

Digitalization in professional learning and education

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Abstract - Nowadays, new technologies play a fundamental role in industrialized societies and have become essential in everyday life. They also have a growing impact on education and training, insofar as they have revolutionized the way people learn. However, some areas of knowledge seem to be incompatible with this new learning path. Therefore, we asked ourselves if every area of knowledge is suited for digital broadcast, and whether or not traditional education can be replaced with digital teaching methods. This article questions the influence of technology on education and comments on how electronic devices such as smartphones, tablets and computers can help the learning process. Our findings confirm that new technologies have an increasing impact on education and training strategies both in the professional and educational field: e-learning represents a significant share of training solutions in large companies, and digital trainings help increase productivity as they are more accessible and contribute to saving time.

However, the efficiency of IT is limited in practical fields in which virtual training is impossible, as they require manual practice or application in everyday life.

Keywords: innovation, education, training, information technologies, controversy mapping, e-learning

Methods

The original working title of this paper was “Innovation in education and professional training”. Our first key point was therefore to define and clearly distinguish the terms, “innovation” and “education”. The major innovation of these past few years is the digitalization of education. This mass digitalization was made possible by the development of specific IT (in particular HTML5, Flash, Wifi, fiber optic cabling, and cellular networks) as well as by the democratization of connected devices that these technologies use, such as computers, laptops, tablets, and smartphones. Coming to this conclusion, we found that “digitalization” was more relevant to the subject than “innovation”.

We had originally decided that the term “education” would only refer to school. However, taking into account our professional experiences, we realized that digitalization was also part of the workplace as some companies use IT for their distance trainings. As a result, we decided to include the effects of digitalization in the workplace in our research.

The second step was to find an issue related to the use of IT at school and in the workplace. As we experience this digitalization in our educational and professional activities, we see how it changes the way we learn. For example, instead of looking for a word in the dictionary, we look it up on Google or Wikipedia. Nevertheless, we wondered whether digital learning could become a substitute to “traditional” learning and whether IT-based training was suitable for all knowledge fields, from know-how to social skills subjects. Hence a few questions we asked ourselves: are new technologies the solution to everything? Is it really possible to use information technologies in any field? Consequently, can IT-based methods replace traditional courses in education and professional training?

Building on these questions, we first wanted to obtain global figures about IT and its use in everyday life. We found numerous articles about this subject as it is a trending topic. Then, we focused our research on their use for educational purposes. To interpret this data, we drafted the 6 following questions:

- 1) What is the business line of your company?
- 2) Does your company use connected devices (computers, tablets, smartphones...) as training materials?
- 3) If so, how many training courses have been developed for use on these devices in the past 5 years?
- 4) What is the percentage of trainings developed for each device?
- 5) What are the innovative solutions considered by your company in the short / long-term?
- 6) Are there any needs could not yet be fulfilled by these IT methods?

However, according to one of our managers, these questions were too specific and did not answer our research needs. As a result, we adapted them:

- 1) Why do your customers use IT for their trainings?
- 2) What are the most used devices?

- 3) What innovative solutions has your company considered to meet training needs?
- 4) What were the potential benefits of these solutions?
- 5) Is digitalization relevant to all training subjects (knowledge, know-how, and social skills)?

At the beginning, the questions were in written form. With these new questions, we thought that a better solution would be to interview our colleagues directly. Talking to a subject matter expert establishes a dialogue that makes it easier to ask for specifications, which is not that simple with a written answer.

Introduction

Information technology (IT) has become central to modern societies and has progressively been integrated into education. Information technology, or "IT", refers to computing technology including networking, hardware, software, the Internet, and many other areas. The first computers were introduced into education in the mid 1960's and shortly after, universities began to teach high-level programming languages to their students. In the 1980's, computers were used as teaching aids and the emergence of the World Wide Web in 1995 in the professional and educational field made it a real resource for educators (for instance with the creation of web pages and mass access to Internet).

Along with the development of these technologies, e-learning and distance education developed in the mid-2000's building on a brand new concept: self-paced online lessons accessible to all. Massive Open Online Courses (also called MOOCs) are lessons with open access via the web. Created in 2008, they have developed massively from 2010 and are now an integral part of the educational system. This potentially interactive form of e-learning allows students to experience distance education. MOOCs offer a great variety of courses, mostly theoretical lessons aimed at high school or university students. The world leader in this sector has no less than 15 million attendees and offers around 1880 courses.

Over time, technology has developed in the educational field and can provide new teaching methods, at the expense of what we will call "traditional education". Traditional education refers to the customs established at school by society. It is often associated with the idea of a teacher conducting lessons in front of a whole class of students and involving textbooks, lectures, and individual written assignments.

In the professional field, the proportion of digital devices increased significantly in the 2000's and online trainings started almost simultaneously with MOOCs. Nowadays, many companies have IT departments to deal with the new work methods and business needs resulting from the "information age".

According to Denys Lamontagne in his article "L'utilisation du e-learning en milieu de travail : les pratiques effectives", professional trainings are efficient if they are attended during a work

period as they can be used and put into practice directly. As a result, they help reduce costs related to “classroom” trainings such as transportation or accommodation.

In the her article “Formation à distance en entreprises en France : hybridation en développement rapide”, Christine Vaufrey evidences the ever-growing demand on pedagogical expertise as well as on the improvement of online professional trainings. This mass digitalization both in educational and professional fields has revolutionized the way people learn.

Though information technology is often the subject of debate and controversy, several research studies such as “Autonomie et apprentissage : l’innovation de la formation” (Barbot M.J. and Camatarri G., 2015), “Handbook on Information Technologies for Education and Training” (Pawlowski J.M., *et al*, 2015), or “The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation” (Higgins S., *et al.*, 2012), have shown the importance and potential of IT in the educational and professional field. The increasing variety of devices and the ability of even very young children to cope with new technologies are more reasons that justify its fundamental role in society. It has also been proven that the implementation of new pedagogical strategies has been made possible by the use of new technology.

Nonetheless, e-learning has shown certain limitations, such as for example technical difficulties, lack of motivation on behalf of the learner or organization of the learner’s time. The constant evolution of IT tools can cast doubt on their potential for implementation in the educational field, and emphasizes the need to adapt existing pedagogical methods.

With this in mind, it is important to note that information technology is not systematically relevant and may be a poor choice in some areas of knowledge, especially those in which know-how is involved. Our article questions the ability of information technologies to cover all knowledge areas and to replace “traditional education” on all points. Even if technology evolves with society, we will question its ability to meet all learners’ needs and try to find out the limits of its influence on the training field.

Results

In this part, we discuss our observations on the different pedagogical methods.

3D Content for Education

Traditional education faces the challenge of modern expectations in learners. People now strive for lifelong learning, learning by experience, explorative learning, and independent learning.

In addition to collaborative and interactive content, learners are also looking for more intuitive learning paths. Courses or lessons online follow the WIMP metaphor (Windows, Icons, Menus, Pointer; a term coined by Merzouga Wilberts in 1980). Although the term has fallen in disuse, it can be applied to new technologies as it denotes how the user interface is built around the interaction that the user has with online courses.

In recent years, Virtual Reality Modelling Language (VRML), 3D (Web3D technologies) and similar tools have gained traction. These tools enable learners to manipulate content directly and freely from anywhere. They also provide with immediate feedback which is one of the advantages.

Several tools can render Virtual Reality files such as Quick Time VR which relies on image-based rendering, meaning it can render an object in 3D in one click. Once the object has been photographed from all angles, the software can create a 3D representation of that object, so that learners can rotate the object to study it.

VRML97 is the official ISO standard for 3D on the Internet so all educational developers have to be careful in what they use. The Web3D Central data structure of VRML97 is the scene graph. A scene graph is a tree structure for a virtual world, be it in 2D or 3D, built from parent and children nodes. You can have as many children nodes as you wish. There is a hierarchy of nodes which can represent spatial groupings, object positions, object animations or logical relations between nodes and there are the objects in themselves. A scene graph does not allow to build a complete virtual world but it helps structure the representation of the 3D world.

Theoretically, the advantages of 3D learning contents are numerous and highly-relevant in the information age that the Internet has generated. They provide (almost) instant feedback from any location, at any time and can reach a worldwide audience. 3D learning content mostly exists in the form of simulations or multi-user virtual environments.

One example of 3D content sharing: a teacher can now share 3D content with his students via a 3D console and the appropriate software. The teacher can, for example, manipulate a catamaran and show the different parts of the boat. The teacher would be the only one with the 3D glasses and the stylus but students would be able to see what the teacher is doing thanks to a video projection. This method is still a niche in education amongst all the other modern pedagogical methods but some secondary and postsecondary schools have begun to capitalize on these new technologies.

3D content is often associated with another teaching method: the flipped classroom (another derivative is the flipped laboratory). The principle of a flipped classroom or laboratory is simple: Activities at home and school are reversed. At home, they study theory at their own pace via resources the teacher made available for them previously. In school, they practice or correct what they studied at home. Class is not focused on theory but on practice and concepts. It enables teachers to create interactive content to encourage their students to participate and actively learn.

One example of flipped classroom is a dentistry course in Lyon I University, France where interactive courseware was created to complete and improve 1st year courses. Using 3D content, the students operate a cavity via animated representations of the tooth, cavity and the tools needed to treat it. It demonstrates how to perform the treatment of a cavity.

Controversy Mapping: innovation in social sciences

Innovation in higher education is an issue that has seen its popularity escalate in the past few years. Secondary and postsecondary schools as well as universities gradually assimilate new learning technologies and tools in all knowledge fields, among which the field of social, economic and political sciences. We have touched upon the issue of innovation in practical knowledge fields such as dentistry, where 3D technologies enable students to practice dentistry techniques through three-dimensional simulations, however the humanities are another matter altogether.

What is now important to consider is pedagogical innovation in social, economic and political sciences. One example of this is a pedagogical innovation initiative that advocates the merging of “hard” sciences and human sciences in order to help high school students understand scientific and technical controversies. This pedagogical method called controversy mapping was initiated by French sociologist and professor Bruno Latour over 15 years ago, with the objective of training students to understand techno-scientific debates through the use of digital tools to analyze and represent data. At the crossroads between multiple knowledge areas such as sociology, economics, web-mining, design and social enquiry, this course is currently taught in several European and American universities (Paris, Lausanne, Milan, Dublin, Cambridge...).

The emphasis of this course is the exploration of socio-technical controversies through digital tools. As a matter of fact, students are trained to master traditional and digital methods of investigation while studying a specific controversy, in order to explore and visualize its complexity.

An example of digital tools they use is a web-scraper that crawls links in chosen internet pages and thus helps visualize a network of websites of a given field; a method that helps, as we said earlier, explore and visualize a controversy. Students use this tool to build web corpora in the context of their controversy studies.

Another example of digital tools students use is a website creation tool that renders a website from a hierarchy of folders on Google Drive. Students are invited to organize their whole controversy study in a Google Drive folder, which will at the end of the course turn into a simplified website exposing their semester’s work.

Another innovative aspect of controversy mapping is active learning. In fact, in the span of a controversy mapping course, students are invited to debate via simulations of international collective negotiations, with the aim of rendering and thus understanding the internal functioning of institutions or organizations. Active learning enables immersion through role playing; each student plays a specific role that represents one of the stakeholders of the controversy and has

to defend its position and interests with valid arguments. Throughout this process, students therefore become “actors” of their learning process.

The relevance of active learning methods is most apparent in the development of new classroom spaces through the reconfiguration of “traditional” learning spaces. An example of this can be seen in an active pedagogy classroom designed at Sciences Po University in Paris. It features modular and digital equipment (tables, chairs, video projectors, curtains...) that enables the classroom to be used in several ways: theatrical configuration, debate and simulation configuration and group work configuration, thus creating an environment that is reconfigurable to accommodate multiple uses in a fixed space. Consequently, teachers now have a new range of configuration possibilities for their courses, all of which enable students to learn in an active and interactive way by placing them at the center of their learning process. This innovation represents a major shift from “traditional” educational methods since teachers are no longer “knowledge containers” but rather mentors that give advice and guide their students in their projects.

In our examples of pedagogical innovation through digital exploration tools, we can see that digital tools help the learning process and provide a new perspective to learners. While digital methods of investigation present information in a different, more interactive way by, for example, using website creation to render controversy studies, digital tools are not exclusive and only work in unison with traditional teaching methods. Therefore, the idea is not to abandon traditional pedagogical methods but to integrate new technologies with the aim of revolutionizing the educational system and increasing the range of possibilities presented to the learners.

A New Form of Innovation: “Uberization”

“Uberization”; definition: “*n.* The conversion of existing jobs and services into discrete tasks that can be requested on-demand; the emulation of the Uber taxi service, or the adoption of its business model.” (Uberization, [Word Spy](#)).

This neologism can be applied to education. In this case, it is about independent learning: people have the desire and the means to learn with and from other people. There are no educators or teachers, only learners who help other learners. For instance, someone finds a new way to perform a task; he or she describes the process, maybe shoots a video and posts it on his or her company intranet. An employee interested by this video only needs a smartphone to watch their content and gain new knowledge.

This new method changes from the traditional teacher/student relationship and from the educator/learners. Here, there is a sense of mutual help, there is no real authority apart from the one the learner holds.

“Uberization” is a way for people to reconquer learning in their own way. It provides a self-satisfaction feeling: you did not need a teacher to learn and succeed in doing that specific task.

Survey

We conducted a survey which was submitted to eleven people in total. Only seven people answered, which represents a response rate of 63%. The respondents were mainly project leaders and marketing managers, aged between 30 and 40. There were both men (75%) and women (25%).

As an answer to the question “Why do your customers use ITs for their training courses?”, all respondents agreed by saying that it aligns with a trend in society. According to them, people want to project a contemporary image of their company. In addition, the respondents answered that digital trainings are very profitable to the company, as IT trainings reduce the costs of classroom trainings such as travel expenses. Digital trainings are easily accessible as customers can complete the training anywhere and at any time, providing a sense of freedom to learners. The respondents also highlighted the fact that the learning path is made more enjoyable for the trainees in such a way that training now seems less of a burden and that ITs provide a means to create diverse learning paths for different kinds of knowledge.

In answer to the question “What are the most used devices?” computers and smartphones were the most quoted devices. Tablet use is increasing, especially in Asian countries, where their rate of sale is much higher than in Europe. In France, online trainings are often first designed for computers but tend to be later adapted for smartphones and tablets. However, very few training courses are developed exclusively on tablets or smartphones as they are not often used in the workplace. Overall, the choice of electronic devices is determined by the client’s needs, computing equipment, budget, and knowledge of e-learning.

As for technologies to create pedagogical content, respondents answered they mostly use software programs dedicated to e-learning solutions such as Captivate or Storyline Articulate.

As an answer to the question “What are the innovative solutions considered by your company?” the majority of respondents quoted the following:

- Virtual reality (VR)
- Graphic innovation

- HTML5 (published at the end of 2014)
- Personalized trainings
- Multiple outcome training
- Smartphone games
- Interactive videos

These innovations could contribute to develop better partnerships with a large number of customers in the long term.

Discussion

To further explore the benefits and disadvantages of each methods, studied the answers given to the question “What were the potential benefits of these solutions?”.

How does a flipped classroom or flipped laboratory impact the learning path? It impacts the learners and the teachers at the root of traditional education: teachers do not play the traditional role of giving all the keys of knowledge to students. In a flipped classroom, teachers become guides for their students, they do not lead but help them understand the course.

Sharing 3D content with students is also a very effective way to teach a lesson. Even though students do not have individual computers to visualize 3D content, they can still appreciate the novelty, and become more engaged with learning content. However, aside 3D content you can play on the internet with a 3D web player, it is an expensive endeavor. You need the appropriate software programs, skills, and 3D developers to create interesting and innovative content. Schools might not have the budget to implement these methods.

Graphic innovation enables information to be provided in a different, more interactive way using for example infographics and videos. It has been proven that people tend to remember more if the displayed information includes graphic elements.

Virtual reality has a lot of advantages as it facilitates immersion and role playing. It also prevents the learners from traveling and thus losing time. Virtual Reality models 3D objects which are not easy to see and observe in classroom trainings and can simulate dangerous situations in a safe context. This method is one of the most cost-effective and profitable.

HTML5 enables, amongst other things, the standardization of technical performance of digital training, guarantees a good user experience as it is the most mature technology, as well as a reduction of costs for the customers. Personalized trainings, for their part, help the clients feel involved in the training, guarantee consistent trainings in both form and substance and provide a more precise analysis of the customers’ needs. Multiple outcome training provides different outcomes depending on the learner’s answers. As for smartphone games, they provide an

entertaining and relaxed learning environment. Last but not least, interactive videos can become an asset to traditional courses.

In response to the question “Is digitalization relevant to all subjects (knowledge, know-how and social skills)?”, the respondents agreed in saying that digital trainings cannot replace practical trainings in a classroom. For them, digital trainings are a complement to classroom based trainings as far as a human presence is necessary even if it is digitized (video conferences for instance). All subjects can be treated digitally but they won’t be approached in the same manner, depending on the type of knowledge involved.

A respondent gave the example of virtual reality which can be suitable for know-how or social skill trainings but won’t be very efficient for subjects related to general knowledge.

Online trainings can be suitable for knowledge, know-how, and social skills depending on the technology used.

As shown in the results of the survey, the majority of respondents share the same opinion, that is to say that information technologies have become essential in the training field as far as they present many advantages. In addition, depending on the type of knowledge involved, certain types of technology are more relevant than others.

When it comes to information technology, it is important to distinguish software technology (such as HTML5 or Flash) from electronic media (such as computers, smartphones or tablets) which host those technologies. Innovations can be technological or “electronic”, software or hardware-based.

The results were limited to a small number of respondents and thus, cannot be representative of the overall views on this subject. Furthermore, all respondents are active workers in the e-learning field, and in the same company, which cannot produce a truly objective data set, as their work is based on information technology to begin with. Overall, they all share the same opinion on the subject.

If further surveys are conducted, with respondents from different backgrounds, the results might be different. However, we were not able to interview a large range of professionals as we selected people that were available in our companies, with whom it was easier for us to conduct and implement the interviews.

Conclusion

Innovation, digitalization, Information Technologies, Controversy Mapping; all these notions are at the forefront of education and professional training. Recent years have seen an evolution in education that deeply changes educators’ and learners’ roles. We have witnessed the

appearance and development of innovations such as MOOCs, 3D content and, more globally, the “uberization” of content.

Learning paths are gradually changing to fit the learners’ expectations and requirements. However, the implementation of information technologies in the field of educational and professional training is a highly adaptable process; different areas of knowledge require different technological tools to achieve different goals. That being said, we can undoubtedly state that digitalization will occupy a key position in all educational fields in a medium and long-term vision.

Overall, we have gathered evidence that pedagogical innovation whether technological or content-wise will not stop evolving. It is a profitable market for companies specialized in developing pedagogical content because people will always want to learn, participate and share what they have done. Indeed, learners or future learners gain from this innovation; it brings more interesting, interactive and collective content to study and train on.

Bibliography

BARBOT, M-J. and CAMATARRI, G. (2015). *Autonomie et apprentissage : l'innovation de la formation*. Éditions Puf.

LEBRUN, M. (2005). *L'hybridation dans l'enseignement supérieur : vers une nouvelle culture de l'évaluation*. Editeur: ADMEE Europe

CAUDRON, A., DESBOIS, A., NELLER, S., ORY, J. (July 2015). *Innovation and training: Targeting, designing and broadcasting*. ComTechP7.

BAUJARD, C. (2005). *Stratégie d'apprentissage e-learning. Le point de vue du gestionnaire*. *Distances et savoirs* 2005/1 Vol. 3, p. 29-48.

PAWLOWSKI, J-M., ADELSBERGER, H-H., COLLIS, B. (2015). *Handbook on Information Technologies for Education and Training*. Springer, Extracts.

Knewton.com, an infographics on Flipped Classrooms.

See <https://www.knewton.com/infographics/flipped-classroom/>

Openscenegraph. (May 2012). Knowledge Base.

See www.openscenegraph.org/index.php/documentation/knowledge-base/36-what-is-a-scene-graph

LAWLESS, K., PELLEGRINO, J. (December 2007). *Review of Educational research - Professional Development in Integrating Technology Into Teaching and Learning: Knowns, Unknowns, and Ways to Pursue Better Questions and Answers*. University of Illinois at Chicago

ZHANG, W., SPURLOCK-JOHNSON, J., GAO, X. (November 2007). *Can E-learning Replace the Traditional Classroom? A Case Study at a Private High School*.

HIGGINS, S., XIAO, Z., KATSIPATAKI, M. (November 2012). *The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation*. School of Education, Durham University.

VAUFREY, C. (May 2012). *Ce que la formation en ligne académique peut apporter à la formation professionnelle continue*. The cursus.

See <http://cursus.edu/article/18221/que-formation-ligne-academique-peut-apporter/%20-%20.V1qBWzEsCZY#.V72QRxJEqQI>

VAUFREY, C. (June 2011., Formation à distance en entreprises en France : hybridation en développement rapide. The cursus.

See <http://cursus.edu/dossiers-articles/articles/3895/formation-distance-entreprises-france-hybridation-developpement/%20-%20.V1qCkDEsCZY#.V72QMxJEqQI>

LAMONTAGNE, D. (January 2011). L'utilisation du e-learning en milieu de travail : les pratiques effectives.

See <http://cursus.edu/dossiers-articles/articles/5435/utilisation-learning-milieu-travail-les-pratiques/#.V72QuhJEqQk>