Review of the Use and Impact of Nano-Learning in Education

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Abstract

With the birth of Connectivism as a historical evolution of education and the birth of e-learning 2.0 which is developed by Downes (2005), a new branch of education derived from e-learning and based on small pieces of learning, known as non-learning, is also born. This article presents a literature overview of non-learning in education with a summary of some historical main background theories that formed new paradigms of education. Nano-learning can be defined as a smaller component of micro-learning that involves dividing micro-content into small chunks to address a single objective. More ideas are represented in this article pertaining to the uses, impact, and challenges of nano-learning in education, where social and communication technologies have changed the bases on which the knowledge and learning are based and constructed. The current debates on this topic inspired us to review related literature on the concepts of nano-learning in the era of social networking. Therefore, the main contribution of this work is to encourage further debate among researchers and practitioners in the field of education to introduce new social media platforms and instructional designs that are influenced by nano-learning principles and can enrich learning.

Keywords: design, e-learning, instruction, micro, nano, content

1. Introduction

Individualization and personalization of the learning process is no longer a trend and fashion but a strict necessity. The one-size-fits-all school was good for educating factory workers. Nevertheless, the situation has changed - society does not need those who will work on the assembly line but those who will create robotic lines. People are used to personalization. It has changed them and their view of the world: targeted advertising, personal managers everywhere, from banks to online shops, everyone has media perfectly tuned to their interests in their phone. Moreover, education has to match this reality.

Adaptive systems in online education are already helping teachers build personalized learning plans. Such an adaptive system is nano-education, which is now gaining popularity in the field of learning. One of the main features of nano-education is its close connection with information technology. For example, there are systems for group learning that generate unique assignments for each student, check them, and compile statistics for the whole class. The teacher, in turn, proposes a personal developmental trajectory for each student based on this data. He will have time to think about it because artificial intelligence will relieve him of

the routine checking of work and track each student's progress. Until recently, a schoolteacher or a professor at an institute was the only medium of knowledge. A lecture was the only way to impart information to students.

Today, however, every piece of information can be found on the Internet. Everyone has access to online libraries, research, video and audio materials. This approach requires structural changes. Firstly, smaller groups - this way of teaching does not work in large classes; one has to pay attention to each student. Second, there are higher demands on teachers' professionalism: it is no longer enough for them to skim through the material and give a straightforward lecture. Teachers must be able to use modern teaching methods, which are now more important than knowledge of the subject matter itself. This essay will discuss such changes and the possibility of introducing nano-learning into the education system in general.

2. Literature Review

2.1 Definition of Nano-learning

Nano is one of the prefixes used in the International System of Units to form the names and designations of decimal units. A unit whose name is formed by adding nano to the name of the original unit is the result of the multiplication of the original unit by 10-9. In other words, the newly formed unit is equal to one billionth of the original unit. By understanding the meaning of the word 'nano', the meaning and designation of nano-learning can be more easily understood.

Nano-learning is also known as bite-sized learning. It is a continuous learning process in which the learner gains knowledge without spending long hours. Nano-learning offers shorter learning capsules in which maximum useful information is synthesized. For example, a two-minute interaction with an expert will clear the net of doubt and improve the learner's knowledge quotient (Gramming et al., 2019). Alternatively, short reading materials can help understand the logic of a concept or formula. Such materials are much easier to absorb because of their short duration. The human brain does not tire of long lessons and interaction with the teacher while getting the maximum information needed to understand the subject matter (Illeris, 2016). Nano-learning is defined as a learning program designed to enable a participant to learn any subject in a ten-minute period of time. This takes place via electronic media and without real-time interaction with an instructor.

Nano-learning programs tend to focus on one specific learning objective or one specific subject. No more than one subject can be switched in one drop course, and the focus of learning usually does not shift from one objective. It is important to remember that nano education is not a group program. The point is to give each learner the exact capsule of knowledge he or she needs. This approach eliminates the possibility of group training in even the smallest of groups. Another critical point is that nano learning is not a substitute for comprehensive programs that address complex issues. Instead, the format is suited to tackle specific areas of the subject matter that are unclear or explain narrow topics. For a qualitative understanding of a broader subject, the learner needs sufficient time for an extensive explanation, which nano learning cannot provide (Pritchard, 2017). This is because one nano-lesson usually lasts between two and ten minutes. This is quite enough time to explain a narrow topic or clarify certain aspects of a broad topic, which is ultimately the purpose of nano learning.

2.2 Definition of micro-learning

Microlearning is learning in small chunks that take just a few minutes. Microlearning modules, or micro-courses as they are called, are a great way to provide a clear, practical answer to a specific question or problem. Any online content - training videos, podcasts, presentations, scripts, and assignments - can be delivered in a microlearning format (Dolasinski & Reynolds, 2020). Learners enjoy microlearning because it gives them instant access to the information and skills they need. In addition, microlearning is usually tailored to mobile devices - so one can take the courses anywhere (Railean, 2019). Educational designers love microlearning, too, because great microcontent can be created quickly and inexpensively. For a company, microlearning is an excellent opportunity to build a system for training employees quickly and engagingly.

This type of training has many distinctive advantages. For example, microlearning is a natural cure for forgetting. With a series of short micro-courses, specific skills can be well leveraged and securely reinforced. Studies show that microlearning reduces the likelihood of mental fatigue because it is specific (i.e., it is easier for the brain to concentrate on one thing) and short (i.e., it is easy to take a break) (Emerson & Berge, 2018). Through repetition, information is transferred from short-term memory to long-term memory - which is how we build knowledge. Many companies are already successfully using micro-courses for on-the-job training. For example, Walmart has used micro-courses to train employees on safety rules (Hamilton et al., 2021). As a result of the program's launch, there was a significant increase in knowledge retention and a 54% reduction in accidents.

Another essential benefit of microlearning is that learners themselves enjoy this format. A recent study found that people born between 1980 and 2000 and the even younger Generation Z together make up nearly half the US working-age population (Jahnke et al., 2020). Young professionals are avid fans of technology - both in work and in learning. Today's learners love efficient, accessible, and fast materials. Microlearning, as a format sharpened for mobile devices, perfectly covers the needs of employees who want timely answers to questions that arise in the workplace. BH Media, which owns and operates 119 newspapers in the US, has launched a series of microlearning courses for sales managers. 98% of employees who took the training said the content was beneficial and applicable on the job (Wright, 2018). A recent study from LinkedIn revealed that the most significant barrier to practical training is time. The microlearning modules are much shorter than traditional e-learning courses, which means that an employee can complete several modules per week. This training format is therefore convenient and practical for any audience of learners.

2.3 Nano-learning in public and higher education

Nano-education in public education manifests itself not only in the form of capsule courses but also in the form of nanodegrees in universities. Some researchers argue that nanodegrees may be an alternative to higher education for some people. However, some of these people were not going to go to university to take a classical course and get a classical degree anyway. University is extremely expensive, and it is argued that too many people get higher education. If nanodegrees show a viable alternative, they could help reduce the inflation suffered by recent graduates by existing as vocational education (Wilkinson et al., 2018). At the same time, since physical resources are no longer needed, nanodegrees can be obtained more cheaply and efficiently than vocational education.

Many people involved in academic education condemn the idea of obtaining nanodegrees. The fact is that nanodegrees are simply a different kind of education from a classical liberal arts education. Nanodegrees provide targeted training for one job, whereas a classical liberal arts education provides skills for different jobs (Railean, 2017). Therefore, people in classical education should not fear for their institution, but neither should nano degrees be dismissed as useless. Both types of education can co-exist and serve different purposes. A classical liberal arts education can provide a wide range of skills, but it will take a fair amount of time. At the same time, nano-education in public education can exist as separate capsules designed to fill knowledge gaps. In addition, nano-learning can help students who missed out on a topic catch up on the knowledge they missed out on.

2.4 Nano-learning in curriculum design

A curriculum is a normative document that defines the activities of the creators of textbooks and teaching aids. Curricula define the scope and content of the material required for vocational education and training. It must be constantly updated to reflect the needs of production. The principle of variability, which is being implemented in the country, allows educational institutions to structure the pedagogical process according to various models, including the author's models. The content and scope of the teaching material are reflected in the blocks and modules of the curriculum (Serret & Gripton, 2020). This makes it possible to ensure consistency of presentation in accordance with the logic of labor and technological processes and to take into account the requirements of the educational standard. With this in mind, nano-learning can fit well into the development of training plans. The fact is that there are no precise volume requirements when it comes to the study of narrow topics.

Moreover, while for classical liberal arts education, the curriculum must be designed to teach in a group, there are no such requirements for online learning (Redondo et al., 2020). If to talk about introducing nano-learning into a face-to-face form of education, it will still be about video lessons, as this format does not imply direct contact with the teacher. Such lessons can be an excellent complement to a regular group program and add some variety to it. If nano-learning is embedded in the program, students will be able to get the necessary amount of material from the short capsule lessons themselves instead of rehashing an entire lecture (Zhang & West, 2020). This approach will provide more free time for the students and more interest in the learning, which now takes place in a convenient format. When introducing nano-learning into an educational program, it is essential to remember that this format cannot replace a complete course in a subject.

2.5 Nano-Learning for Lifelong Learning

The concept of lifelong learning is to continue developing professionally and personally. After graduation, the knowledge acquired quickly becomes obsolete. Many modern professions require the ability to improve one's knowledge and skills to keep up with research, new developments, and breakthroughs in the field (Drakidou, 2018). Many people face some problems in continuous learning, which can easily be solved by nano-learning. For example, it is pretty easy to lose motivation in continuous learning. In most cases, this is because the person is exhausted by the long courses and the amount of time that needs to be spent on learning (Longworth, 2018). The primary purpose of nano-courses is to accommodate a large amount of helpful information in a short period of time. This form is particularly suitable in the context of continuous learning, as a person can receive new information all the time

without having to spend much time. This advantage is also revealed by the fact that the vast majority of adults who practice lifelong learning have a principal occupation.

Many people drop out of this practice precisely because learning is impossible when there are other things to do, such as work or household chores. Nano-learning solves this problem, as it becomes easy to fit new and exciting information into an adult's busy schedule. Another problem with continuing education is a lack of money. Most full-fledged training courses cost much money because their creation requires a lot of human resources (Lee et al., 2020). In the case of nano-education, the creation of such a course does not require the cost of a teaching space or the regular payment of teachers' salaries. It is an already created and recorded program which can be revised and re-dried many times without requiring new resource inputs. The cost of such courses is thus significantly reduced, making this format very practical in lifelong learning.

2.6 Nano-learning in language education

Nano-courses can also be very effective for language education. This format increases the efficiency of the learners and, therefore, the quality of the knowledge acquired in general. Due to its capacious structure, nano-courses fit perfectly into the learning process and provide the proper knowledge at the right time. Such a course covers one topic at a time, so students get the most factual information quickly and effectively. APA PsycNet conducted a study where some learners received information about workflow in consecutive small portions (Dingler et al., 2017). In contrast, others studied the same process in a more comprehensive format. The former performed much better and were able to explain the process steps to their colleagues without difficulty. Such rules apply in language learning as well, as learners need to explain specific rules for better understanding.

One of the main reasons for the popularity of nano-language learning is that this format aligns well with how the human brain consumes information. Good nano-courses include only the right content, so learners do not have to waste time with empty words and exercises for a tick. Research from the Association for Talent Development (ATD) has confirmed that learners like nano-courses better than traditional courses: they are better remembered and digested (McLelland, 2017). This advantage is particularly important for learning a new language, including remembering new words and constructions. A similar principle is used in language apps, which suggest spending no more than five minutes a day learning a new language (Simons & Smits, 2020). This format is attractive because it is easy, and the amount of time required is minimal.

2.7 Nano-learning with Y & Z generations

Nano-learning is particularly popular amongst Generation X and Z, and there are a number of natural reasons for this. Generation Z already learns much more from short videos on Snapchat, Tik Tok, and YouTube than textbooks and outdated learning modules. Because Generation Z grew up with smartphones, learning will be unrecognizable to the next generations (Bertaux & Thompson, 2020). Learning with short, entertaining videos used to seem impossible, but today this idea has become the basis of the concept of nano-learning. Fast and entertaining content provides learners with the information they need in a way that holds their attention (Marks, 2021). Nano-learning is a way of delivering compressed information in an engaging format. It provides a few sound bites or offers of valuable and relevant content through platforms such as Tik Tok, Twitter, or text messages (Khaif & Salha,

2021). These platforms are viral among Generation X and Z, which is why they are the most active users of nano-learning today.

Learning content on social media most often begins with humor or a shocking fact or draws readers in with a summary. Teachers need to win the learner's attention quickly to leave the world of protracted training courses and videos; corporate trainers need to win the viewer's attention quickly - otherwise, they risk becoming irrelevant (Kirschner et al., 2018). Although this content is limited in length, it does not pose any additional problems, just a developmental boost. Learners who value a fast format and progressive learning will share the good content. As a result, learning content will be more widespread and accessible than ever before. Fewer barriers for the learner will mean fewer barriers for the teacher. As content is easier to read and access, it will be easier to create and deliver. Topics will be more relevant and flexible than ever before.

2.8 Challenges of nano-learning in education

There is no doubt that without new experiments in any field, no development is possible. However, any introduction of new things should be a step-by-step process: pilot implementation - analysis of the effectiveness of new methods - targeted implementation. It is important to remember that nano-learning is a new tool but by no means an alternative to comprehensive professional development. It is a long way from a short-term training of individual skills to developing a competent high-caliber professional. The main reason for this is that the main problems in practice arise at the interface between different fields (Cope & Kalantzis, 2017). The qualification of a specialist is to be able to combine their skills masterfully, which cannot be taught in the nano-format.

For newcomers, online information and online self-monitoring can be a great help in learning how to deal with the most common typical situations. Nevertheless, what comes next is multi-variant behavior, forming one's view, and the ability to develop a specific solution; all this is much more effectively taught in dialogue with a teacher, a consultant, and colleagues (Crompton & Traxler, 2017). It is essential to understand this fact and distinguish between the scope of classical education and nano-learning. The main problem with nano-learning is that it is only a tiny part, a supplement, and not a core course. It cannot prepare a qualified person from scratch. Suppose a person wants to start learning a new field in nano-education. In that case, he or she should realize that such a course will not give complete and extensive knowledge.

2.9 Status of nano-learning during COVID-19 pandemic

Nano-learning is a significant trend in education because of its progressiveness and convenience and because of its distance format. When people had to self-isolate from society at the beginning of 2020 to avoid being infected by COVID-19, distance learning became the primary method in education (Bloor, 2017). Nano-learning has also become much more polarized, as it involves an online format. In addition, many people during the quarantine period wanted to develop themselves and gain knowledge in new areas. Nano-learning offers them short lessons to try out a new topic and assess their ability to learn it. This factor has helped nano-education to gain even more popularity among the population. In addition, this format allows sufficient time to devote to entirely different topics, as a lesson takes between two and ten minutes. In this way, the student is immediately immersed in a particular topic, saving time by taking lengthy courses. With the help of analytics and unique algorithms, the learning process can be optimized and organized to make it easy for everyone to work with

even large amounts of information. Nano-learning helps to personalize learning, which is a valuable advantage during a pandemic.

2.10 Nano-learning efforts in Saudi education

Researchers and technology providers see great potential in education and distance learning in Saudi Arabia. The same is true for nano-education, which is part of introducing information technology into learning (Kapp & Defelice, 2019). Through adequate benchmarking, Saudi Arabian universities will eventually be able to fully autonomize their e-learning systems and position themselves as key players in education in the region and globally. Given the country's rapidly growing population, e-learning arguably provides the most comprehensive and realistic approach to learning to ensure that Saudi Arabia's population expands educationally. Saudi Arabia should be commended for taking systematic steps to strengthen e-learning. Mobile e-learning is the latest approach that has shown the most significant potential in this sector.

Saudi Electronic University has been a key player in promoting mobile e-learning systems. It has one of the best-integrated learning systems offering fast and convenient access to learning materials and lessons (Aljaber, 2018). Doing so has eliminated some of the common shortcomings of distance learning, such as poor communication and poor connections between students and instructors. Built with flexibility and adaptability in mind, this university constantly improves its systems. It ensures that all stakeholders take full responsibility for their work. Its willingness to encourage faculty and student inputs in developing the concept is a flagship for e-learning in the state. With the Kingdom's efforts in ensuring a prospective competing and effective online learning, a large-scale study was taken over in 2020 to explore the status of online learning during the time of COVID19. The study covered periods before, during and after the tense times of the pandemic. The study, as described "culminated in a number of recommendations to allow the Kingdom of Saudi Arabia to effectively build infrastructure and capacity and to deliver high quality online learning. With a focus on eight dimensions, several subdimensions (such as Leadership, Curriculum Design and Planning, Online Teaching and Learning, Assessment, Technology, Student Support, Training and Support, and Evaluation and Continuous Improvement) were explored as well. Large numbers of participants participated in surveys and interviews, contextualized within the Saudi higher education environment for development and analysis. (O'Keef, et al, 2020).

Authors of the study describe their methodology as "Survey and interview analyses resulted in recommendations across all eight dimensions that will allow for the development and implementation of higher capacity and quality in online learning. Themes throughout, and particularly related to communication and technology indicate that though some challenges existed prior to COVID-19, the rapid shift to online learning following the pandemic resulted in increased visibility of challenges (both prior to and following COVID-19) as well as increased need in these areas. Study results indicate that immediate action was taken on these items, though challenges remain. Moving forward, direct attention to technology and communication, particularly between administrators/staff and faculty, and between faculty and students, is essential to the development and delivery of effective online teaching and learning opportunities" (O'Keef, et al, 2020).

One of the most recent and smart nano-learning initiatives in Saudi Arabia as well is "Madrasati". Madrasati means 'my school' in Arabic. The Madrasati platform is launched by

the Ministry of Education, to enable students access education in the most severe situations, which later has become an online landmark of a blended teaching and learning environment.

Madrasati currently serves 4862118 students and 402468 teachers in public schools and 178068 students and 13585 teachers in private schools hosting 56525584 lessons utilized by 292 million visits per semester.

3. Discussion

From the above, one can conclude that nano-education is an up-and-coming area of development in learning. There is a perception that nano-education is just a new format that will soon be forgotten and relegated to the back burner. However, this will not be the case because new generations are finding it harder to learn. There is an overabundance of information, much advertising, clip thinking has emerged: the brain perceives the world through short, vivid images (Corbeil et al., 2021). A legitimate solution is the emergence of nano-courses, making it possible to assimilate large amounts of knowledge more quickly. As mentioned earlier, online programs based on this model have proven effective with students. A nano-course may take longer to create than a conventional course, but it is several times more effective. Like any course, it should have a clear structure and a script that takes the learner from point to point. A nano-course is an independent block of content with its learning objectives. Moreover, this information is as specific as possible. The challenge for the teacher is to adapt the necessary material to this format.

For example, it is necessary to develop an art course dedicated to Andy Warhol. A voluminous course touches upon all periods of creativity. In a nano-course, the teacher sets a different goal: by the end of the course, the student should know all of the artist's significant works and history. So, for a nano-course, one will need to select paintings and information related to the history of their creation. One painting is one lesson, plus a test on each block and a final at the end. In this way, the student will be able to learn the necessary information point by point without studying the whole voluminous biography. This is the main advantage of such training and, at the same time, its main disadvantage - the pinpoint volume of information in a short time. Educators have a somewhat ambivalent attitude towards this format. There is nothing strange about this, as all innovations have to undergo an adaptation period to fit comfortably into everyday life. Nevertheless, it cannot be denied that this format is unparalleled in modern education in the context of time consumption and usefulness.

4. Conclusion

To sum up, nano-learning as an approach is the concept of absorbing any knowledge in small units. This approach can be used to acquire professional skills. Systems for evaluating the results of nano-training take into account many different factors, and they can be adapted to the needs of a specific training event. Each micro-course aims to form one skill, information about which is provided in small portions. Nano-courses are an effective training format that meets modern realities. The reference point of nano-training should be considered not the duration but the educational goals. It is designed not to reduce the time of studying any topic but to achieve 100% of hitting the educational goals and objectives.

Thanks to the format, nano-training does not require breaks, deviations from the topic, there is no unnecessary information. The material is fixed due to repetition at specific

intervals. Nano-learning is a way of presenting educational content, not the content itself. It can involve any content, depending on the set educational goals: videos, texts, images, tests, games, and much more. Nano-learning can be used for any complexity of the material. It is more important what educational goals are solved with the help of micro-training. Suppose one correctly identifies the needs of students, sets a goal, and applies the right strategy. In that case, nano-learning can become a true companion, regardless of the complexity of the content. Nano-training is adaptive and personalized. It meets the student's specific needs, adapts to them, and therefore is suitable for everyone.

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