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TECHNICAL SPECIFICATIONS FOR THE DEVELOPMENT OF DOCTORSAAM: AN INSTRUCTIONAL FRAMEWORK FOR FIRST AID IN 9TH GRADE HUMAN BIOLOGY

Sand Jourdain Jeduthun[i],
Youmba Agape Love
Master's Degree Student,
University of Yaounde I,
Yaounde, Cameroon

Abstract:
Due to the world's gradual dependency on Information and Communication Technologies (ICTs) and the Cameroonian educational system's goal of digital integration, there is a clear need to train citizens for a globalized world. In Human Biology (SVTEEHB), an experimental discipline requiring simulations and visual aids, there is an increasing need for localized ICT resources. The goal of this project is to develop a comprehensive technical specification document for DOCTORSAAM (Docteur en secourisme et accidents de l'appareil moteur), a tool designed to assist learners with first aid practices for motor system injuries. To fulfill these objectives, we followed the phases of the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). We began with a survey and data collection to detect pupils' specific needs, which were then translated into functional requirements. Following the elaboration of these specifications, the DOCTORSAAM tutorial was developed and tested on a sample of 25 pupils across four colleges in Yaoundé. Results convincingly affirm that DOCTORSAAM is an effective solution for ICT integration, with 80% of the lesson's objectives fulfilled. Conclusively, the Cameroonian educational system can rely on these specifications to provide a teaching aid that facilitates the social and academic integration of young citizens.

Keywords: DOCTORSAAM, technical specifications, ADDIE model, human biology, ICT integration

[i] Correspondence: email sandjourdain0@gmail.com

1. Introduction

1.1 Context: ICT in Education and the Cameroonian Challenge

Information and Communication Technologies (ICTs) have transformed global education by enabling interactive, visual, and accessible learning (Karsenti, 2009). In Cameroon, despite efforts to integrate ICTs, such as establishing multimedia resource centers and training teachers at Higher Teacher's Training College (ENS Yaoundé), accord to observation and (Djeumeni, 2010), critical ICT integration gaps persist. A good example in the Cameroon Secondary School system is the Science of Life and Earth Education (SVTEEHB), an experimental discipline requiring simulations and visual aids, which lacks localized digital tools for practical topics in various chapters like first aid for motor system injuries. The SVTEEHB subject will be the main focus of this study.

1.2 Problem Statement

Current Human Biology (SVTEEHB) teaching still relies on theoretical methods, leaving students unable to visualize or practice first aid procedures. In December 2022, we conducted a survey in several schools in Yaounde, which revealed the following:

- 99% of students depended solely on textbooks.
- 80% struggled with abstract concepts (e.g., injury management).
- Students spent about 10.5 hours/week on phones/TV but only 2 hours on SVTEEHB revision, highlighting a disconnection between their ICT engagement and learning.

These results underscored the need for an ICT-based tool to bridge pedagogical gaps and leverage students' affinity for technology, leading to the objectives as follows.

1.3 Objectives

This study aims to:

1) Design DOCTORSAAM, an interactive didactic software for first aid training in SVTEEHB (grade 9).
2) Evaluate its effectiveness in improving learning outcomes.
3) Innovation and Significance.

Unlike prior works like Dibend Francis's 2016 blood circulation tutorial, with the help of its ADDIE-model-based design, which ensures pedagogical rigor, DOCTORSAAM focuses on motor system injuries, combining:

- Visual simulations (e.g., 3D injury models).
- Step-by-step first aid protocols.
- Gamified quizzes for engagement.

1.4 Research Questions

In order to attain these objectives, the following research questions were posed:

1) What are the difficulties encountered by 9th grade students on the SVTEEHB chapter on motor injuries and first aid?

2) How can ICTs enhance SVTEEHB students' understanding of motor system first aid?
3) What design features optimize engagement and knowledge retention for better student performances?

1.5 Scope
The study was conducted in 3 secondary schools of Yaounde, targeting 9th grade Human Biology (SVTEEHB) students and more precisely concerning the chapter on motor injury first aid.

2. Literature Review

2.1 Key Concepts
2.1.1 ICT in Education
According to UNESCO, ICT in education refers to the diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information for educational purposes. This includes computers, the internet, broadcasting technologies (radio/TV), and telephony. (UNESCO, 2020). In Cameroon, ICT integration in education remains low regardless of projects like multimedia resource centers (Djeumeni, 2010).

2.1.2 Didactic Software
Didactic software refers to computer programs specifically designed to facilitate teaching and learning processes, integrating instructional content with interactive elements to achieve predefined educational objectives. (Alonso C. M., 2017).

2.1.3 Motor System Injuries First Aid
Motor system injuries refer to damage affecting the bones, muscles, joints, tendons, or ligaments, impairing movement and function. First Aid for Motor System Injuries. First aid involves immediate care to prevent worsening, reduce pain, and promote recovery; thus, practical SVTEEHB training requires visual simulations to manage abstract concepts.

2.2 Theoretical Frameworks
2.2.1 Learning Theories
In order to have a deeper insight into the psychology of the students and the different pedagogical needs in designing DOCTORSAAM, the following theories framed this study:
1) **Behaviorism:** Interested in observable outcomes (e.g., correct quiz answers) (Watson, 1913),
2) **Constructivism:** Students actively learn through interaction (Piaget, 1967),

3) **Socioconstructivism:** Learning is enhanced through peer interaction (Vygotsky, 1920s),
4) **Cognitivism:** Concerned with memory and information processing (Bruner, 1960).

DOCTORSAAM incorporates all four theories as shown in the table below:

Table 1: Mapping Learning Theories to DOCTORSAAM Pedagogical Functionalities

Theories	**Elements of the theories contained by the lessons**	**Links between the theories and the functionalities of DOCTORSAAM**
Behaviorism	Learning is being able to give an adequate answer	Correct answers to exercises prove the observation of a behavior.
Constructivism	Interaction between the student and the environment	The learners interact with the environment and construct their knowledge based on the constructivist model.
Socioconstructivism	Contact and dialogue with others	Through group assessments, students interact with each other using the learning tool. This exchange is achieved through socioconstructivism.
Cognitivism	Memory	Memorization of the concepts from different lessons through congnitivism

2.3 Instructional Design Models

For this project, we went through several instructional design models, amongst which are the following design models:

a) **Dick & Carey Model:** The model approaches instruction as a complete system, focusing on the interactions between context, content, learning, and teaching. As Dick and Carey assert, 'Components such as the instructor, learners, instructional materials, teaching activities, delivery system, and learning/performance environments interact synergistically to produce desired student learning outcomes.' The accompanying figure illustrates this nine-phase model. Focuses on systemic interaction between content, learners, and environment.

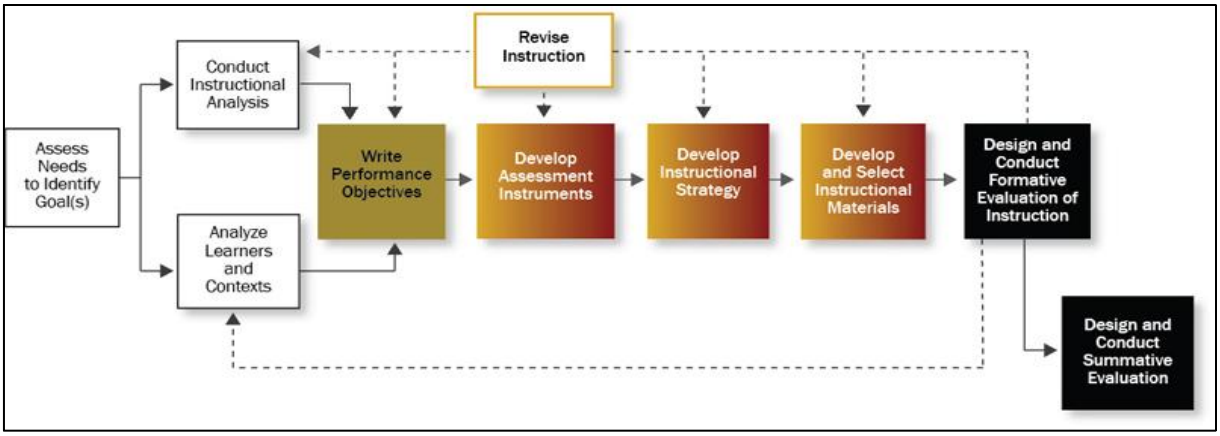

Figure 1: The Dick and Carey Model (Source: Wikipédia)

b) **ADDIE Model:** ADDIE is an abbreviation for the methodical steps (Analysis, Design, Development, Implementation, Evaluation) to ensure pedagogical rigor (Basque, 2004).

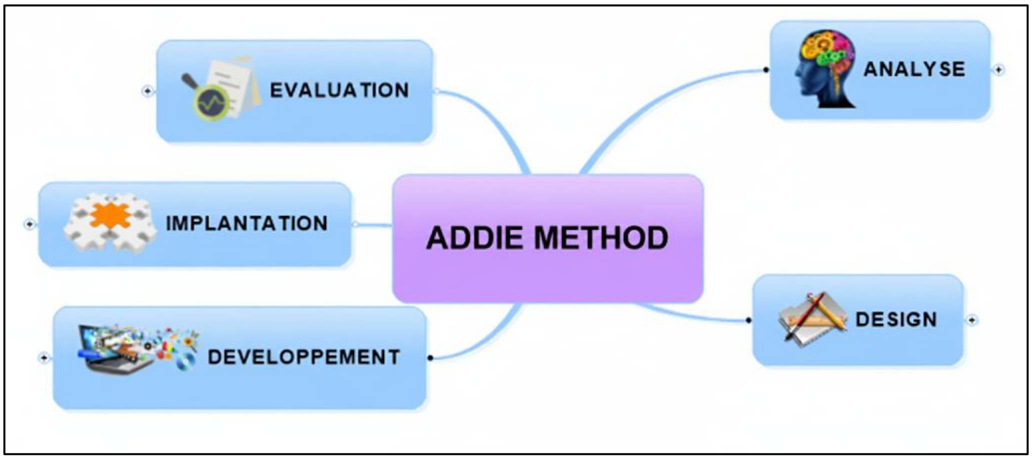

Figure 2: Stages of the ADDIE Model. (Source: Wikipédia)

Since a great part of this work involves developing technical specifications for an educational tool focused on motor system injuries and first aid for 9th grade students in Francophone secondary education (ESG). The project required the design of learning content structured through the ADDIE instructional model, which provides a rigorous framework for analysis leading to comprehensive technical documentation. In addition, because of its flexibility for adaptation to Cameroonian classroom system and constraints, I decided to use the ADDIE model for coming up with the technical specifications for DOCTORSAAM.

2.4 Pedagogical Approaches

This section explores various pedagogical approaches influenced by teaching-learning models. Pedagogy is defined as a set of methods for educating children and adolescents.

Three key approaches are highlighted:

a. **Competency-Based Approach:** Aligned to Cameroon's educational reforms, focusing on "savoir-agir" (applied skills) (Roegiers, 2010). Emphasizes "savoir-agir" (know-how) by integrating knowledge, skills, and real-life contexts. Aligned with constructivism, it prioritizes student agency and societal relevance, making it the chosen approach for this study due to its structured, learner-centered framework

b. **Objective-Based Approach:** Rooted in behaviorism (Tyler, 1935), it focuses on measurable outcomes, with learners expected to achieve specific behavioral goals. While teacher-centered, it risks reducing students to passive executors.

c. **Project-Based Approach:** Grounded in socioconstructivism, it empowers students to actively construct knowledge through collaboration and real-world projects, with teachers as facilitators. This contrasts with traditional rote learning.

2.5 Evaluation Methods:

a) **Formative Evaluation:** DOCTORSAAM embedded quizzes for immediate feedback.
b) **Summative Evaluation:** This is an end evaluation to determine knowledge retention, which was also introduced in the specifications of DOCTORSAAM.

3. Methodology

3.1 Research Design

The research employed a mixed-methods design, combining:

- **Quantitative data:** Pre/post-test scores, survey answers (Likert-scale questions).
- **Qualitative data:** Semi-structured interviews, open-ended survey answers.

3.2 Experimental Procedure (Data Collection)

3.2.1 Participants

- **Study Population:** SVTEEHB 9th graders in Yaounde, Cameroon, schools and teachers of the same grade.
- **Sample:** 154 pupils + 9 instructors from 3 institutions (Lycée Bilingue d'Application, Lycée de Ngoa-Ekellé, Lycée de Biyem-Assi), chosen through quota sampling (representing high, mid, and low achievers).

Table 2: Distribution of Participants by Institution

Schools	Teachers	Students
Lycée Bilingue d'Application	3	50
Lycée de Ngoa-Ekellé	3	50
Lycée de Biyemassi	3	54
Total	**9**	**154**

From the above, the representation rate was calculated and justified at 69.76% representation rate (>20% criterion for generalizability with a confidence level according to Lokesh, 1972).

3.2.1 Data Collection

For data collection, we used the following:

3.2.1.1 Instruments

3.2.1.1 Pre/Post-Tests

- o Assessed mastery of motor system trauma/first aid (80% learning objectives achieved),
- o Employed MCQs, matching tasks, and scenario-based simulations.

3.2.1.1.2 Surveys

- Students: 54 participants (32 females, 22 males) on:
  - ICT utilization (94.44% utilized computers; 55.55% had prior experience with edtech).
  - Difficulty in learning (74.07% found abstract subjects challenging; 85.18% favored ICT tools).
- Teachers: Semi-structured pedagogical deficits interviews (e.g., lack of visual aids).

3.3 Data Analysis and Data Treatment Methods

3.3.1 Functional Analysis

In this method, the requirement(s) that will serve as the solution to the problem and through which the objectives of the project will be achieved were identified. The student requirements document contained all the needs and desires, expressed by the students in natural language. The purpose of this requirements document is to analyze the needs and derive the functional specifications of the learning tool as described by the students. In order to successfully achieve this, we used the APTÉ Method.

APTÉ Method: Identified core functionalities via horned beast ("bête à cornes") and "PIEUVRE" diagrams (e.g., quizzes, glossaries, simulations).

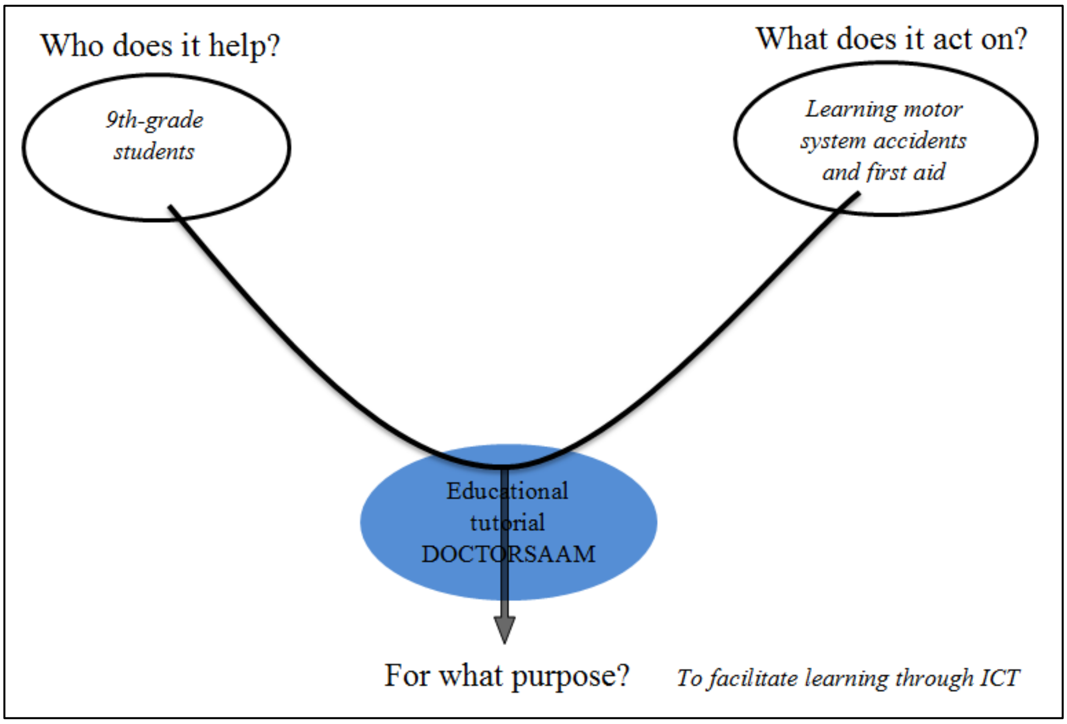

Figure 3: Horned Beast Diagram

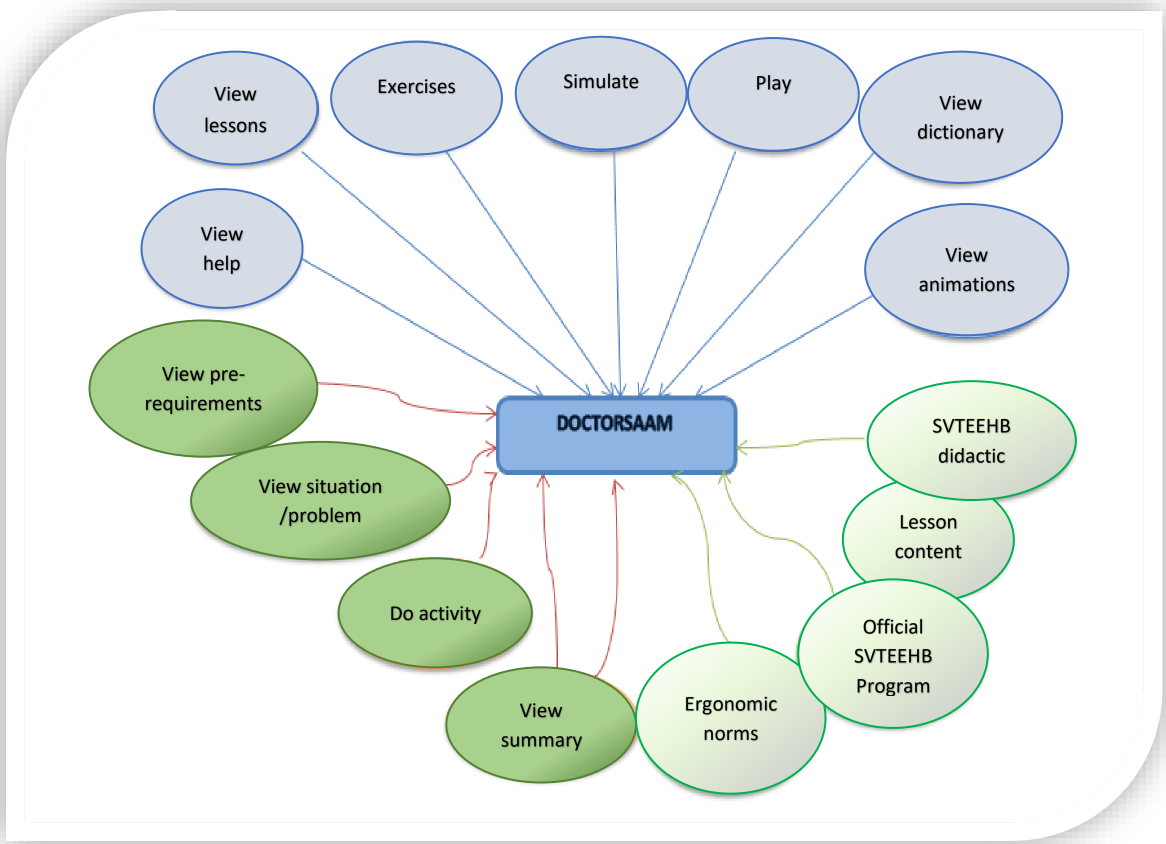

Figure 4: DOCTORSAAM "Pieuvre" Diagram

Legend:
Functions implemented in DOCTORSAAM.
- : Main service function.
- : Constraint function.
- : Supplementary service function.

3.3.2 Pedagogical Engineering

The development of learning content typically follows structured phases derived from pedagogical models. These models serve to conceptualize real-world scenarios, facilitate effective communication strategies, and help define appropriate learning objectives, data collection methods, and educational approaches. While terminology may vary across instructional design frameworks, Glaser (1964) identified five core components common to all models.

The ADDIE model, foundational to this research, encompasses these key stages: Analysis, Design, Development, Implementation, and Evaluation. Accordingly, the course content on first aid and motor apparatus accidents has been structured following the complete ADDIE framework to ensure a systematic and effective learning design.

A. Analysis phase

Figure 5: Description of the analytical phase

This analysis phase was resumed as follows:

- **Learner Profile (Who, Where, and When?)**
  - Who: Target learners (demographics, roles, backgrounds),
  - Where: Learning environment (classroom, online, hybrid),
  - When: Timing of instruction (scheduled sessions, self-paced),
  - Why: Ensures the course design aligns with learners' needs and constraints.

- **Media and Technology Selection (By Whom?)**
  - Whom: Decision-makers (instructors, instructional designers, institutions),
  - What: Tools/media selected (videos, LMS, simulations),
  - Why: To match pedagogical goals with effective delivery methods.

- **Pedagogical Profile**
  - What: Teaching methods (e.g., constructivist, flipped classroom),
  - Why: Justifies the chosen strategies based on learning objectives and audience.

- **Entry-Level Competencies, Knowledge, and Attitudes**
  - What: Prerequisite skills/knowledge (e.g., math proficiency, digital literacy),
  - Why: Ensures learners are prepared to engage with the course content.

- **Course Prerequisites**
  - What: Formal/informal requirements (e.g., prior courses, technical skills),
  - Why: Filters learners to maintain course efficacy and avoid skill gaps.

B. Design Phase

In this phase, we designed the course to be taught as follows:

Course: First Aid and Musculoskeletal Injuries (Cours : Secourisme et accidents de l'appareil moteur)

Lesson 1: Bone Injuries and First Aid (Leçon 1 : Accidents des os et secourisme)

1.1 Fractures (Les fractures),
1.2. Bone Deformities (Les déformations).

Lesson 2: Muscle Injuries and First Aid (Leçon 2 : Accidents des muscles et secourisme)

2.1 Muscle Strains and Cramps (L'élongation et les crampes),
2.2 Muscle Tears (Les déchirures musculaires),
2.3 Sudden Muscle Tears (Le claquage).

Lesson 3: Joint Injuries and First Aid (Leçon 3 : Accidents des articulations et secourisme)

3.1 Sprains (L'entorse),
3.2 Dislocations (La luxation).

Figure 6:
Massage technique

Figure 7:
Cold massage therapy

Figure 8:
Depicts sudden, painful muscle contraction

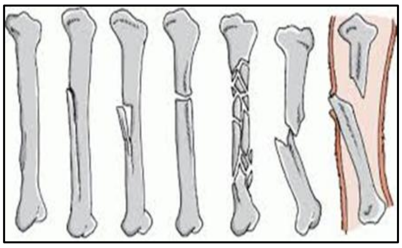

Figure 9:
Fractures (closed & open)
(fractures fermée et ouverte)

Figure 10:
Elasticity limit (Elasticité limite)

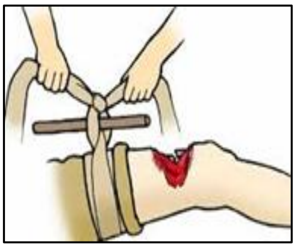

Figure 11:
Limb Immobilization / Muscle Strain (Immobilisation du membre / Élongation)

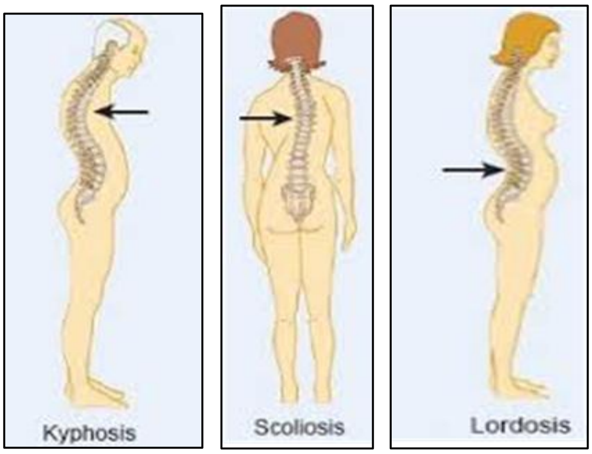

Figure 12:
Kyphosis (Cyphose)

Figure 13:
Complete fractures

Figure 14:
Bandaging technique

Figure 15: Elongation

Different images of animations and simulations

C. Development Phase

The Development Phase focuses on creating an effective learning framework for the DOCTORSAAM tutorial, integrating instructional strategies, pedagogical methods, and educational tools.

- **Instructional Strategies & Methods**

A consistent approach is applied across all course units to engage learners through relevance, confidence-building, and satisfaction. Five core pedagogical methods are considered: expository, demonstrative, interrogative, discovery-based, and experiential. DOCTOR SAAM prioritizes active learning (trial-and-error scenarios) and experiential methods (hands-on practice), supplemented by cooperative learning to foster autonomy and teamwork.

1) Pedagogical Techniques

To address gaps in visual aids, the course employs:

- Glossaries (clarifying terminology),
- Simulations (role-playing for decision-making),
- Animations (demonstrating injuries/first aid),
- Exercises (quizzes, case studies).

Quantitative (surveys) and qualitative (teacher interviews) research informed the design, alongside the ADDIE model for structured development.

2) Competency-Based Strategy

Aligned with administrative guidelines, the competency-based approach emphasizes know-how (savoir-faire), knowledge (savoirs), and attitudes (savoir-être). It answers what to teach (first aid protocols) and how (interactive, real-world tasks).

3) Required Readings

Resources include:

- Life Sciences textbooks (9^{th} grade),
- Articles (e.g., sports-related musculoskeletal injuries),
- Clinical guides (e.g., pediatric first aid)

This phase ensures a learner-centered, multimedia-rich toolkit for mastering first aid and motor apparatus injuries.

a. Implementation Phase

In the implementation phase, we had the whole course planned and lesson distribution by time allocation:

Table 3: Breakdown of course content by lesson and duration

Course	Lesson	Time Required
Lesson 1: Bone Injuries & First Aid	**Lesson 1.1**: Fractures	10 minutes
	Lesson 1.2: Bone Deformities	
Lesson 2: Muscle Injuries & First Aid	**Lesson 2.1**: Muscle Strains & Cramps	9 minutes
	Lesson 2.2: Muscle Tears	
	Lesson 2.3: Acute Strain	
Lesson 3: Joint Injuries & First Aid	**Lesson 3.1**: Sprains	10 minutes
	Lesson 3.2: Dislocations	
Total: 29 minutes		

b. Evaluation Phase

The evaluation plan of DOCTORSAAM looks as thus:

D. Final Project

The final project we will assign to learners will simulate a real-life scenario where they must provide first aid to an injured person. This will require them to integrate the knowledge (savoirs), skills (savoir-faire), and attitudes (savoir-être) acquired during the course to effectively solve the emergency situation.

a. Assessments/Activities/Discussions and Their Connection to the Final Project

For each section of our lessons, learners will complete the following formative assessments, all designed to progressively build competency for the final project:

- Knowledge Checks (Quizzes on fracture types, muscle injury identification),
- Skill Demonstrations (Practice sessions: simulations),
- Case Study Discussions (Analyze real injury scenarios with simulations).

It should be underlined here that Evaluation is conducted at each phase of the ADDIE model to verify alignment with requirements.

4. Results

This chapter has three key aims:

- **Implementation Outcomes:** To present the tangible results of applying the ADDIE model, specifically the finalized design specifications (Cahier des charges) for the DOCTORSAAM tutorial.
- **User Testing Analysis:** To share findings from field tests of these specifications, conducted with a sample group of 9th-grade students (classe de 4ème), evaluating the tutorial's practical application.
- **Comparative Discussion:** To analyze outcomes before and after deploying the didactic solution, highlighting its impact.

4.1 Implementation Outcomes (Technical Specifications Document)

Following the ADDIE model analysis, this document outlines the functional requirements and objectives for developing the DOCTORSAAM learning tool. Designed for 9th grade students, this interactive tutorial covering first aid and motor system accidents through:

- **Core Features:** Lessons, simulations, animations, games, exercises, and a glossary
- **Pedagogical Alignment**: Complies with 4th-grade Life Sciences curriculum and Bloom's taxonomy
- **Technical Requirements**: Multi-platform compatibility (computers/smartphones)
- **Ergonomics:** Follows ISO 9241-111 standards for clarity, readability, and intuitive navigation
- **Assessment:** Immediate feedback with color-coded responses (green/red) and remediation
- **Constraints:** Zero-cost academic project with a 1-year development timeline

Upon completion, the comprehensive technical requirements document, incorporating all necessary pedagogical and functional specifications, was delivered to the developer for implementation of the DOCTORSAAM tutorial system. The development team subsequently produced the interactive learning tool based on these validated specifications. The following screenshots showcase key interfaces of DOCTORSAAM:

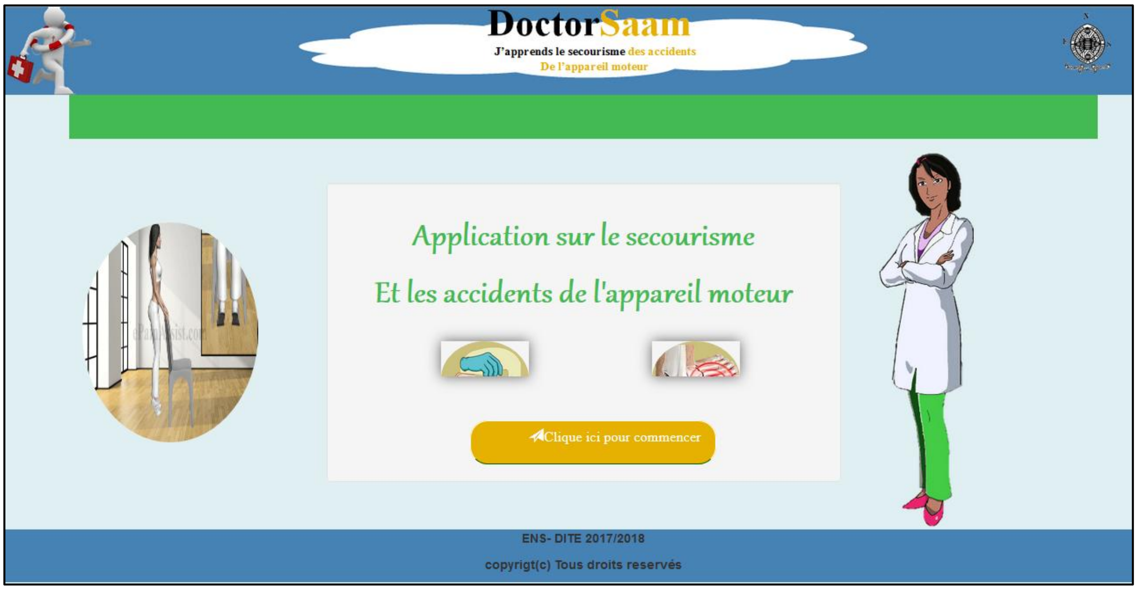

Figure 6: DOCTORSAAM Homepage

Figure 7: Lesson 1 Launch Page

Figure 8: Glossary Interface

Figure 9: Simulation Module

4.2 User Testing Analysis

The initial assessment, based on developer feedback, confirmed that the tutorial met all technical specifications. However, the true evaluation came from its primary users: students. A sample of 25 ninth-grade students from four schools tested the tool's functionality through pre- and post-use assessments.

4.2.1 Key Findings

Technical Evaluation:

- **Clarity of Objectives:** 72% strongly agreed that the goals were clear,
- **Usability:** 84% found navigation intuitive,
- **Workload:** 92% perceived the information density as manageable,

- **Adaptability:** 68% felt the tool matched their experience level.
  Feature Testing (Table 11)
- **Top-rated functions:** Glossary (100% "Excellent"), Animations (96% "Very Good").
- Areas for improvement: Simulations and games ("Fair" to "Good").
  Performance Comparison (Table 12)
  All schools showed significant score improvements post-use:
- Collège Vogt: 62.5% → 87.5% (+25%)
- Lycée de Biyemassi: 50.5% → 82.5% (+32%, highest gain).

4.2.2 Comparative Discussion

Despite prior classroom instruction, DOCTORSAAM boosted comprehension, with all target objectives achieved within the projected timeline. The results validate the tool's efficacy in enhancing first aid knowledge, particularly through interactive elements like the glossary and animations.
Visual Evidence:

Table 3: Comparative analysis of student performance scores before and after DOCTORSAAM intervention

Institution	Pre-test (Before DOCTORSAAM)	Post-test (After DOCTORSAAM)	Gain (%)	Sample Size (N)
	Min / Max / Rate	Min / Max / Rate		
Collège Vogt	10 / 15 / 62.5%	15 / 20 / 87.5%	+25%	10
Lycée d'Etoug-Ebé	07 / 14 / 52.5%	13 / 18.5 / 78.75%	+26.25%	07
Lycée de Biyemassi	09 / 13 / 50.5%	14 / 19 / 82.5%	+32%	03
Collège Victor Hugo	09 / 16 / 62.5%	15 / 20 / 87.5%	+25%	05

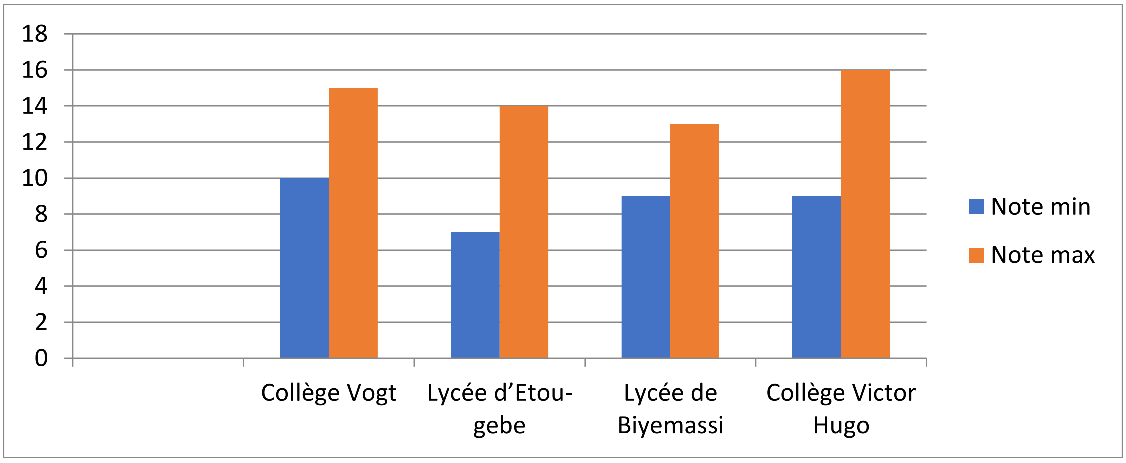

Figure 10: Graph of student performance before DOCTORSAAM intervention

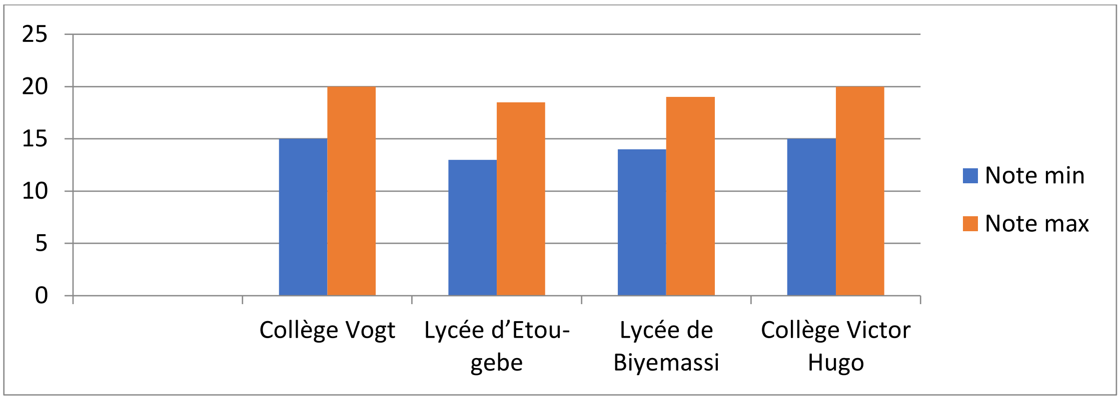

Figure 11: Graph student performance scores after DOCTORSAAM intervention

Figures 20 and 21 illustrate consistent score rises across institutions, with success rates increasing by 25–32%.

This confirms the hypothesis that interactive, specification-aligned design directly improves learning outcomes.

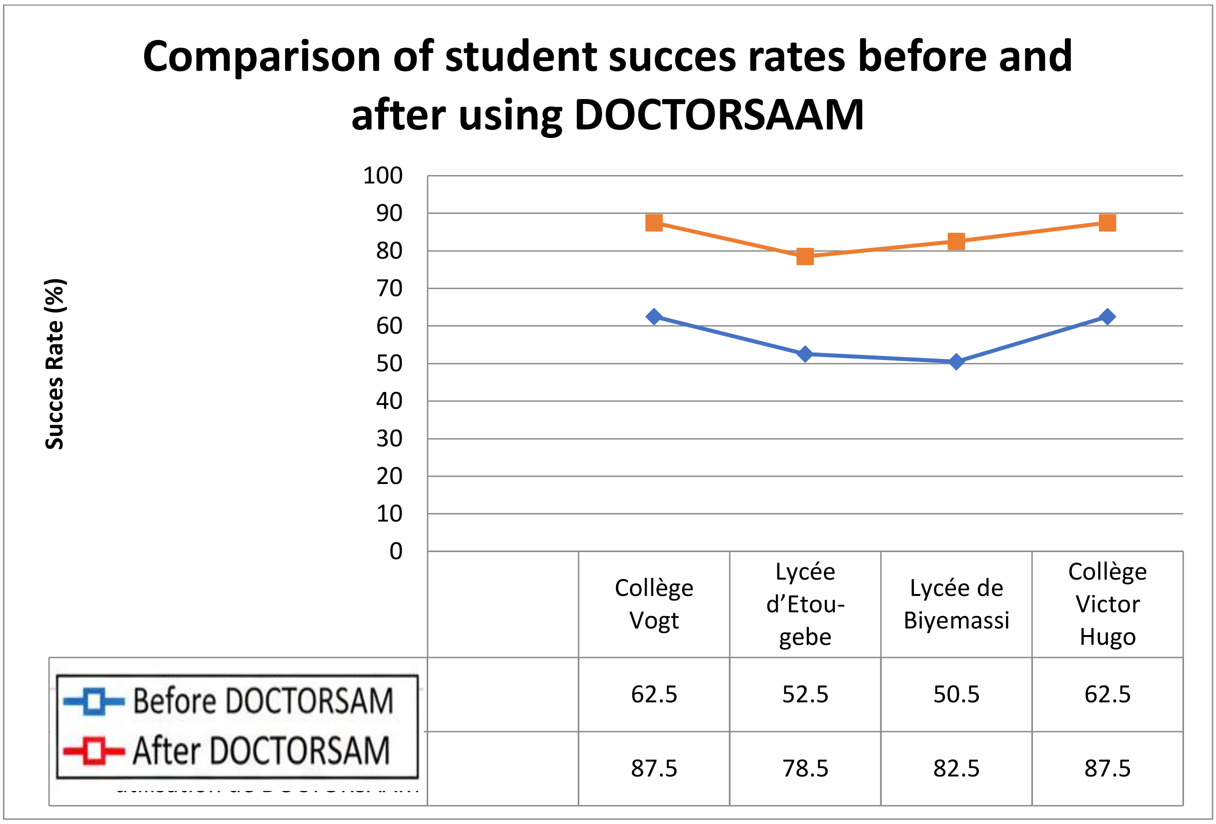

Figure 12: Success rate comparison graph of DOCTORSAAM tutorial

The evaluation of DOCTORSAAM demonstrated significant improvements in student performance across four schools, with success rates increasing by 25-32% (Collège Vogt: +25%, Lycée d'Etoug-Ebé: +26.25%, Lycée de Biyem-Assi: +32%, Collège Victor Hugo: +25%), achieved within the projected timeline while meeting all objectives, despite students having previously taken the course in traditional classroom settings;

these results not only validate the tool's effectiveness in enhancing comprehension of first aid and motor system accidents beyond conventional teaching methods but also highlight its potential for scalable implementation in STEM education, suggesting that interactive digital learning tools can successfully address gaps in traditional instruction.

6. Conclusion And Recommendation

The DOCTORSAAM spec document facilitates a shift in teaching from instructor-centered to learner-centered, aligned with Cameroon's competency-based education (Roegiers, 2010). The evaluation of DOCTORSAAM, an interactive learning tool for first aid and motor system injuries, demonstrated significant pedagogical effectiveness across multiple educational institutions. Post-implementation data revealed consistent performance improvements of 25-32% among ninth-grade students, with particularly notable gains at Lycée de Biyem-Assi (32%) and comparable advances at Collège Vogt, Lycée d'Etoug-Ebé, and Collège Victor Hugo (25-26.25%). These results were achieved within the projected development timeline and fulfilled all specified learning objectives. Importantly, the tool's success persisted even among students who had previously completed traditional classroom instruction on the same material, confirming its value as a supplemental educational resource. The study substantiates that well-designed digital learning tools can effectively reinforce complex practical knowledge and bridge gaps in conventional teaching methodologies. Furthermore, the consistent outcomes across diverse school environments suggest strong scalability potential for similar interactive learning solutions in STEM education. Future research should investigate long-term knowledge retention and explore applications to other technical subjects requiring both theoretical understanding and practical skill development. The project ultimately provides a replicable model for enhancing competency-based learning through targeted technological integration.

Conflict of Interest Statement
The authors declare no conflicts of interest.

About the Authors

Sand Jourdain Jeduthun is an educator, techno-pedagogue, and researcher specializing in the integration of information systems within educational frameworks. His professional scope extends into the study of modern parenting, exploring the intersection of family dynamics, technology, and child development. With a diverse academic foundation that includes a Master's degree in Educational Sciences, a professional teaching diploma in ICT, and a full undergraduate cycle in Mathematical Economics, he analyzes educational challenges through a unique lens that blends pedagogical, technical, and socio-economic perspectives. His international teaching experience across primary and secondary levels in Cameroon, Russia, and American-curriculum schools informs his practical approach to curriculum development and technology-enhanced learning. His research and publications focus on education management information systems, digital learning tools, and the analysis of student engagement through digital traces. He is currently advancing his work in educational technology and preparing for further doctoral research.

Youmba Agape Love is a researcher and petroleum engineer whose work bridges the energy sector and interdisciplinary academic studies. Her professional expertise is rooted in petroleum engineering, with a specialized thesis project on the challenges, technologies, and legislation surrounding offshore completion. Her research scope actively explores the transition to renewable energies, examining the technical and policy frameworks required for sustainable energy systems. As a scholarly collaborator, her co-authored publications in international journals explore themes at the intersection of education, governance, and technology. This dual focus allows her to contribute a valuable, systems-engineering perspective to discussions on institutional effectiveness, educational governance, and sustainable development.

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