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The Learning 6.5 System: Effective Technology for Distance and Online Education in Science and Technology

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Abstract: The purpose of this article is to assess the potential of a technological artifact called "Learning 6.5 system" that addresses both the long-standing need to simplify the computerization of scientific and technical documents and the emerging need for online teaching and evaluation of scientific knowledge. The Learning 6.5 system is a complete e-learning solution that offers end-to-end management of the entire process of computerizing teaching and evaluation materials, distributing and delivering courses, organizing and grading assignments or exams, and publishing results. Its integration of scientific knowledge processing & presentation technology with multimedia & internet technology significantly improves online learning experiences and results. The Learning 6.5 system is built upon a totally new concept based on an original technology for processing composite characters (structural units consisting of ordinary characters, mathematical symbols, polymer structural formulae, geometrical configurations, etc.) and on a non-linear document theory that allows for the appropriate solution of digital processing and network transmission of ordinary, scientific and technical documents, as well as the dynamic presentation of natural logic. Consequently, it makes possible, for the first time in history, real and effective face-to-face "student-teacher" distance learning and online state examinations including middle and high school entrance exams, university entrance exams, university exams, etc.

Keywords: Technology, Distance and Online Education, Science Teaching, Learning 6.5

1. Background

Over the years, mankind has had to adopt new habits, invent new tools or, more generally, redefine its needs and equip itself to adapt to the realities of the present or a given future.

In the education sector, the need to integrate information and communication technologies (ICT) into teaching to enhance learning is widely recognized. Governments are making considerable efforts to equip schools with computers, not only to improve but also to renew the teaching and learning environment.

Hence, the call for innovation in the education sector is becoming more and more pressing. Teachers are increasingly required to adapt their teaching and assessment to the requirements of E-Learning, including the online availability of teaching modules and assessment tests. This becomes a real headache when it comes to scientific and technical disciplines where the current means used are very complex and not very efficient. The COVID-19 experiment not only demonstrated the relevance of the need for online teaching and assessment, but also revealed the inefficiency of existing online teaching platforms. State exams were canceled and online courses were made with great difficulty, not to mention the fact that many schools were simply closed.

The struggle for the effective integration of ICT into education continues to be a challenge to many. All too often,

when schools mandate the use of a specific technology, teachers are left without appropriate tools or skills to effectively integrate the new capabilities into their teaching method. The results are that the new investments are underutilized, not used at all, or used in a way that mimics an old process rather than innovating new processes that may be more engaging for students. As far as the much mediatized supporting devices are concerned, they are known to be a lengthy appropriation or instrumentation at the heart of teaching practices. On the other hand, the teacher selects and transposes knowledge through one or more media devices which, in turn, influence their choice.

Chaachoua [1] observes that one of the obstacles related to technologies applied to education concerns the effects of "computer transposition". For Balacheff [2], the development of computer environments and their introduction into schools and teacher training are accompanied by phenomena relating to computer transposition in the treatment of knowledge. In the context of developing educational software, this transposition is extremely important and means, in fact, a contextualization of knowledge that can have important consequences for learning outcomes. The author also states that, in addition to the restrictions and conditions related to the process of didactic transposition, we have those related to the modeling and computer implementation of the knowledge to be taught: restrictions of compatible modeling, restrictions related to computer language and those related to the storage capacity of the machines.

As for Terry Anderson and Pablo Rivera-Vargas [3], there is great need to tackle "aspects that have not been completely satisfactory in the transit and transformation that education has undergone, from its more traditional, campus-based conception, toward its new configuration marked by the continuous use of digital technologies and environments". This is underscored by the many challenges facing distance education, particularly in science and technology subjects. In other words, the early enthusiasm in distance education is yet to match with reality.

2. Objective

The aim of this article is to assess the potential of a technological artifact called the Learning 6.5 system, which has been developed by Novoasoft and promoted by Beijing Elearning Technology (BET). The system not only solves the daily thorny problem of digitizing scientific knowledge, satisfies the quest for an effective tool for online science teaching, but also proves to be an effective working tool for the teacher in a new concept of school with much wider boundaries.

Furthermore, this paper, without going into detail, suggests that backpacks full of notebooks and books, heavy for students to carry, should no longer be necessary. An electronic tablet would suffice to follow an entire living course containing dynamic learning objects, and to complete exercises and state exams in all subjects, facilitating highly efficient learning and considerably lightening the teacher's task, both in delivering the course and in correcting homework or exams.

In short, this article exposes the unusual and surprising potential of a tool that could redefine and reshape a new vision of schooling

needed to face some of the major challenges humanity may be facing, given that the Covid 19 experiment is just a warning.

3. Assesssing Learning 6.5 System

In order to better assess the system, we have divided our study into four parts: the first is a very concise presentation of the system as a whole; the second presents the components of the system's software suite; the third is a brief presentation of the system's network technology; the fourth and last present some new possibilities for teaching and scientific publishing involving the use of the Learning 6.5 system.

3.1. Learning 6.5 as a New Generation of Technology

As Comlan [4] holds it, Learning 6. 5 system is a combination of *network technology* and a revolutionary and *versatile software suite* that not only facilitates the creation and operation of a digital virtual school, but also the processing of any type of scientific document, the design of all kinds of presentation or science teaching slides, and distance learning and assessment involving various applications of mathematical sciences using a computer. The transition from traditional *classroom* teaching to *online* learning is seamless using the same formats of teaching and assessment resources.

The software suite includes: ScienceWord 6.5, Class 6.5, Skill 6.5, Marking and Symtone.

It is truly a set of working tools that offer simple ways for:

1) Processing scientific and technical documents, using ScienceWord;
2) Creating presentation and teaching slides for science education, using Class;
3) Collaborative work and distance learning including all scientific subjects over internet synchronous), using Symtone;
4) Assessment of content (Test/Exam) on computer using Skill including full answer option made of any kind of scientific text. (Comlan [5])

3.2. Brief Description of the Components of the Learning 6.5 System Suite

3.2.1. On Typing Scientific Documents and Teaching - ScienceWord 6.5

ScienceWord 6. 5 is an outstanding software for word processing that greatly facilitates the processing and the publication of scientific documents of all types. It brings to life: the most revolutionary, natural and flexible way ever of writing mathematical formulae; the most natural way in completing geometric and dynamic constructions; a very natural and intelligible way of sketching chemical structures; a very flexible way of graphing functions in linear, 2D and 3D coordinates; an amazing way for performing elementary school vertical calculations such as long division in English, French and other formats. Contents created can be used for lecture in teaching mode. In addition, the software provides very powerful and efficient tools for editing test (or exam) to be carried out on computer.

ScienceWord is indeed a new technological paradigm and a universal format in which the Scientific Community can *communicate freely at every educational level.*
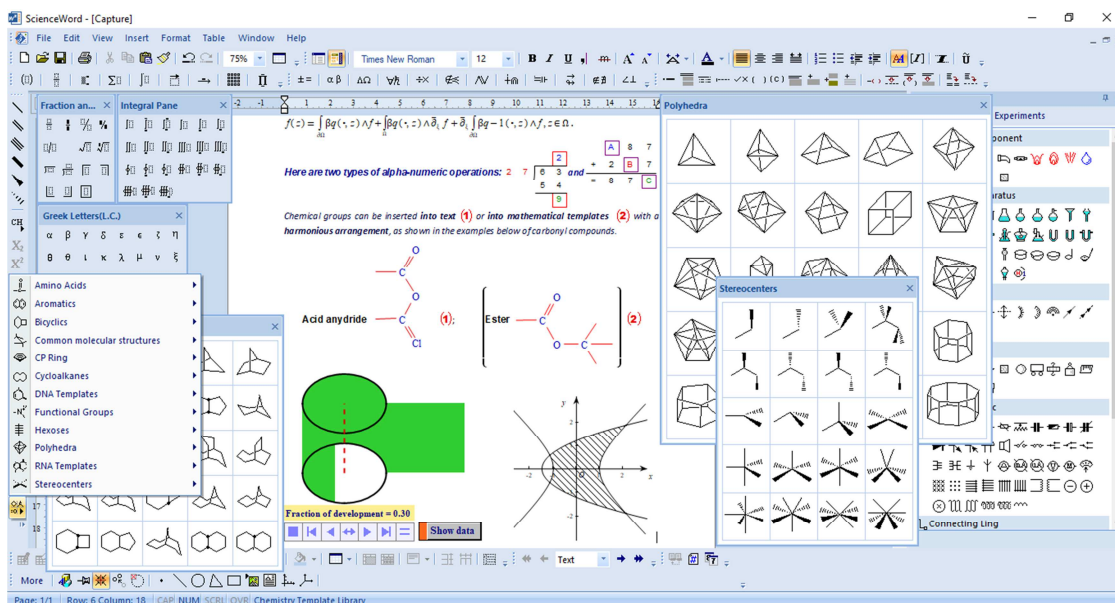

Figure 1. *A screenshot of Science Word 6.5 standard interface.*

3.2.2. On Creating Scientific Presentation and Lectures Slides - Class 6.5

As for Comlan and Almouloud [6], Class 6.5 is a revolutionary, versatile, powerful and effective teaching tool that encompasses all the scientific features of ScienceWord, the traditional presentation slides and a new working environment called teaching mode where a presenter can give written explanations within an extendable environment embedded with powerful whiteboard tools, creating thus the traditional classroom situation.

When using Class with an interactive whiteboard or interactive video-projector, the user not only will enjoy the traditional classroom teaching situation with handwriting, but will be also able to write standardized mathematical or bio-chemical formulas, draw at scale, plot functions graphs, do any kind of dynamic constructions, insert video with full screen option, etc. He is not limited to staying by his computer but can carry out all the manipulations from the projected screen area. The traditional *classroom* and *online* teaching use the same Class 6. 5 format of teaching resources.

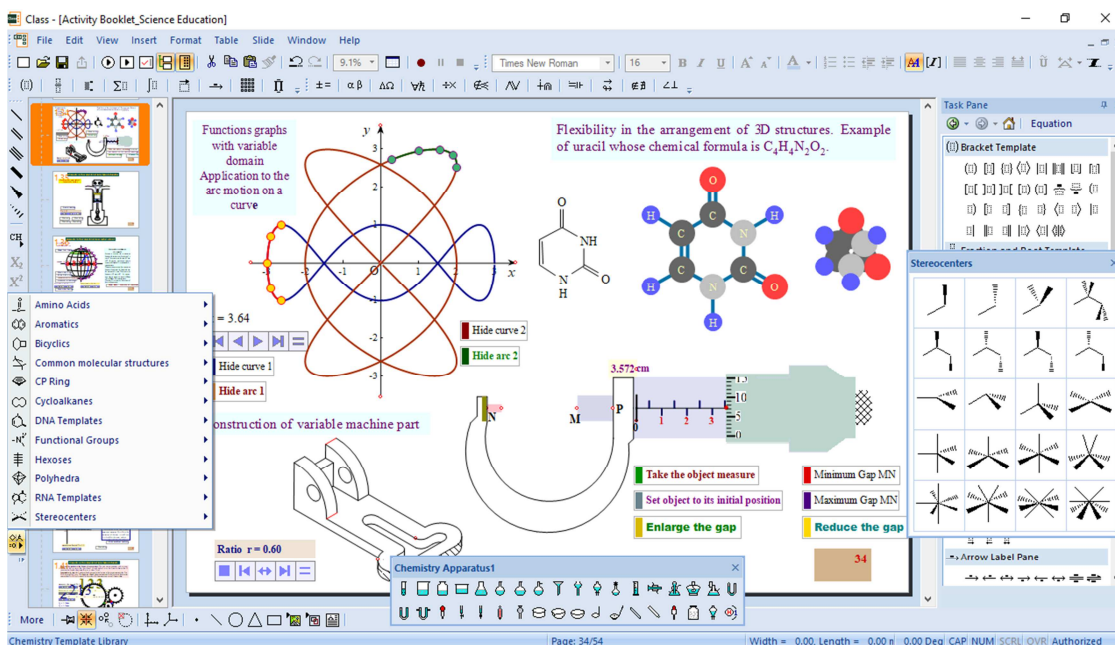*Class 6.5 is just a master piece for creating science education slides and teaching.*

Figure 2. *A screenshot of the Class 6.5 standard interface.*

3.2.3. On Collaborating over Internet and Teaching - Symtone

Comlan [7] says that Symtone 6.5 is a real-time remote interactive teaching software that has seamlessly integrated scientific tools, Instant Communication and Video technologies to significantly improve the experience and effectiveness of online education as well as tutoring, with minimal requirement for hardware and internet bandwidth.

All you need is a computer on which Symtone is installed and Internet connection. Then, the remote communication can be done:

From computer to computer or from computer to interactive white board or from Interactive white board to interactive white board.
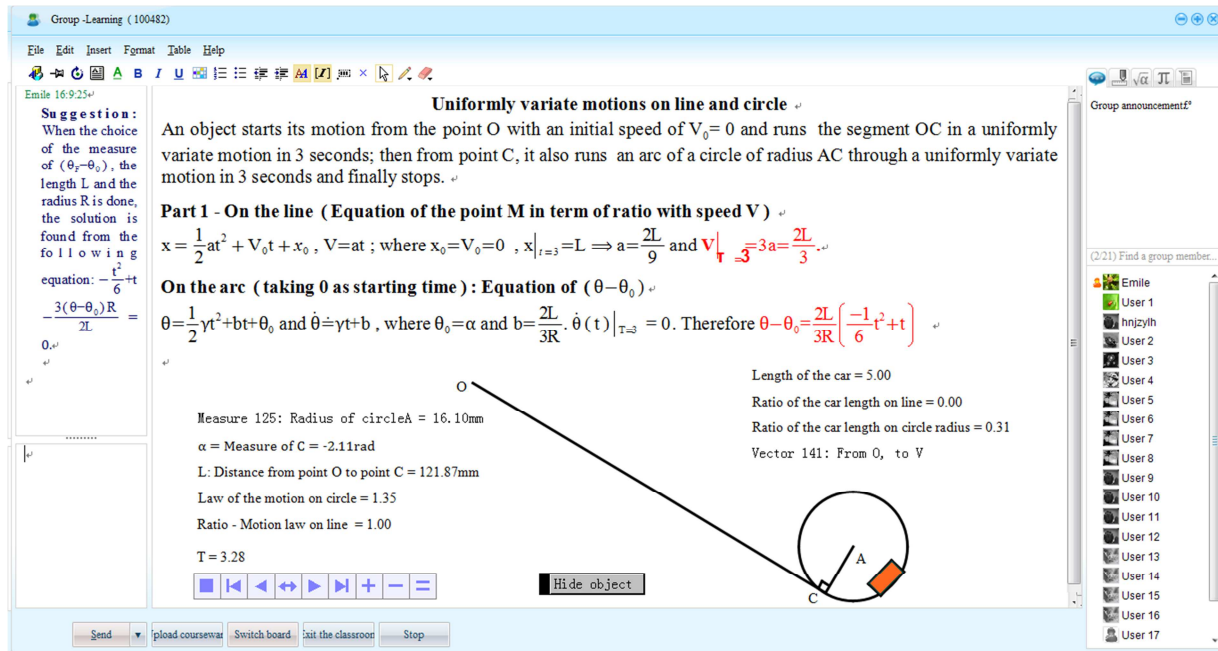

Figure 3. Illustration of a physics lesson in Symtone's - A class of up to 500 students.

The topics cover any kind of tutorial, supervised work, collaborative work, etc. The result is just perfect when both sides use an interactive whiteboard where it is more convenient for everyone to use handwriting, thus creating the lost classroom situation with an additional advantage of saving all discussions at once. Symtone can even open PowerPoint and Class for instant distance public presentation over INTERNET.
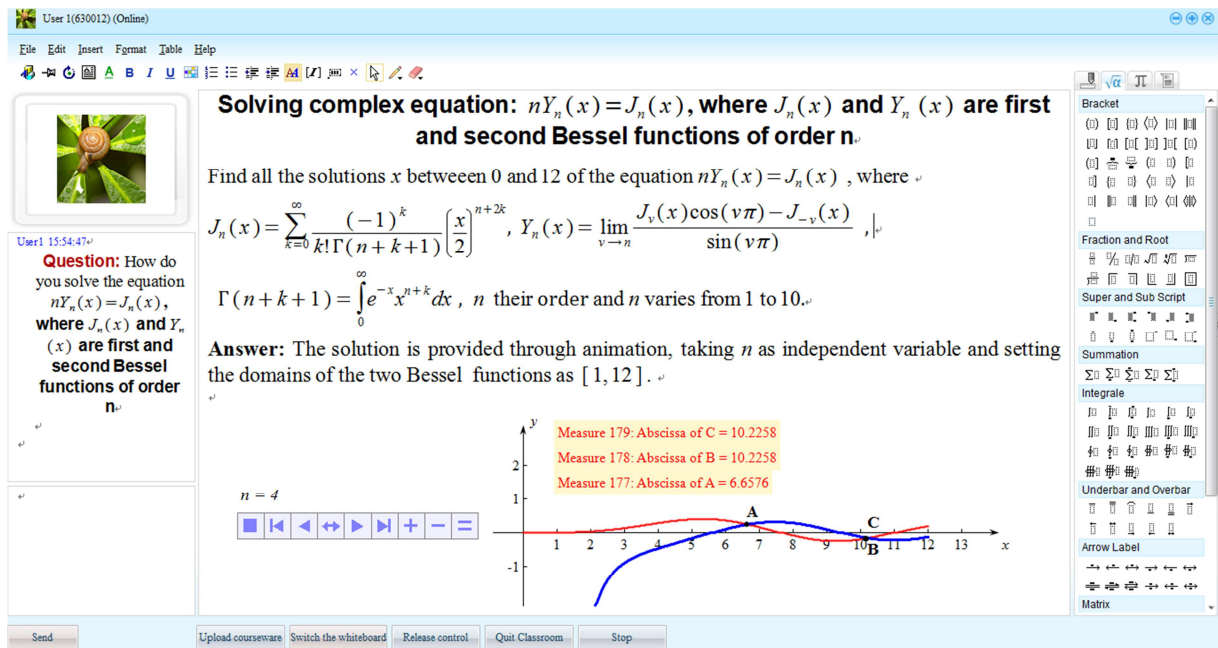

Figure 4. Illustration of a mathematics lesson in Symtone's - A single-student class.

The topics cover any kind of tutorial, supervised work, collaborative work, etc. The result is just perfect when both sides use an interactive whiteboard where it is more convenient for everyone to use handwriting, thus creating the lost classroom situation with an additional advantage of saving all discussions at once.

Symtone can even open PowerPoint and Class 6. 5 files for instant distance public presentation over INTERNET.

3.2.4. On Performing Test (or Exam) on Computer - Skill 6.5

According to Comlan [8], Skill 6.5 is a very revolutionary program for performing test (or exam) on computer through all types of questioning techniques. It is equipped with all the necessary scientific functions for writing detailed answers or solutions in mathematics, chemistry, physics, biology, etc. using the keyboard. However, the student can just use a pen to complete an assignment or exam on a pad or touch screen computer, more conveniently than on paper! The transition from traditional paper-based exam to online computer-based test is seamless using the same format [9].

Figure 5. *Capture of Skill interface with essay question.*

The use of Skill 6. 5 for computer-based tests takes into account all the formats used for traditional paper-based assessments! Skill 6.5 also features an electronic drafting sheet with a yellow background that can be placed above or below the writing area, making it very convenient to use. Errors in writing or drawing are erased with the other end of the pen without leaving a trace. Students taking a test, and teachers correcting it, will no longer have to deal with several sheets of test answers!

3.2.5. On Grading Assigments, Homeworks or Exams - Marking 6.5

Marking 6.5 is a very convenient program for correcting homework on computer. This correction can be done with the

mouse or a stylus (in case of a surface that supports the stylus). When the correction takes place with a stylus, everything happens as in the classic case of a paper test where you can circle the writing errors, write comments according to the actual steps of the scoring, reproduce in a very convenient way the traditional scene of the batch change operation. The graded assignments are released to each student in a given class in one click.
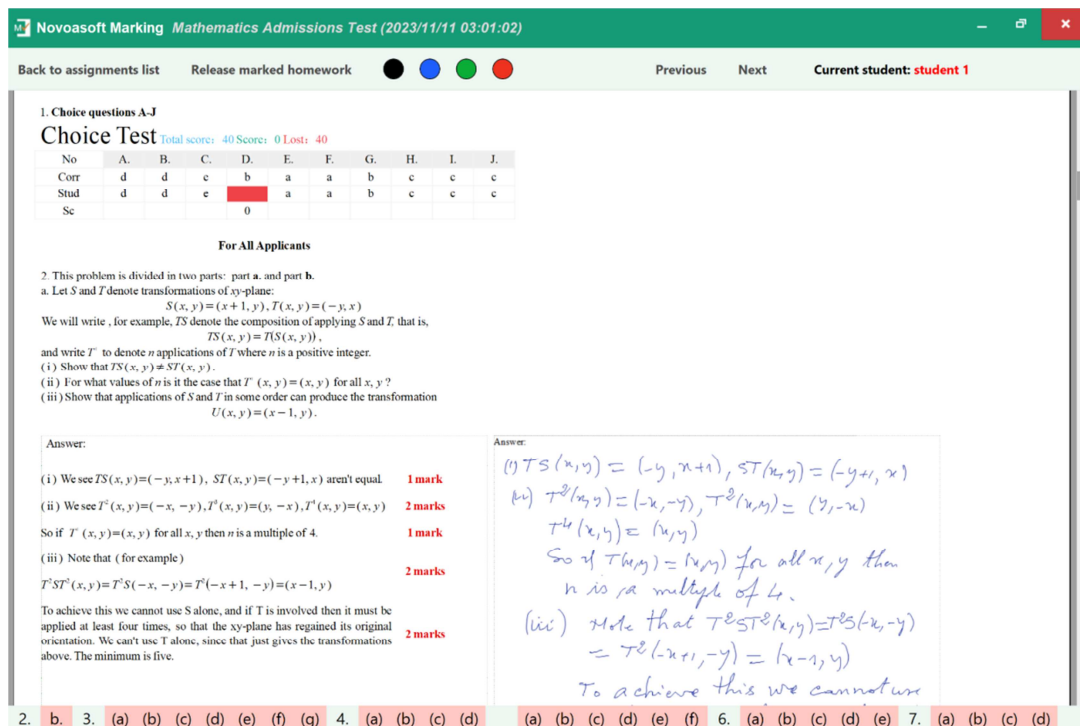

Figure 6. *Capture of Marking interface.*

3.3. Brief Description of the Network Technology of Learning 6.5

The Learning 6.5 system's network technology offers the opportunity to easily create a virtual school (or university) which is made up of several grades (or faculties); a grade is made up of several classes (or departments).

The network technology can be made available on the website of any institution that requests it. This platform facilitates:

1) online courses, online homework and online exams with automatic grading and summary report of results;
2) online training;
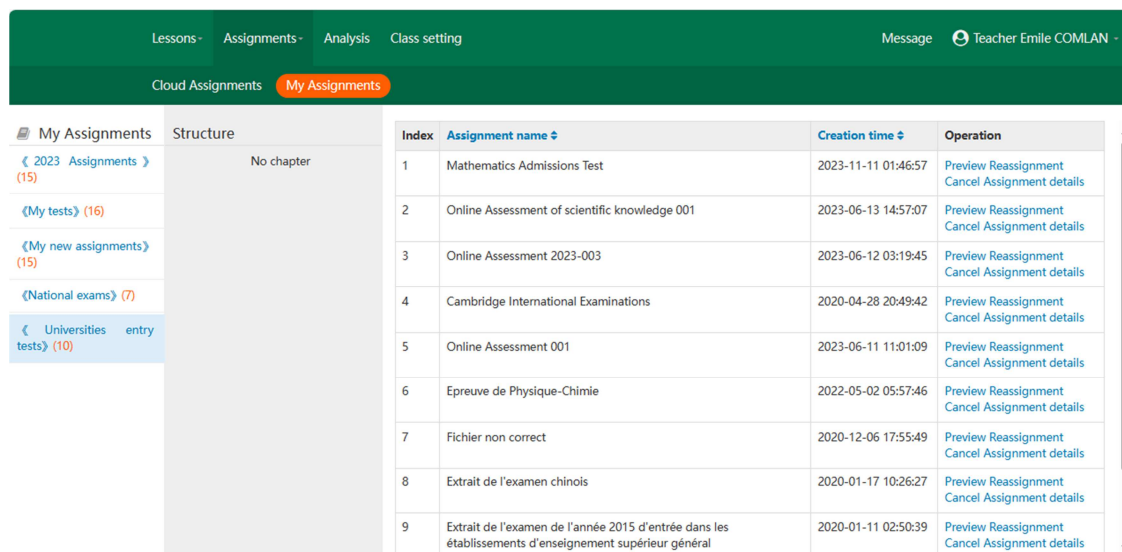3) online access to periodicals, publishing journals, libraries and bookstores;
4) etc.

Figure 7. *Above is a teacher's Learning 6.5 system web page.*

3.4. Some Implications of Revolutionary Concepts Generated by Learning 6.5 System for Science Teaching and Publishing

3.4.1. A New Highly Effective Teaching Method Generated by Learning 6.5

The integration of Skill 6.5 to lessons delivery brings to life a revolutionary teaching method. In fact, thanks to Learning 6. 5's online teaching and assessment technology, the teacher can test all students at the same time in the classroom or remotely during the course and instantly display their results, with the option of restricting each student's access to his or her results only. The exercises are corrected in ScienceWord's teaching mode, where the default veiled solutions can be displayed by double-clicking in the answer fields, with the additional option of using a pen to write explanations. The teacher can occasionally display the best solutions offered by learners and comment on them directly on the screen. This situation assures:

1) an effective participation of students during the process of learning;
2) a healthy, invigorating and permanent competitive atmosphere among the students;
3) a craze with students for learning and acquisition of knowledge;
4) a real motivation for teachers to constantly improve the quality of their teaching with a variety of learning activities.

Material required: each learner must be equipped with a pad while the teacher needs a video projector and a computer and all devices (pads and computer) must be connected to Internet.

3.4.2. Specific Scientific Editing Solutions of Learning 6.5 Suite

Learning 6.5 not only satisfies the quest for one stop software capable of dealing with scientific and technical documentation but also offers:

1) The most revolutionary, comprehensive and flexible way ever of writing mathematical formula!
2) The most natural way to carry out dynamic geometric constructions using the concepts of logical drawing, smart mode, and object properties!
3) A very flexible way of plotting functions graphs.
4) An easy way of drawing experiment setups
5) A natural way based on human behavior of drawing chemical bonds!
6) A very smart way in manipulating arithmetic vertical notation used in basic schools including formats in English, French, Chinese and many more.

(i). Fast Input Option: Unique Convenience for Writing Mathematical Formulas

The user can insert any mathematical symbol using a very simple method called "Fast Input Option", which uses a customizable syntax and can simply be the name of what you are inserting. As you start to spell the name of what you are looking for, a menu opens up for your choice. You just have to key from the keyboard the corresponding number; no need to use a mouse!
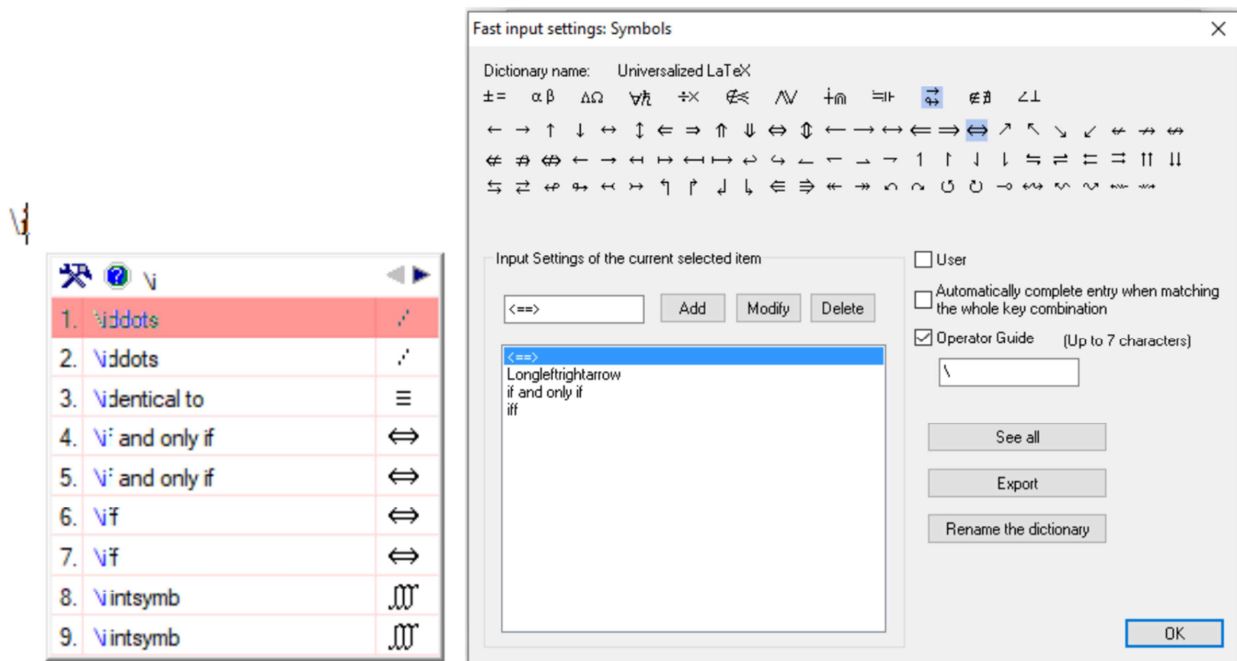

Figure 8. *Fast Input Option.*

For greater convenience, several syntaxes can be assigned to the insertion of the same symbol. For example, the user can define the following three syntaxes "\long arrow left right", "\if and only if", "\iff" to insert the symbol ⟺. There is no constraint on memorizing a syntax.

(ii). Powerful Geometric and Dynamic Construction Capabilities, with a Revolutionary Concept

The entire drawing process is reduced to the use of just two principles: The logical drawing and the object properties. It's a new concept that uses a natural procedure for geometric constructions, so very little knowledge is required to master drawing!

1) Logical drawing consists in selecting basic elements of the plan to obtain the tools needed to draw a desired geometric figure.
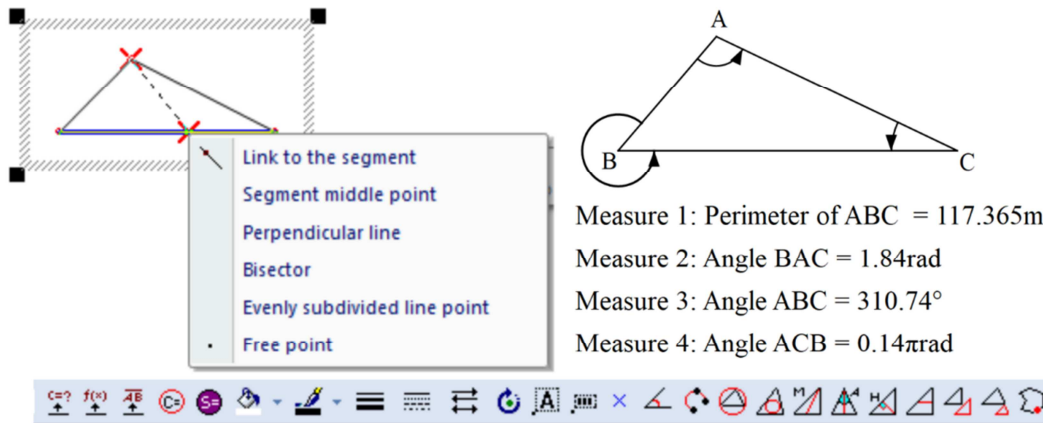
2) Object properties, to which we're already accustomed with traditional word-processing software, allow us to make modifications to an object.

However, in "Smart graphics" mode, users can directly draw points, lines and circles using, intelligible geometric relationships, including intersection, ratio, perpendicularity, parallelism, tangency and so on.

Below are few illustrations of the principles related to a triangle.

Figure 9. *Triangle logical and smart drawing tools.*

(iii). Plotting Graphs of Functions

Learning 6.5 suite offers an easy and very flexible way of plotting points in line coordinate and functions graphs in 2D and 3D coordinates systems. Below is a graphical representation of the Lagrange polynomial $f(x) = A_5 x^5 +$ $A_4 x^4 + A_3 x^3 + A_2 x^2 + A_1 x + A_0$ of degree at most 5, passing 6 variable points $P_i(x_i, y_i)$, assuming the x_i values are all distinct. The Lagrange coefficients A_i of course vary according to the values of the pairs (x_i, y_i).
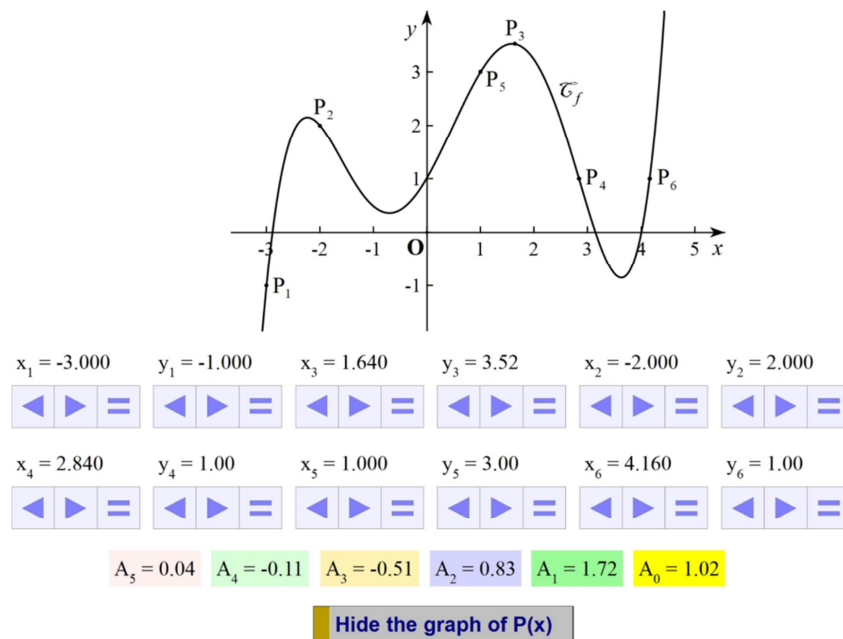

Figure 10. *Plotting graphs of functions.*

(iv). Experiment Setups

Learning 6. 5 suite allows the user to easily draw complex experiment setups from the varied range of laboratory tools of physics, chemistry, etc.
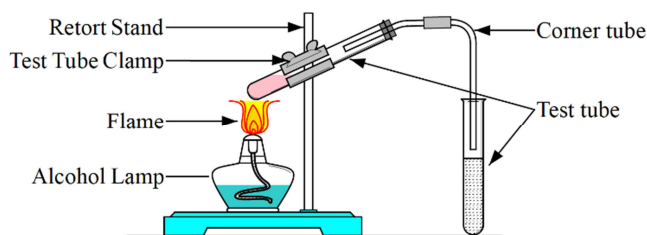
Figure 11. Tools of physics, chemistry, etc.

(v). Sketching Chemical Structures

Editing chemical formulas is naturally simple and intelligible. Chemical bonds and chemical symbols, in a kind of partial grouping, benefit from the same kind of formatting and variable geometric orientation. Chemical structures are generally highly flexible, with variable symmetry, and made up of chemical symbols, single chemical bonds, chemical groups or macromolecules. They can be inserted into text or mathematical models with appropriate alignment, as shown in illustrations (1) and (2) below.

Finally, it's worth noting that chemical structures use configurations that make it easy to generate graphs of crystal systems.
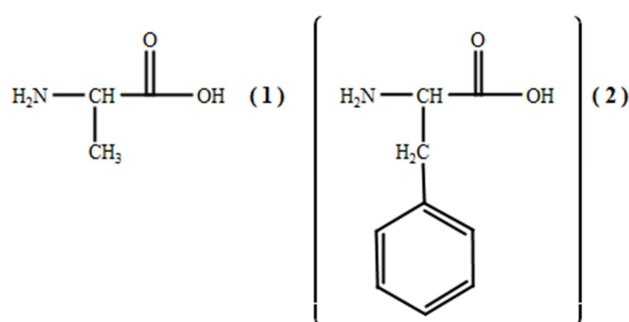

Figure 12. Editing chemical formulas.

(vi). Basic Schools Vertical Calculations

Just through a dialog box the user can set as fast as possible any kind of vertical calculation format, in both English, French systems, and many more. The manipulation of the calculation is of unparalleled flexibility! For example, to divide 1435 by 15, simply enter 1435/15 in the expression field of the arithmetic dialog box as shown below. Just to the right of the arithmetic dialog box, we present the results in English and French formats.
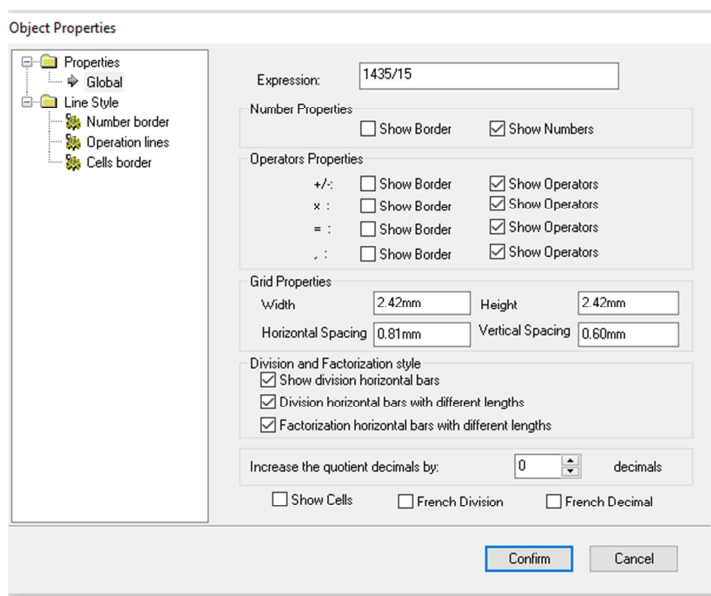

Figure 13. Vertical calculations.

Below are three factorization formats for the number 10101 obtained with the arithmetic dialog box; the first two in English and the third in French.

Figure 14. Factorization formats for the number 10101.

(vii). Extended Graphics Library

After creating a drawing, labeling an image, or writing a note in a text box, consisting of scientific text including any type of formula, the user can simply right-click and select the "Add to extended graphics" command from the context menu that opens, to create a graphics library in which to save what

has been created for future use. This manipulation covers all subjects' area including biology, physics, mathematics, etc. All dsg and psg files in graphics libraries (folders) created with ScienceWord and Class in this way, as well as all kinds of images, including jpeg, bitmap, emf, wmf, tif, png, ico, exif, are opened from Graphics Resources centre in a task pane.

(viii). Unmatched Capabilities for Creating Interactive Learning Objects for Science and Technology Education

In most definitions, a learning object refers to an object that can be reused in training and learning. According to Wikipedia, a learning object would be "a collection of content items, practice items, and assessment items that are combined based on a single learning objective". Wikipedia also quotes the Institute of Electrical and Electronics Engineers (IEEE), which defines a learning object as "any entity, digital or non-digital, that may be used for learning, education or training". In the new era of digital technology the field of application for learning objects is very broad. In Science and Technology education Learning 6.5 suite through the ScienceWord 6.5 *scientific word processing technology*, the Skill 6.5 *assessment technology* and the Class 6.5 *scientific presentation technology,* greatly facilitate the creation of electronic notebooks for all disciplines, including:

1) lively learning activities with animated and interactive learning objects that make knowledge fun to learn and easier to understand;
2) tests for self-assessment on the computer or pads online or offline, in class and at home. These electronic notebooks facilitate self-learning and knowledge review in science and technology education; they are unalterable and can therefore be reused by other learners.

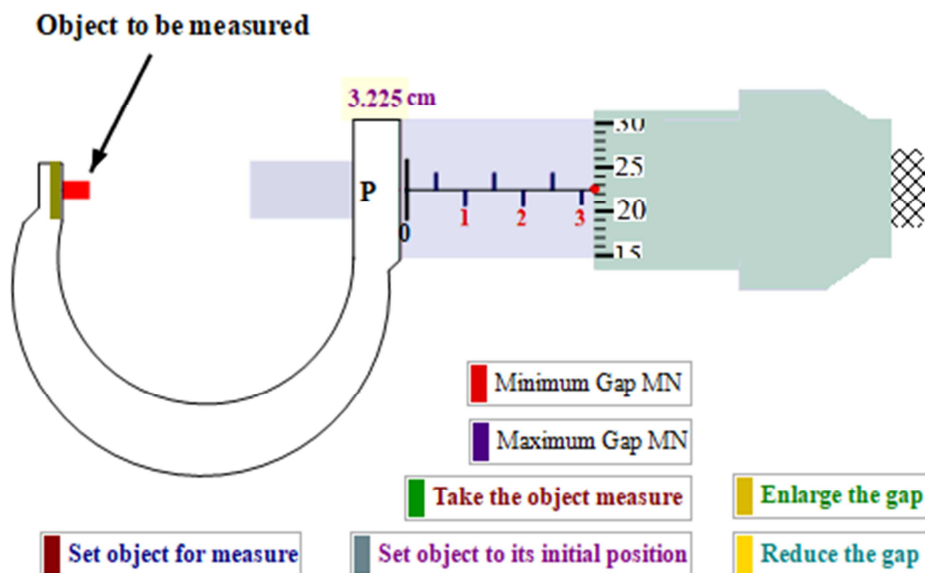Here are a few examples of learning objects created with the Learning 6.5 suite:

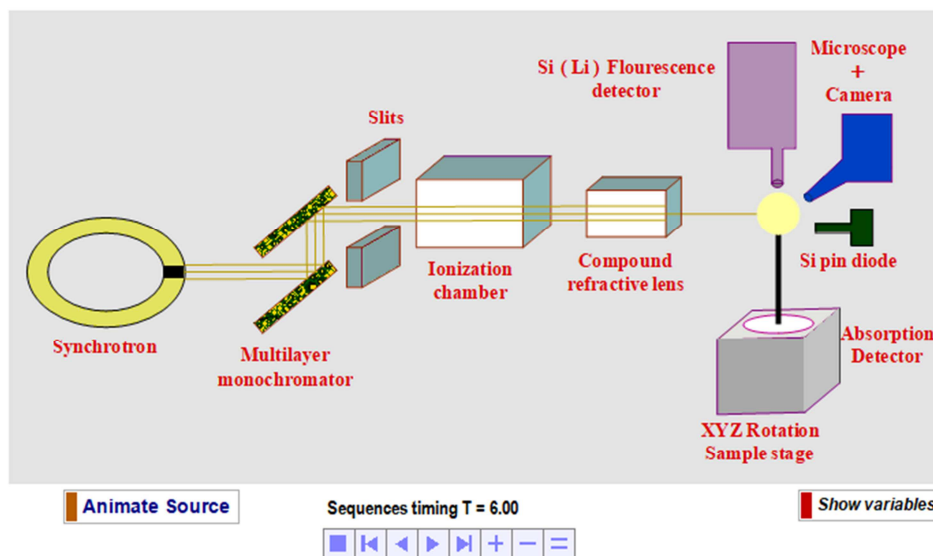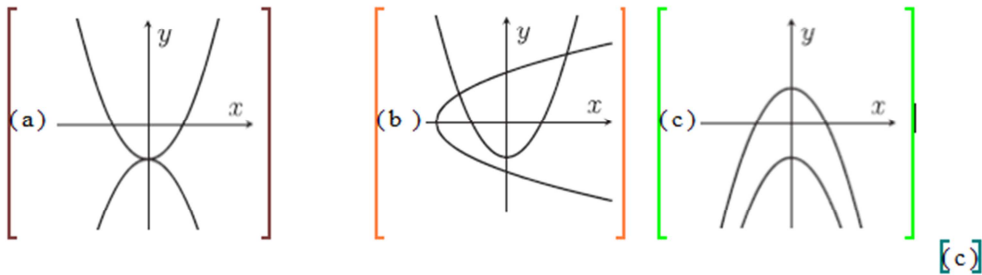*Figure 15. In technical education: Operating a vernier caliper.*

Figure 16. In higher education: A synchrotron-excited X-ray source which gives intense and mono energetic X-ray photons.

I. A sketch of the curve $\left(x^8 + 4yx^6 + 6y^2x^4 + 4y^3x^2 + y^4\right)^2 = 1$ is given in

[c]

Analytic

I. Note that $x^8 + 4yx^6 + 6y^2x^4 + 4y^3x^2 + y^4 = \left(x^2 + y\right)^4$. So the equation is $\left(x^2 + y\right)^8 = 1$, which has solutions when $y = 1 - x^2$ or when $y = -1 - x^2$. This is a pair of parabolas, and y is negative for large x in either case. The answer is (c).

Figure 17. In Assessment: Multiple Question Choice with (c) as right choice, in ScienceWord.

(ix). Carrying out in the Most Natural and Comprehensive Way Teaching and Learning Activities in Science and Technology Education

The Learning 6. 5 suite uses the basic elements of mathematical concepts, the notion of independent variable, which can be any type of parameter such as the length or weight of an object, any measurement, etc., and finally the notion of functional variable, which uses a real multivariate function. It is this kind of unusual concept that facilitates its use in the study and exploration of scientific concepts in a wide variety of fields, such as mathematics, physics, biochemistry, engineering and so on. What's more, the ability to animate scientific models, to directly apply scientific concepts to real-life activities, to explore and probe for solutions to scientific questions using the Learning 6.5 software package considerably broadens the scope of its applications, making it a powerful pedagogical tool that not only extends the teacher's teaching activities, but also prepares students for future tasks related to scientific research.

4. Field Evidence of ScienceWord and Learning 6.5

Very often, when teachers are called upon to use a specific technology, they lack the necessary tools or skills to integrate it effectively as a working tool. The result is that new investments are under-utilized, not used at all, or used in a way that mimics an old process rather than innovating new processes that might be more attractive to students.

In the field of science, technology, engineering and mathematics, commonly referred to as STEM, the preparation of a living lesson, the study of a concept, the search for innovative teaching and assessment methods, etc., are done progressively, with stages that require a draft and numerous corrections and, in many cases, a mixture of text, mathematical symbols, chemical structures, geometric drawings, function graphs, etc. Today, with the new demand to include the Internet in the teaching and learning environment, the challenges facing STEM teachers and researchers are clearly enormous. It is becoming increasingly clear that the Learning 6.5 suite, which includes ScienceWord 6.5, Class.6.5, Skill 6.5 and Marking 6.5, seems to be a very good solution.

Given the unrivalled utility of ScienceWord, in August 2006, the General Office [10] of the Ministry of Education of China took the important decision to implement a project on its use in 13 colleges and universities, 68 modern distance learning pilot schools and 100 secondary schools. To promote the use of ScienceWord, competitions were organized in which participants, all teachers, had to edit scientific documents, with prizes awarded to the teachers who produced the best documents.

Today, while the Learning 6.5 system is not yet widely known in China, it has been successfully promoted through trainings in Benin, Ghana, Mali and a few other African countries. For example, the Ministry of Education [11] and many educational institutions in Benin, the Ministry of Higher Education [12], the Training Center for Development [13] and all the major public universities in Mali, the Ghana Education Service [14], all the major public universities, all the institutes of the Council for Scientific and Industrial Research (C.S.I.R), all the technical institutes and several pedagogical institutes in Ghana, the Abuja National Mathematics Center in Nigeria, the Central Library in Togo, etc., have all organized training on the use of either Scienceword or Learning 6.5 system.

This shows that, even for a program as easy to use as the Learning 6. 5 system, training is essential. What's more, Learning 6.5 system is a very revolutionary tool in its conception. The relevance of the use of an ICT program depends on the abilities or skills of the users. Training of teachers is important because it fosters professional development and integrates information technology into classroom and online teaching. So, it is easy to see why the use of a tool as revolutionary as the Learning 6.5 system needs to be explained to potential users.

5. Conclusion

The availability of Learning 6.5 for the education system will give a boost to online education, which leads to a profound change in teaching and learning methods. One of the main advantages of Learning 6. 5 is its disruptive innovation, which demystifies the production of dynamic, interactive learning objects and makes scientific and technical knowledge so interesting to learn and so easy for students to understand, whether in the classroom or online. Indeed, the whole Learning 6.5 System is built in a totally new concept, equipped with a natural and sophisticated technological working environment that enables convenience, flexibility and creativity. Furthermore, Learning 6.5 has also provided a flexible virtual environment that incorporates interactive features and makes possible for the first time in history, a face-to-face "students-teachers" distance learning, real and effective. It's a powerful package that facilitates Content Development, Content Presentation, Content Delivery and Assessment for online and offline teaching, learning and training [15].

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[11] Letter No: 6578/MEPS/CAB/DC/SGM/DES/SPES dated December 12, 2004, from Benin's Ministry of Primary and Secondary Education, for the use of ScienceWord in schools.

[12] Report No: 2022-000131 / MESRS-CAB of July 20, 2022 listing the universities and institutes of higher education in favor of acquiring the Learning 6.5 system.

[13] Annual decisions by the Board of Directors of the Training Centre for the Development of Mali, to implement a series of training courses on the Learning 6.5 system for teachers.

[14] Letter No: 2022-000131 / MESRS - CAB dated June 25, 2012 from Ghana Education Service which enabled the implementation of teacher training in all ten regions of Ghana.

[15] E. C. B. Comlan, Effective Integration of ICT in Education Using Learning 6.0 Package - Computer Applications for Science Education. Page 137 in the book of abstracts of Online Educa Berlin conference in December 2016.