

Digital Transformation of Education Brought by COVID-19 Pandemic

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[Abstract]

In this paper, the author found and analyzed the problems caused by the change of traditional teaching methods to online in classrooms and laboratories. Looking at the analysis of major problems, first, there were various technical problems, including not all environments and facilities being connected to the Internet. Second, the effectiveness of virtual classes, which were suddenly switched online, could also be questioned. Finally, in the face of a new environment, the stress of teachers to adapt rapidly to the new teaching methodology was a problem. The author proposed digital transformation as a way to address these problems. The author analyzed educational changes, learning modalities and various technical tools, and various tasks to enable digital transformation. First, the author investigated, analyzed, and presented the factors necessary to efficiently operate the classroom environment that will change to online. Next, the author analyzed the factors and problems needed to make the students' classes reliable and efficient, and proposed solutions. Finally, the author pointed out the problem that during online lectures, the responsibility of learning is excessively transferred from teachers to students, and proposed a solution to this problem. Subsequently, the author proposed future studies.

▶ **Key words:** Education, E-Learning, COVID-19, Digital Transformation, Pandemic

[요 약]

본 논문에서 저자는 교실 및 실험실 등에서 진행되던 전통적인 교육 방식이 온라인으로 바뀌게 됨으로 발생하는 문제점들을 찾아 분석하였다. 주요한 문제점으로 분석된 것들을 살펴보면, 첫째, 모든 환경과 시설이 인터넷으로 연결되지 못하였음을 포함하여, 다양한 기술적 문제가 있었다. 둘째, 갑작스럽게 온라인으로 전환되어 시행되는 가상 수업의 효과도 의심받을 수 있었다. 마지막으로, 새로운 환경에 직면하여, 새로운 교육 방법론에 빠른 속도로 적응해야 한다는 교사들의 스트레스가 문제였다. 저자는 이러한 문제점들을 해결하기 위한 방법으로 디지털 전환을 제안하였다. 저자는 디지털 전환이 가능하도록 하기 위한 교육 변화, 학습 양식 및 다양한 기술 도구, 그리고 다양한 과제에 대해 분석하였다. 먼저, 저자는 온라인으로 바뀌게 되는 교실 환경을 효율적으로 운영하기 위해 필요한 요소들을 조사하고 분석하여 제시하였다. 다음으로 저자는 학생들의 수업을 내실있고 효율적인 것으로 만들기 위해 필요한 요소 및 문제점들을 분석하였으며, 해결방법을 제안하였다. 마지막으로, 저자는 온라인 강의가 진행되면서 학습의 책임이 교사로부터 학생에게 과도하게 전가된다는 문제점을 지적하였으며, 이에 대한 해결 방법을 제안하였다. 이후 저자는 향후 연구를 제안하였다.

▶ **주제어:** 교육, 이-러닝, 코비드-19, 디지털 변환, 판데믹

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I. Introduction

The COVID-19 brought positive and negative impact on education. The scale of the COVID-19 epidemic's impact on the learning and well-being of education systems, children and young people is increasing every day[1-3]. This is a global crisis that is preventing children and adolescents in all countries, including those affected by conflict and displacement, from fulfilling their rights to quality, safety and inclusive education. On the positive side, because of this pandemic, distance learning is now a new general, and with this change, education is also available in our homes, and learning resources are now available in digital form. People have a good time with their family while learning [4-6].

The digital transformation of education is the integration of digital technology into all areas of education, delivering value to learners and fundamentally changing the way they operate [7-9].

Information and Communication Technology (ICT) learning is expanding. ICT is becoming faster, more user-friendly, and more widely used on campus, libraries and learning centers, offices, and homes. Their attractive commitment to greater learning productivity and performance is reinforcing their appeal to bureaucrats, managers, policymakers and students. As a result of these and other developments, learning skills are central to all areas of education. At the same time, learners' needs are changing in response to major economic, social, political, and technological changes. Classroom-based learning is less acceptable and, if necessary, learners are demanding new learning methods that reflect the needs of their work and lifestyle. Adaptability, portability, and interactive learning, as well as appropriate and relevant support resources. It supports services that enable you to adapt to new roles and responsibilities as you move from dependent classroom-based learners to independent learners. Teaching is changing from a teacher-led way to a learner-centered way. Flexible

learning comes from a combination of skills and learner-centered teaching and learning styles.

Despite the efforts of the government, education sector, students, and parents, the implementation of remote learning is expected to face five (5) challenges.

For instance, online education is restricted by infrastructure. Due to the large number of students and teachers using the online platform at the same time, the network can become overburdened and crashes can occur. Furthermore, gaps in information technology (ICT) infrastructure may be important and trigger issues. In remote regions, network coverage is inadequate, which can contribute to educational inequity.

Second, the use of online educational tools is still uncommon; online courses are regarded as a complement to conventional learning. It can be difficult to complement offline learning if it is used as the primary mode of learning.

Third, online learning can have an effect on educational quality. Teachers may be reluctant to implement these new methods because they have no prior experience with online education. Teachers' attitudes toward the use of technology can vary, as may their willingness to learn new online resources.

Fourth, when teaching and learning at home, both teachers and students face difficulties. For example, a home environment may not be conducive to learning due to noise, household tasks, and other distractions that may make it difficult for them to pay attention and complete their activities and homework. Teachers may not have had adequate space to conduct online learning, and distractions may have hampered their effectiveness. Finally, inadequate hardware and an unreliable network link at home can have an effect on teaching and learning.

Fifth, it is uncertain which teaching mode and pedagogy would work better for online education. While "Suspending Classes Without Stopping Learning" helps to prevent hasty copying of the

offline curriculum to online teaching, there has yet to be a generally accepted consensus about how such copying can be avoided by teachers and students. Furthermore, more research is needed to determine how to account for and incorporate the specific characteristics of online education into everyday online teaching and learning.

In this study, the author discussed the challenges and the learning modalities and different technology tools to make the digital transformation possible.

II. Review of Related Literature

In the midst of the COVID-19 outbreak, the Chinese government initiated an emergency policy plan called “Suspending Classes Without Stopping Learning” to continue teaching practices as schools throughout the country were closed to contain the virus. However, there is controversy and debate regarding what to teach, how to teach, teacher and student workload, the classroom environment, and the consequences for educational equity. The policy may face difficulties due to the following factors: the vulnerability of the online teaching infrastructure, teacher inexperience (including unequal learning outcomes caused by teachers' varying experience), the knowledge gap, the dynamic environment at home, and so on [10].

The impact of COVID-19 triggered a change in educational approach from traditional classroom to remote, distance, or online learning environment. To keep up with the new normal, national and international attempts to use technology for remote learning, distance learning, and online learning [6] have been prioritized.

The effects of the pandemic in the field of education were the subject of this research. Specifically, a hectic and sudden movement occurred in a paradigm shift that assumes a shift from face-to-face education to online education and how education practitioners should adapt to the

current global environment through online forms.

As a result, education practitioners are undergoing a complex phase of assimilation to new circumstances, resulting in high-stress situations [8].

Before COVID-19, the faculty at the Beijing Jiaotong University (BJTU), Weihai campus, did not teach or offer courses online. However, as a result of the COVID-19 pandemic, the BJTU is refreshing its approaches to online teaching and learning. They are introducing three (3) initiatives to move to digitalization: (a) Help the Faculty - use of MOOC tools gathered from well-known overseas websites for online teaching reference has been given for BJTU teaching staff in Weihai Campus, (b) Investigate and test platforms - Features such as live streaming teaching, online conferences, file sharing, and community interaction are examined, examined, and exchanged on campus-based Enterprise WeChat networks, which have created even more options and backup solutions for online teaching. (c) plan ahead of time - A week before the official start of the online lecture, the tentative plans and platforms used in all courses were thoroughly summarized and checked during the first four weeks [11].

III. Challenges in the shift in Education Paradigm

Since not all of them have an internet connection, the transition from a face-to-face classroom environment to a virtual/online class has presented many difficulties in terms of connectivity. The efficacy of virtual classes is also being challenged. This research examined the current state of education in the light of the COVID-19 pandemic. The global health emergency resulted in people being locked up, and the closure of centers and a shift in face-to-face education to online education. Faced with this reality, teachers had to adapt quickly not only to modern methodological approaches but also to their

confinement, which resulted in high levels of stress.

With the risk of infectious diseases caused by COVID-19, the current situation is causing a series of changes in various areas of social, political, labor and economic life. Different governments have launched emergency policy programs focusing on suspending classes and closing education centers to continue the practice of teleologically teaching from home through the use of information and communication technology [8].

According to a study of over 10,000 teachers [9], 92.8 percent of teachers experienced mental fatigue, tension, anguish, or anxiety as a result of confinement and distance education. Teachers cited unnecessary bureaucracy, contradictory orders, a lack of teleworking support, and a lack of technological means as the key issues. Weak online teaching infrastructure, a lack of teacher preparation, a knowledge shortage, and a diverse home climate are all possible obstacles for such policies. This analysis recommends teacher training through a set of training guidelines to resolve the particular issue of teacher training [10].

COVID-19 has a number of positive consequences for introducing new learning experiences, but it also has several drawbacks. The provision of internet services is the most important problem. Second, the available internet access is unreliable, as connectivity fluctuation persists for a variety of reasons. Since there are few service providers in valleys that offer internet access, children can find it difficult to engage in online modes of learning. Another problem is the lack of control, which has a direct effect on the relations between students and teachers [12-15].

Students' evaluation, one of the most critical instruments for gauging children's learning, is jeopardized. Teachers directly track learners' academic aptitudes in face-to-face immersive classrooms and provide appropriate assistance to resolve learning gaps. Visual classrooms and other online interactive forms, on the other hand, did not

offer comparable opportunities for the teacher to measure students' learning. Students are unable to establish the requisite learning in such circumstances, which could be done by direct contact with the teacher in a real classroom environment [16-19].

To summarize, the current crisis seems to be having a negative effect on the education sector, but it has opened new doors for students. On the one side, classrooms are closed and there is no direct contact in schools, but this has driven students to pursue learning through technical resources. It has raised awareness among parents about the value of implementing novel approaches to their children's education by offering alternate forums for engagement with teachers.

IV. Learning Modalities

There have been many learning modalities proposed to pursue education despite the COVID-19 pandemic. Flexible learning is seen to be possible and has many methods of delivery. In flexible learning, there are four (4) components: Pace, Place, Process and Product. The figure below shows the Flexible learning structure. It is important to note that the teacher or professor has the options as to whether the Pace is teacher-led or self-paced, the Place is residential or distance / remote, the Process is modular or simulative and the Product is traditional or non-traditional. A mix of different approaches is better. The important thing is to make a better plan and schedule on how to handle a class using different modalities [20-23].

In this study, the author mainly focused the discussion on remote learning. There are two types of remote learning modalities, the wired flexible learning and the non-wired flexible learning. There are a number of options for streamlined, flexible learning: Computer Management Learning (CML), Computer Support Training (CAI), Synchronous Online Learning, Asynchronous Online Learning,

Fixed Online Learning, Adaptive Electronic Learning, Linear Electronic Learning, Interactive Online Learning, Individual Online Learning, and Collaborative Online Learning. Non-wire variable learning options include: Communication learning, project-based learning, radio broadcast learning, television broadcast learning, on-demand learning kits, special circulation periodicals and course supermarkets.

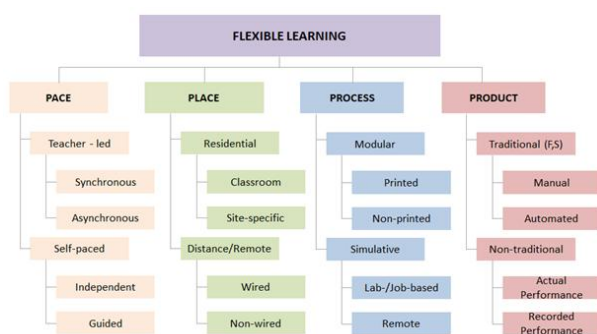


Fig. 1. Flexible learning structure

V. Flexible Learning

Flexible learning has many classes and faces. It has different degrees of approach in terms of location, time, speed, content, and learning methods. The main purpose is to increase opportunities and options for learners and to control the learning process for learning modes and diversity of interactions. It encourages learners to learn by offering them more options.

Flexible learning will give teachers options in other areas.

- Material types and interactions: Curriculum development will require teachers to choose relevant resources and how they can be used and communicated to learners.
- Content and structure: Program content should be well prepared and organized (su) in a way that meets the needs of the learners.
- Speed: Consideration should be given to

appropriate learning speeds that are not overwhelming for learners.

- Interaction and collaboration between learners, teachers and learners: It is very important to consider when designing good programs for learners and teachers to communicate and interact with each other.
- Types and e-learning tools used: Teachers should choose the appropriate media, content, tools and learners' needs.
- Learner's self-speed: Teachers should allow students to learn asynchronously. This will help them learn independently and guide learners based on the direction teachers provide.
- Constraints: Access to time, space, learning resources, and experience is always constrained.

The different aspects of flexible learning are discussed below. All aspects are discussed individually. They are integrated and balanced to enable and achieve quality learning. Some of these aspects are not necessary, but they are nevertheless important. Depending on context, learner matching, and specific requirements, these aspects are used to drive learning and achieve core aspirations.

A. Pace

The flexibility of the learning pace allows the learner to control the speed of the learning process. This includes the time the learner can choose between part-time or full-time. As long as learners can get the expected output. The decision is made by the learner. Universities also propose courses suitable for different levels of learners. Because undergraduate and graduate students have different understandings, the unit per semester depends on the level. Universities also exercise maximum and minimum course load in a way that regulates learning speed. Each approved proportion has a parameter. Learners must achieve a specific goal at a given time. This is to achieve expected learning outcomes.

Advantages

- Allows learners to determine their own learning speed and ability.
- Controlling and taking responsibility for learning speeds can motivate some learners. It can minimize the pressure of time and finishing.

Disadvantages

- Learners may lack the ability to learn without instructions and instructions from teachers.
- Control and responsibility may be difficult for inexperienced learners.
- Poor time management can lead to delays and failure to achieve learning outcomes.

B. Learning style

Flexible learning approaches can be designed to accommodate different learning styles and learner types. Learners have their own motivations, experiences, interests, learning experiences, learning styles, language skills, and learning skills levels. It allows students to learn according to their needs and culturally relies on one learner and another. Also, different knowledge also requires different ways of understanding. The level of understanding is also based on the level of understanding of each student. Therefore, designing programs for all learning styles is not easy. This is especially true when the size is large. Adopting an educational strategy accordingly requires serious effort because the least a teacher can do is to know that not all students will learn the same way. It is important to pay attention to the learning style and pay more attention to the types of learning that can be widely mixed with lectures, discussions, group work, and laboratory work. Various learning can be better for all students. Regardless of designing a wide set of learning styles, it is worth considering that when students go out into the real world, employers are unlikely to accept other learning styles because they are the adaptability they expect from their

graduates. Therefore, the learning style you choose should allow learners to adapt.

C. Assessment

The transition from a general form of evaluation to a student-centered negotiation evaluation. The most common understanding of flexibility in relation to evaluation is when students have the opportunity to negotiate about evaluation. In this approach, the criteria that apply to the interpretation of the task and the judgment of the assessment task are also central.

The assessment is an assessment designated by the instructor at one end, which can be viewed as an area in which the learner has limited or no control over the assignment and the criteria used to judge it. Flexibility and negotiated evaluations are most common when teachers use true evaluations, as well as when students bring their needs, plans, and goals to participate in real-world learning activities. In these learning activities, we consider individual changes in learning. True evaluation is more related to the evaluation process than to the synthesis of knowledge.

This requires students to think about the association between teaching and learning as well as the concept of measurement as well as success and consequences.

The negotiated evaluation is not sufficient for all research processes or units, but it is important for the tertiary setup because it:

- Include students in the creation and implementation of assessments;
- Be applicable to the learner;
- Have sufficient ability to elicit from mature and professional students.;
- Build collaborations and learning teams.

Much of the topic structure is dynamically generated over the course of the unit, depending on the student's interests, rather than on the

closely defined set of topics that make up the unit. This type of evaluation typically takes time due to negotiations and discussions on tasks as well as monitoring progress that increases students' awareness and understanding during the semester by forming a unit center. However, the versatility of evaluation is flawless and has been criticized for the following reasons.

- Only available in small groups
- Mainly suitable for senior students
- Not suitable for beginners who are not risk takers
- Resource intensive in terms of instructor time and input
- Learners take longer to identify their problems.
- Questions about the validity and reliability of actions
- Not suitable for any unit or course
- Different quality levels
- High probability of student resistance Flexible learning and evaluation:
- Always adhere to good evaluation principles.
- Continue to require equivalent assessment regardless of where and how learners learn.
- Successful evaluations should be accurate, reliable, and appropriate for the purpose, whether they are for learning to promote understanding or for evaluating learning that provides certification.

D. Collaboration

Successful communication necessitates a shift in teaching practices to allow for the exchange of ideas, as well as designs that promote and respect user/student-generated content and the use of learners' collective intelligence. This is a broad concern that is addressed in depth in other modules available on the Institute of Learning and Teaching web-site, namely: group assignments, group assignment evaluation, working in groups, peer evaluation, self and peer evaluation, and online collaboration.

VI. Learning Platform and Tools for Wired Flexible Learning

Moving from face-to-face instruction to a wired, remote learning mode will not be an easy or straightforward process, requiring a paradigm shift in the teacher's role from "the sage on the stage" to "a guide on the side." Furthermore, faculties have less than a month to up-skill and prepare instructional and assessment resources.

A Learning Platform is a collection of interactive online platforms that offer content, tools, and resources to teachers, students, parents, and those interested in education in order to support and improve educational delivery and management. A Learning Platform is a comprehensive framework that provides a stable, web-based training and e-learning solution with an easy-to-use user interface.

The type of online learning system you choose will be determined by the nature of your online program. This, in turn, is dependent on a variety of variables, including what students should know and be able to do, technological considerations, and the abilities of online teachers. This article looks at a few choices for selecting an online learning "system."

A wired classroom is just what it sounds like: a classroom with internet access. A wired classroom, in particular, uses the internet and other facets of digital technology to boost student learning. This form of learning will include introducing wireless technology into schools and organizations, as well as creating fully virtual classrooms that are accessible through the internet.

Education can now keep up with the trend in learning toward instant feedback, real-time knowledge, and a personalized experience for each student thanks to advances in technology. This pattern is exemplified by the fact that four out of every five students are now enrolled in online courses.

The standard lecture form used in schools is

one-size-fits-all, assuming that all students learn in the same manner. In reality, students learn in a variety of ways. Many students must actively engage in their education in order to learn content effectively. With the ease and speed with which information can be obtained today, this need is becoming more prevalent. Teachers are using the internet to improve learning both inside and outside of the classroom.

There are four (4) choices when it comes to selecting an online learning platform. The first choice is to use Learning Management Systems (LMS), the second is to use Social Media and Peer-to-Peer Networks, the third is to use Online Meeting or Conferencing Software, and the fourth is to use Two-Way Audio.

LMSs are widely used, and there are numerous LMSs available online. Adobe Captivate Prime, SAP Litmos LMS, LearnUpon LMS, Inquisiq LMS, Mindflash, iSpring Learn, TalentLMS, Loop, 360Learning Engagement Platform, Coassemble, CoreAchieve, Skillcast LMS, EduMe, Agylia, and many others are famous LMSs.

VII. Technology and Its Role in Flexible Education

In a recent report across Australia, Scott, Coates, and Anderson described how social, political, economic, technological and demographic changes have affected Australia's higher educational institutions that interacted with institutional contexts and cultures. [13]. The effect of the information and communication revolution, along with "exponential growth in computing capacity and rapid expansion of Internet speed," is one of the major factors of change they describe. This naturally changes the learner's desire and available learning opportunities. The demand for education and training is increasing. Higher education institutions see it as a convenient way to approach learning flexibly and are gradually

turning to e-learning to meet it [12]. Although e-learning is considered to increase the efficiency of professors, institutional responses to e-learning are different. Although it is a practice accepted by most higher education institutions in Australia and developed countries, organizational structure, strategy, staff and student support, and funding vary greatly from institution to institution. Having said that, there are numerous examples of solid organizational frameworks, well-developed practices, well-considered pedagogical methods, and good e-learning resources.

VIII. Evaluating Flexible Learning Environments

Evaluating a flexible learning environment is an important step towards 'Closing the loop'. There is a comprehensive literary organization that defines the effective characteristics of a versatile educational environment, which is useful when preparing for evaluation. Oliver and Herrington proposed a method to evaluate the possible effects of online learning environments that also apply to flexible learning environments[24]. Their structure is a checklist that has been developed under three main areas for evaluating the quality of pedagogy, tools, and delivery strategies (Table 1).

Table 1. Criteria of evaluating flexible learning environment

Delivery strategies	Appropriate corporate style Appropriate bandwidth demands Clear goals, directions and learning plans Communication Equity and accessibility Reliable and robust interfaces
Pedagogy	Authentic tasks Engineering Learner-centered environments Meaningful assessment Opportunities for collaboration
Resources	Accessibility Currency Inclusivity Purposeful use of the media Richness

IX. Current Solutions

A. Virtual Classrooms

The advantages of virtual classrooms are numerous. Schools can prevent issues with crowded classes, dull lectures, and low participation by encouraging students to participate in online distance learning.

Instead, distance learning over the internet encourages people who may not otherwise be able to engage in education to do so. People with a busy schedule, for example, can find it difficult to attend institutions at specific times. Alternatively, people do not live in a comfortable distance from an education center, rendering institution-based education unattainable for them. Streaming tutorials, video conferencing, interactive learning environments, and course management tools are only a few of the many facets of online learning. All of these resources allow online learning to be as effective as possible for those who participate.

B. Course Management Software

Content management systems (CMS) for educational materials are provided by course management tools such as Blackboard Learn, Moodle, and A Tutor. The platform's aim is to serve as a virtual classroom. Materials and assignments may be given by teachers. Students will research, take exams, and take part in discussions.

Online classrooms are extremely affordable. Building costs, as well as textbooks and other physical materials, are reduced. This encourages individuals to access education at a reduced rate, which helps those who may not be able to afford conventional education.

In addition, the learning space on course management software enables students to connect with the learning material in ways that are not feasible in a classroom setting. They will tailor their learning

experience by selecting which materials to read or watch. This allows students to learn in the way that works best for them. Some people, for example, prefer to watch videos while others prefer to read the content. Students can also refer to the material as many times as they need if they need further help.

This form of software program also improves the speed at which learning can be accomplished. Distractions, unrelated tangents, or class discussion cutting into lecture time may cause material to be delayed in physical classrooms. When studying online, this is not a problem. After each lecture, students may be checked to ensure that everybody is on the same page. These assessments are easy to administer, automatically scored, and the results are available immediately. This enables students and teachers to gain immediate input on their learning and teaching styles.

C. The Shift in Learning Responsibility

Of course, in online schools, the learners bear more of the responsibility for learning and the teachers bear less. This may pose a challenge for people who are used to conventional educational approaches when they are unexpectedly confronted with the need for time management and self-discipline.

Learning can take place at any time in an online environment. This means that students can choose which days they want to participate in learning. Students must also download lecture materials and keep up with readings. Students must be able to motivate themselves to attend class and keep track of their assignments.

Discussions are an essential component of online learning. Students must make time to engage in these events and to ask questions of classmates when they need help with course material. They must also learn strong communication skills and the ability to function independently. Just because learning has moved to the internet and can be done from the comfort of one's own home does not mean that it is a lot easier.

X. The Future of Online Learning

The e-learning sector has increased dramatically as more students select the following online courses. This trend is resulting in lower costs for students and a greater variety of online course choices to choose from. However, some have questioned whether online learning is as successful as conventional classroom learning.

Educating teachers on how to use online tools efficiently in their teaching practice is one of the most difficult challenges to tackle. Teachers need guidance in integrating internet technology in order to improve student participation and teaching performance. Overall, the transition to online learning is a significant step forward because it makes education more available to everyone and offers personalized learning environments.

XI. Conclusion

The COVID-19 pandemic affected many aspects of social and economic aspect of human life including the education system. There have been many learning options which the educational institution can use to continue giving quality education remotely despite many challenges such as poor connectivity and lack of technical expertise in using online tools. However, on the negative side, this will be disadvantage to those who are having no access or limited access to the internet, example for third world countries. This is a very challenging issue to choose which kind of teaching modalities and tools to use. Whatever the learning modalities may be, surely, the pandemic had disrupted the educational paradigm and we have to adjust to the new normal. In conclusion, the current crisis seems to have a negative impact on the field of education, opening a new window for learners. On the other hand, although schools are closed and direct interaction within schools is not rampant, it has pushed learners into technical tools to pursue learning. It has made parents sensitive to adopt innovative

approaches for child learning by providing alternative platforms to interact with teachers.

Digital transformation is the key to implement a better online learning implementation. Making learning resources in digital form, using a Learning Management System (LMS) and conducting synchronous classes using video conferencing tools such as Google meet, FB room, Zoom and Microsoft teams are still the best options. The digital transformation is the key to continue the learning and educating students even if they are in their homes.

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