs critères spécifiques à l'organisation et à l'application du contenu dans le programme d'études.

L'étude a conclu qu'il existe une différence dans l'organisation et la présentation du contenu de l'enseignement de la chimie dans le programme des sciences physiques et de la technologie au niveau de l'école moyenne en Algérie par rapport au programme des sciences aux États-Unis d'Amérique. Cela est dû à la perspective et à la politique éducative de chaque pays en général, et à la



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politique d'enseignement des sciences en particulier, ainsi qu'aux différences dans les philosophies éducatives qui guident chaque système éducatif.

À la lumière des résultats de cette étude, le programme d'enseignement des sciences physiques et de la technologie au niveau du collège en Algérie peut être développé pour adopter des pratiques d'enseignement modernes, renforcer les aspects pratiques et expérimentaux dans l'éducation et adopter une approche globale qui intègre les connaissances, les compétences et les valeurs scientifiques.

Mots-clés : *Programme d'études, science, chimie, enseignement, enseignement secondaire, analyse, comparaison.*

Introduction

Most countries in the world seek to modernize their educational systems and build standards specific to them, in order to keep pace with the developments in science, technology, and development. Curricula are considered among the main components of the educational system, and thus curricula and their components must receive great attention from those in charge of this modernization.

Our study focuses on science curricula due to their effective role in the scientific education of the citizen. According to Donnelly (2004), science education should not be limited to the acquisition of scientific facts only, but should aim to humanize science by linking it to the learners' experiences and cultural contexts. This approach enhances deeper interaction, critical thinking, and a sense of the importance of scientific knowledge, which can motivate students to pursue lifelong learning.

To improve the physical sciences and technology curriculum in Algeria and align it with global developments, this critical analytical comparative study was conducted between it and the science curriculum of the United States of America, as it is one of the leading countries in science teaching due to its use of unified standards in science education. Our focus was on the chemistry content in both curricula as it is part of science and technology education and is taught using the experimental research approach, which allows students to acquire skills specific to this approach, connects them to their daily lives, helps them solve daily problems, provides them with knowledge and skills that help them understand and interpret surrounding phenomena, and gives them manual skills and positive



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attitudes toward science and scientists. The study was limited to the middle school level of pre-university education in Algeria due to the sensitivity of this stage, which is the first phase where chemistry is taught.

The study seeks to provide a precise comparative analysis that highlights strengths and weaknesses and clarifies the impact of structural differences on student learning, and to propose applicable improvements in developing the physical sciences and technology curriculum in Algeria based on successful international practices.

Several studies published in the *Journal of Curriculum Studies* have addressed the topic of analyzing and developing science curricula. For example, Bartholomew et al. (2004) analyzed how curriculum content contributes to shaping learners' scientific identity. Medway (1997) also conducted a precise comparison between science curricula in England and Wales, highlighting the importance of clarity in educational objectives. Fensham (1992) discussed the tensions arising from implementing national curricula in diverse local contexts, pointing to the need to adapt to cultural and social needs.

This study presents an introduction highlighting the importance of science education at the middle school level and the reasons for choosing the subject of comparison between the Algerian and American curricula. It explains the study methodology and the adopted comparison criteria. Then, it provides a descriptive comparative presentation of the features of the two curricula in light of the specified criteria, with a critical analysis of the results. Finally, it presents the conclusions and recommendations drawn, highlighting the scientific contribution of the study to the

development of the physical sciences and technology curriculum in Algeria.

1. Methodology of the Study:

We used the descriptive method in this study, adopting analytical and comparative approaches in the way the chemistry content is presented and organized in the physical sciences and technology curricula for the middle school level after the reform (First Generation and Second Generation), and the science curriculum for the equivalent level in the United States of America.

1.1. Study Sample:

It consists of the following documents:

Algeria:

- The physical sciences and technology curriculum for the middle school level issued starting from 2003 (First Generation Curriculum)
- The curriculum issued starting from 2015 (Second Generation Curriculum)
- Teacher's guide
- Accompanying document
- Textbook adaptation documents
- The Orientation Law for Education (2008)
- The General Reference for Curricula (2009)
- The Methodological Guide for Curriculum Design (2009)

United States of America:

- Reports related to unified science teaching standards across the states



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- The science curricula of a public school named *Madison Public School* located in the state of New Jersey, accessed through its website (www.madisonpublicschools.org)
Through the school's website, we used the following documents:
- (*Curriculum Resources*): includes appendices about standards and curricula
- (*Curriculum Document*): includes the curriculum of each subject for each grade level
- (*Information Assessment*): includes documents related to assessment
- (*Teaching Learning Framework*): documents related to teaching and learning

1.2. Study Tool:

The study tool consists of a standardized grid on how to organize and apply content, used for analysis and comparison. It includes criteria specific to the organization and implementation of curriculum content, and consists of the following criteria:

- Definition of the middle school level in Algeria and its equivalent in the United States
- Start and duration of chemistry instruction
- Chemistry content curriculum
- Method of content presentation
- Total instructional hours and their distribution
- Teaching methods and strategies, tools, and activities
- Appendices (documents attached to the curricula)

The grid was applied to the physical sciences and technology curricula for the middle school level in Algeria

issued starting in 2003 (First Generation Curricula) and the same curricula issued in 2015 (Second Generation Curricula), and to the science curriculum for the middle school level in the United States of America.

Application of the Grid Criteria to Chemistry Content in the Physical Sciences and Technology Curriculum in Algeria and the Science Curriculum in the United States of America:

After analyzing the two curricula, we recorded the following based on the criteria of this grid:

2. The Middle School Stage in Algeria and Its Equivalent in the United States of America:

In Algeria, it is the middle stage of the pre-university education system, which consists of three stages: primary, middle, and secondary. The middle school stage in Algeria currently lasts four years and is organized according to the following three phases:

- First: the *homogenization and adaptation phase*, which aims to reinforce the achievements of primary education, and includes the first year of middle school
- Second: the *support and deepening phase*, which aims to raise the student's cultural, scientific, and technological levels, and includes the second and third years of middle school
- Third: the *fourth year of middle school*, which is the *deepening and orientation phase*, and its role is to prepare the student for either secondary education or vocational and apprenticeship training (*General Reference for Curricula, 2009, p. 36*)



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In the United States of America, pre-university education is called “school.” Public schools are divided into elementary and secondary education, with differences in how grades are structured from one state to another. The following common models prevail in most states:

- (K-5): elementary school, (6-8): middle school, (9-12): high school
- (K-6): elementary school, (7-9): junior high school, (10-12): senior high school
- (K-8): elementary school, (9-12): high school
- (K-6): elementary school, (7-12): combined junior and senior high school

The middle school stage (6-8) corresponds to the middle school level in Algeria. This stage lasts three years and includes the following levels: Grade 6, Grade 7, and Grade 8.

3. Start and Duration of Chemistry Instruction:

Chemistry is taught in Algeria for four years, i.e., throughout the entire middle school stage. Each school year, one field is dedicated to chemistry out of three or four fields within the subject of physical sciences and technology, which is equivalent to 14 lessons per year.

In the United States of America, chemistry concepts are taught over one academic year during middle school in one unit out of three units, consisting of 52 lessons. This may be in the sixth, seventh, or eighth grade depending on the curriculum of each state or each school.

As for the starting age for studying chemistry, it is 11 years in Algeria. In the United States, the age at which chemistry is introduced at this stage varies depending on the year in which chemistry is taught. For example, if the

chemistry unit is studied in the sixth grade, the starting age is (11–12) years, and so on. The ending age for this stage is estimated to be between 15 and 16 years in both countries.

4. Chemistry Curriculum Content:

In Algeria, chemistry is taught as part of the Physical Sciences and Technology curriculum, and the chemistry content is referred to as the "field of matter and its transformations." Firstly, it is noticeable that the term "chemistry" is absent from the title of the Algerian curriculum, and the term used ("matter and its transformations") is an incomplete expression of one of the definitions of chemistry, which is: "the science of the structure of matter and chemical reactions." Secondly, knowledge and concepts from technology are also absent as content domains, even though the curriculum title refers to three subjects: physics, chemistry, and technology.

In the United States, chemistry is taught within the science curriculum, which consists of eight categories of standards: –Unifying concepts and processes in science, – Science as inquiry, –Physical science, –Life science, – Earth and space science, –Science and technology, – Science in personal and social perspectives, –History and nature of science. The physical science standard includes physics, chemistry, and energy.

In addition to the educational programs, students may receive other optional programs before or after school (school-age child care), which are not free and are conducted within the school.



5. Presentation of Content:

In Algeria, content is presented in curricula in a table divided horizontally and vertically. In the first-generation curricula, the horizontal section was called the "domain," divided into units, and presented in a table consisting of three columns titled, from right to left: –Content and concepts, –Examples of activities, –Competencies. The third column, allocated to competencies, included the following elements: –Facts, –Concepts, –Principles and generalizations, –Rules and laws, –Theories, –Attitudes and values, –Skills, –Direct and indirect experiences. These are, as can be seen, not competencies but rather "acquired elements" (des acquis) or competency resources (des ressources de compétences).

In the second-generation curricula, it is called a "field," divided into segments, and each segment is further divided into units presented as partial learning situations. Thus, the content components are presented in a table with seven columns along with other curriculum elements titled, from left to right: –Field, –Final competency, –Competency components, –Knowledge resources, –Types of learning situations, –Competency criteria and indicators, –Time allocated for the field.

There has been a change in how content elements are presented and in their nature between the first and second generation of physical sciences and technology curricula, indicating a correction of the shortcomings identified at the beginning of the reform, which led to the revision and development seen in the second-generation curriculum.

In the United States, content is also presented in a horizontally and vertically divided table. For example,

Madison Public School divides science content into units, each unit into lessons, and the content components are presented in a table with five columns: –Objectives, –Key content and skills, –Suggested assessments, –Standards, – Number of lessons for implementation. The table also includes an overview of the lesson before presenting the content.

6. Total Time Allocation and Distribution:

In Algeria, chemistry is taught during some weeks of the academic years within another subject – Physical Sciences and Technology – with a total estimated time allocation of 56 hours distributed across four years of middle school.

In the United States, chemistry is taught within the science curriculum, consisting of 52 lessons, with each session lasting between 40 and 50 minutes, totaling approximately 44 hours in one year of middle school.

7. Teaching Methods, Strategies, Tools, and Activities:

In Algeria, there was a significant change in this aspect between the first- and second-generation curricula. In the first-generation curricula, multiple teaching methods were listed, including: the experimental method, the historical emergence method, the project-based method, the modeling method, and the problem-solving method.

In the methodological guide for preparing second-generation curricula (2009), some paragraphs infer teaching and learning strategies expressed as types of approaches: problem-solving approach, project approach, and scientific approach. According to our assessment, the curriculum designers allocated two parts of the accompanying document for this component of the second-generation



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curricula (issued in 2016): the section on subject presentation and the annual learning plan section. Teaching strategies were expressed through what was called “learning situations.” These consist of basic learning situations or initial ones, integration situations, and problem situations.

Learning situations enable mastery of knowledge and represent stages in learning planning and tools. According to the accompanying document (2016, p. 8), the learning plan starts from a relatively complex initial situation requiring analysis between students and the teacher to determine the required tasks and identify the necessary knowledge resources and their sources, with resolution postponed to the end of the plan. Basic learning situations are designed to acquire competency resources as presented in the curriculum and consist of a series of (learning) activities aimed at building new concepts, laws, rules, or scientific attitudes and values to serve as resources for constructing the targeted competency.

Afterward, learning integration is required, and a learning integration situation is proposed to facilitate resource integration. The next step is solving the initial situation. The final stage of this plan is evaluating the competency through a proposed formative evaluation situation (which may coincide with the formal periodic assessment period). The plan concludes with a pedagogical remediation plan directed at correcting students' difficulties and the teacher's plan.

Analysis of this curriculum component shows that curriculum developers did not allocate a detailed section specifically naming the adopted strategy or theory to implement the content knowledge and concepts. Parts of this

section are scattered across documents. For example, the methodological guide for preparing curricula in Algeria includes paragraphs from which teaching strategy activities can be inferred, as they are labeled with terms uncommon in educational literature and use various expressions to describe operations or implementation steps such as: – method, – approach, – guidelines, – pedagogy, – curriculum implementation guidelines, – how to acquire resources, – method of teaching and learning curriculum content, – plan, – strategy.

In the United States, science curricula tend to align with national science teaching standards, which include six main domains (1996, National Science Education Standards):

1. **Standards for science teaching:** describe what science teachers at all grade levels should know and be able to do.
2. **Standards for professional development:** offer a vision for enhancing teachers' professional knowledge and skills.
3. **Standards for assessment:** define criteria for evaluating the quality of assessment practices in science education.
4. **Standards for science content:** outline what students should know, understand, and be able to do in science across all grades (K–12).
5. **Standards for science education programs:** define conditions needed for quality school science programs.
6. **Standards for science education systems:** provide criteria for evaluating the overall performance of science education systems.



These science standards are considered the most comprehensive and essential. According to El-Mohssine (2002), science teachers create inquiry-based programs for their students, guide and lead instruction, incorporate continuous assessment in their teaching, design and prepare learning environments that give learners the time, space, and resources needed for science learning, and build scientific communities that reflect the intellectual power, inquiry mindset, and social values of science. They actively participate in the developmental and improvement plans for the school's science programs. These curricula are characterized by their reliance on scientific inquiry.

8. Appendices (Curriculum Accompanying Documents):

According to Algeria's general curriculum reference document, the accompanying materials are divided into three categories:

- **Student-targeted documents:** textbooks, printed and audiovisual materials.
- **Teacher-targeted documents:** guides, accompanying documents, and textbook adaptation guides.
- **Documents for other stakeholders:** relevant supporting materials.

Each first-generation curriculum, issued starting in 2003 for each middle school year, was accompanied by a textbook and an accompanying document. The accompanying document consists of: – Introduction, – General guidelines, – Specific pedagogical guidelines, – Appendix.

The second-generation curricula issued in 2016 were accompanied by several important documents designed according to the competency-based approach, including two

documents for all four years issued in 2016: the accompanying document and the accompanying document's introduction for middle school. Between 2016 and 2019, each of the four grades received a teacher's guide titled: "Teacher's Guide" or "Guide to Using the Physical Sciences and Technology Textbook." The accompanying document consists of the following elements: –Introduction, –Subject-related difficulties, –Learning plan, –Suggested learning situations, –Assessment, –Other subject components.

The introduction to the accompanying document for middle school consists of: –The role of the accompanying document, –How curricula are developed, –Commentary on graduation profiles, –Commentary on the conceptual matrix, –Commentary on the participation table, –Commentary on the annual program table, –Teaching, –Assessment, –General recommendations.

In the United States, each district or school has its own curriculum, books, and appendices. For example, Madison Public School has a website (www.madisonpublicschools.org) offering a collection of documents, including:

- **Curriculum resources:** containing appendices related to standards and curricula.
- **Curriculum documents:** containing the curriculum for each subject at every grade level.
- **Assessment information:** containing documents related to evaluation.
- **Teaching learning framework:** documents related to teaching and learning.



Discussion and Analysis of Results:

The comparison reveals several differences between the two curricula:

1. **Unified Educational System in Algeria:** The educational system is standardized across the entire Algerian territory, whereas in the United States, each state has the freedom to choose the educational system suitable for it.
2. **Instruction Time for Chemistry Concepts:** The instructional time allocated to chemistry concepts in both countries is similar. The difference lies in how it is distributed: Algeria spreads the instructional time over all years of the stage with specific teaching periods, while the United States allocates one academic year at the middle school level for instruction, with timing and year depending on each state's specific context.
3. **Age of Beginning Chemistry Instruction:** In Algeria, the age to begin chemistry instruction is standardized nationwide, unlike in the United States, where it varies depending on each state's context, considering students' individual differences.
4. **Curricular Integration:** In Algeria, chemistry is taught as part of the physical sciences and technology curriculum. In the United States, it is integrated within the science curriculum.

The Algerian education system is centralized nationwide, governed by the same laws, with limited flexibility and controlled by centralized directives. The U.S. educational system is decentralized, flexible, and adjustable based on the particularities of each state, allowing schools greater

freedom to adapt curricula locally and provide additional resources.

This difference stems from each country's educational philosophy. Flexibility in curricula became essential, especially during the COVID-19 pandemic, which forced countries to change and adapt their curricula based on health conditions.

5. **Curriculum Structure and Evaluation Focus:** The Algerian curriculum for physical sciences and technology focuses on competencies and their components, the knowledge mobilized for those competencies, and evaluation indicators and criteria. In contrast, the U.S. science curriculum focuses on objectives, content, skills, and evaluation standards.
6. **Pedagogical Approaches:** The Algerian curriculum adopts the competency-based approach, where materials are acquired and integrated to achieve competencies, which are then evaluated. The U.S. science curriculum adopts constructivist learning based on inquiry, aiming to acquire skills through content mastery followed by evaluation.
7. **Supporting Materials:** The U.S. curriculum provides more diverse support materials such as digital websites, interactive activities, and resources, while the Algerian curriculum is mostly limited to printed documents.

These differences reflect the impact of each country's adopted educational philosophy, which influences how curriculum content is presented, teaching methods, instructional resources, and supporting materials.

Despite Algeria's official adoption of the competency-based approach, its practical implementation faces several



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obstacles, such as large student groups and the lack of equipped laboratories. This explains the limited flexibility and diversity in teaching methods and educational resources.

The U.S.'s adoption of constructivist, inquiry-based learning explains its strong emphasis on projects, experiments, practical activities, and linking content to real-life contexts. This philosophy aims to make the learner the center of the educational process, equipping them with critical thinking and problem-solving skills.

Conclusion:

The organization and presentation of chemistry education content in the physical sciences and technology curriculum at the middle school level in Algeria differs from the science curriculum in the United States. This is due to each country's general educational outlook and policy, especially regarding science education, as well as differing educational philosophies.

Algeria uses a **centralized teaching system**, where the Ministry of National Education sets teaching goals, prepares curricula, related supplements, and standardized textbooks applied across the entire country.

Chemistry concepts are not taught in independent curricula but are integrated into the physical sciences and technology curriculum. These concepts are allocated to one domain called *Matter and Its Transformations*, included in every year of the middle school stage (four years) and

extending into secondary education. Throughout both stages, the term "chemistry" is not explicitly mentioned.

In terms of strategies and methods, chemistry teaching in the first-generation curricula included several approaches: experimental, historical emergence, project-based, modeling, and problem-solving. Second-generation curricula adopted strategies based on learning situations.

The U.S. education system, however, is **decentralized**, considered a model of non-centralized systems, allowing states, districts, and schools broad space for educational development. Education responsibility in the U.S. is left to each state or local administration. Each state has its own Department of Education and is subject to its own governing laws regarding staff recruitment, student schooling systems, school funding, curricula, and textbooks. The U.S. federal government does not determine what students should learn or their expected achievement level in any subject at any grade level. However, the U.S. Department of Education sets broad educational guidelines such as *National Standards* for each subject and *National Goals*.

Chemistry concepts are not taught through a standalone curriculum but are integrated into the science curriculum. These concepts are presented during one academic year in middle school and are explored more deeply in high school. As for teaching strategies, science teachers in the U.S. adopt scientific programs based on inquiry-based learning.

Recommendations:

- Gradually grant Algerian educational institutions greater flexibility to adapt teaching methods according to student needs and local environmental



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conditions, and improve responsiveness in emergencies.

- Promote the use of inquiry-based and experimental learning strategies, with a strong focus on projects, experiments, and practical activities that connect content to real-life situations in the teaching of physical sciences and technology.
- Organize continuous professional development programs for teachers to enhance their ability to implement active learning and use modern educational resources.
- Review content distribution and include more practical applications that link scientific concepts to students' daily lives while considering individual differences.
- Adopt international science teaching standards to keep pace with global developments in educational curricula.
- Develop educational resources and curriculum supplements, such as digital guides and interactive media, to support self-directed and active learning.

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