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Review Article

Framework to measure effects of digital learning on students' mental health

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ABSTRACT

COVID-19 has had a severe impact on the education sector with the closure of schools. The attempts for continuum of education during lockdown, particularly at school level, through digital learning mediums had limited success. The review brought out that very limited literature are available to assess the effect of digital learning on mental health of students. The review developed the operational definition of digital learning and mental health to make it as much inclusive of all mediums and elements for establishing connectedness between digital learning and mental health. The measuring framework, based on the secondary review, have 13 Likert-type five-point rating scale-based statements to capture the negative and positive effects of digital learning on mental health of the students. The measuring framework will be a useful tool for policy makers, counsellors and academicians to assess the interlinkage between digital learning and mental health outcomes, both positive and negative.

Keywords: Digital learning, Online learning, Mental health, COVID-19 lockdown, Depression, Anxiety, Mental well-being

INTRODUCTION

COVID-19 has had a severe impact on the education sector, leading to long-lasting consequences on the economic and social development. The closure of schools and the move to remote learning highlighted the digital divide and further widened the gap between the advantaged and the disadvantaged members of society.[1] Digital learning was the significant alternative to the face-to-face physical classroom. It helped millions of students during the COVID-19 pandemic.[2] In India, to enable students and academic stakeholders to continue education in the midst of the pandemic, government of India embarked on several initiatives and boosted some of its existing digital platforms.[3] In addition, many popular but non-governmental digital platforms provided a plethora of learning opportunities for students amidst the on-going learning crisis.[2] It is therefore pertinent from the future perspective and preparedness to understand the impact of digital learning on the mental health of students. For majority of the students, the digital learning is a novel approach towards learning and expected to have both positive and negative impressions on the younger minds.

Objectives

Based on literature review, this paper has two key objectives keeping schools' students in the fulcrum to develop operational definition of the two concepts: digital learning and mental health and to develop a framework to measure effect of digital learning on the mental health of school students, particularly in the context of the COVID-19 pandemic.

LITERATURE REVIEW

Most of the reviewed documents (around 60%), were academic studies published in various journals available

online across the globe, while the rest were studies and/or reports published by various organizations, such as UNICEF and world health organization (WHO).

Around 24% of the documents were specific to India; while the rest focussed on other countries (56%) or had a global (10%) focus. A little more than half of these documents (52%) were on digital learning and a few on various technology use among children. Other documents (23%), mainly academic studies, focused only on mental health issues mostly among college students.

There were only a few documents (19%) exclusively on both mental health and digital learning issues. However, various studies have been conducted to examine impact of COVID-19 pandemic on mental health of students.[4,5] While UNICEF conducted a rapid assessment study on learning during school closure in the context of COVID.[6]

Digital learning

Studies on digital learning highlighted that students are interested in using the internet and digital tools for learning purposes. However, there are factors for enabling students' digital learning such as access to computers or phones, prior computer skills, support at home, perception towards digital learning, teacher-student relationship, time spent learning digitally and students' motivation towards learning. These factors have significant effects on academic achievement and student performance in digital learning.[7]

Designing accessible and appropriate teaching activities for digital learning and flexibility in applying technology tools are key points emerging for current information technology integrated education.

There is a large disparity in access to digital learning. Studies in India have shown that receptiveness towards online learning in India during the COVID-19 induced lockdown period was significantly higher among the students from urban areas compared to the students from rural areas.[8]

Mental health concerns

Even prior to the COVID-19 pandemic, as per an estimation 10 to 20% of children and adolescents worldwide experienced mental health challenges, with half of the mental health-related conditions beginning by the age of 14. In India, one student dies by suicide every hour and about 12% of Indian students aged between 4 and 16 years suffer from psychiatric disorders. About 20% of students show signs of mental disorders, out of which 2-5% have serious concerns like autism or bi-polar disorder.[2]

The focus on mental health and well-being of children during COVID-19 increased, as their routines were disturbed, and concerns around trauma due to the pandemic and excessive use of digital mediums for entertainment, communication and learning surfaced.[9]

Parents effectively helped schools in teaching their children during the COVID-19 lockdowns. Most parents faced challenges in their endeavour to assist their children with distance learning. These challenges were personal, technical, logistical, and financial.

The pandemic itself was stressful, disruptive and traumatic for many. Many lifestyle changes, including daily routines, the way we work, socialize, learn, study and entertain, had to be made during the COVID-19 lockdown restrictions. Children were affected drastically by school closures and interruptions in their academic learning.[10] Globally and in India, various initiatives and efforts were made to use digital technologies to somehow engage and continue the learning among school students.[11]

A study in the United States has examined differences in the sociodemographic patterning of school closures and child mental health outcomes using a large, nationally representative sample of households with children aged 4 to 17 years. The association between remote schooling and child mental health varied by child age and, to a lesser extent, household income. Older children who attended school remotely had worse mental health outcomes compared with those who attended school in person, whereas younger children who attended school remotely had comparable or slightly better mental health outcomes than those who attended in person.[12]

Further, research among university students during the first phase of COVID-19 pandemic in Indonesia shows that from the seven mental effects raised from increased screen time, the students admit that they most likely feel fatigued (100%). They experienced physical pain such as headache, shoulder sore, eyesore, and others (100%); had bad time management (98.6%); feel isolation from their classmates (68.6%), and they experienced uncertainty about the lecturer's explanation during the online classes.[13]

METHODS

A systematic search for relevant research articles was conducted in Google Scholar database using various combinations of keywords like "mental health", "digital learning", "online education", "e-learning", "school education during COVID-19", and including "India" to identify all studies published in last ten years i.e. between 2012 and 2022.

Various sources, databases, web resources, grey literature, and academic publications available online were referred to. More than 120 documents and web links were compiled from both academic and non-academic websites, journals and publications.

The inclusion criteria were studies conducted on school digital education and reporting any one of the following outcomes: "mental health", "digital learning", "online learning", "online teaching", "e-learning", "learning or teaching during school lockdown", "web-based teaching materials". The exclusion criteria were studies that did not specify the name of the 'digital or online learning'.

The secondary review was one of the components of the larger research study undertaken using mixed methods study approach, on behalf of UNICEF India in 2022-23. The framework to measure the effects of digital learning on mental health of students was developed, shared with subject experts for internal validity and subsequently pilot tested among a set of students before finalizing and administering it during the study. The internal consistency of the statements used in the framework was also statistically assessed by computing the Cronbach's Alpha value (0.84). However, due to copyright on the data and its findings with UNICEF, the paper has not used primary data and its analysis from the study in this paper.

OPERATIONAL DEFINITION OF DIGITAL LEARNING AND MENTAL HEALTH

To understand how schoolchildren in India adapted to the various digital learning modes and how this digital learning affected their mental health, it is relevant to develop operational definitions of the two key terms, digital learning and mental health.

These operational definitions will provide guidance on how the two key variables are understood, used for further explanation, and in developing relevant parameters of measurement in research tools and analysis.

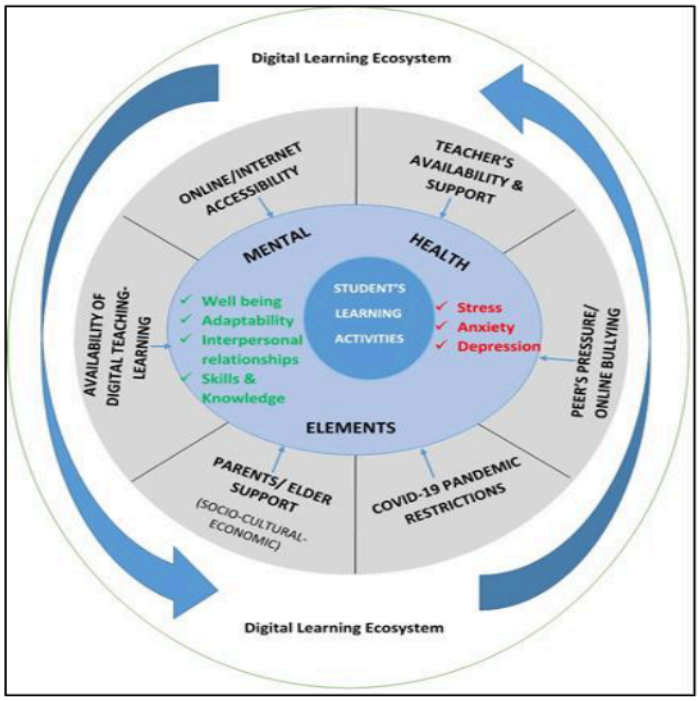

Figure 1: Conceptual framework: digital learning ecosystem influencing different elements of student's' mental health and learning activities.

DIGITAL LEARNING

Digital learning is an umbrella term and it means any type of learning that includes using digital technology. This includes students taking courses online, in addition to students doing internet research or watching online videos in a classroom and teachers using digital tools like smart boards and tablets.

The international association for K-12 online learning defined digital learning as, *"any instructional practice in or out of school that uses digital technology to strengthen a student's learning experience and improve educational outcomes."*

Broadly, the use of any technology or screens to learn or educate oneself is considered digital learning. In other words, all learning experienced, other than physical face-to-face interaction, is considered digital learning. This will therefore include a wide range of adaptations and experiences undertaken at various levels, like providing smart phones or tablets (tabs) to students, sharing lesson plans and assignments on WhatsApp, taking live video classes on Zoom, downloading exercises or even textbooks from online resources, and watching classroom programmes on television, etc.

Other terms commonly included in Digital learning are:

Online learning

This is another broad term, but slightly narrower than digital learning. It means that most of the coursework will be done through the internet-through forums, shared documents, emails, chats, etc. However, it does not imply that there is no face-to-face interaction between students and the teacher. It can include doing coursework in a classroom or at a distance, so long as the communication is primarily online.

E-learning

Referred also as "virtual learning," e-learning generally refers to a course taken entirely over the internet. The teacher and students do not meet face to face at all. All course work and communication are handled via emails, forums, chats, or video conferencing. Some institutions refer to this type of course as a "fully online" course.

Blended or hybrid learning

Blended learning refers to a system of teaching and learning that combines face-to-face classroom methods with computer-mediated activities to deliver instruction. The strengths of this approach are its combination of both face- to-face and online teaching methods, into one integrated instructional approach.

Students are required to be physically present for a predetermined number of classes, but the coursework is also done online. For example, students might have assignments due on Monday and Wednesday that are submitted online but they are expected to attend a class on campus every Friday.

Digital course materials/e-textbooks

This broad term refers to any texts, syllabuses, discussion forums and other resources made available online for students or are available in digital format. E-textbook or digital textbook refers to what has been made available in an e-reader compatible format like PDF, E-pub, or any other text format.

MENTAL HEALTH

According to WHO, mental health is, "*a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community.*"[14]

Well-being is commonly understood in terms of three domains:

Personal well-being

For the individual, this includes positive thoughts and emotions such as hopefulness, calmness, self-esteem and self-confidence.

Interpersonal well-being

This includes nurturing relationships, responsive caregiving, a sense of belonging, and the ability to be close to others.

Skills and knowledge

The capacity to learn, make positive decisions, effectively respond to life challenges and express oneself.

There is now a shift from the biomedical approach of dealing with mental health conditions to the bio-psychosocial approach. This holistic approach encapsulates social and psychological determinants of health instead of viewing mental health merely from a person's biology perspective.

MENTAL HEALTH AND PSYCHOSOCIAL CONDITIONS

Wide ranges of disorders that affect an individual's cognition, emotion and/or behavior and interfere with the individual's ability to learn and function in the family, at work and in society are known as common mental health disorders (CMDs).[15] Mental health challenges are further complicated in a digital learning world. Few studies explored the magnitude of the impact of digital learning on mental health outcomes such as anxiety, depression, substance abuse, and conduct disorder.[10,16]

Mental health concerns/negative outcomes relevant to digital learning are:

Lifestyle (external) behavioural changes

Behavioral issues due to the digital learning regime, including an increase in anger, negativity, irritability and inattention, and other disruptive behaviours among adolescents, is to be considered. Prior studies have identified an association between COVID-19 containment measures (e.g., home confinement and school closure) and an increase in sedentary behaviour and lifestyle changes (e.g., lesser physical activity, higher exposure to screen time and irregular sleep patterns). Some of these lifestyle changes (especially irregular sleep and exercise) were associated with having a lower quality of life (e.g., low self-esteem) and increased psychological distress (e.g., anxiety and depression).[10] Further, it is important to understand, the use of digital learning during the COVID-19 pandemic, how it provided social connectedness, remote learning opportunities, and a way to cope with isolation and stress.

Fear and anxiety

Anxiety pertains to a persistent illogical and irrational fear/ apprehension that something bad is going to happen.

This emotion can become distressing, and can cause physiological, biological, autonomic, and behavioural changes. In context of students, fear and anxiety related to their digital learning experiences due to disruptions to daily routines and COVID-19 school closures as well as worry over the risk to their own health and that of their families need to be captured.

Depression

Depression is a common and serious medical ailment that negatively affects how people feel, think and act. It can cause a feeling of unhappiness and/or a loss of interest in activity. It can cause a variety of physical and psychological complications and can decrease a person's capability to function at home and work (ICD-10). For measuring framework, therefore, it is important to investigate symptoms like sadness, loss of interest in activities, hopelessness, low energy, irritability, guilt related to digital learning.

Alcohol and substance use and abuse

Studies indicated an increase in hazardous and problematic alcohol and substance use among adolescents since the outbreak of the COVID-19 pandemic, and found this to be associated with behavioural problems (including anger and irritability), especially among boys. Hence, the use of alcohol or substance abuse as a coping strategy to overcome stress or anxiety due to their digital learning practices needs to be explored.

POSITIVE MENTAL HEALTH OUTCOMES

The positive attributes of the mental health continuum need to be understood when assessing an individual's well-being. As mentioned, mental health is a complete state of mental, emotional, physical, and social well-being and not merely the absence of disease.

Many studies have indicated that mental health consequences associated with digital learning have also had positive outcomes such as enhanced self-esteem, higher levels of engagement, and increased levels of adaptability, positivity and meaningfulness in life.

Children and adolescents reported perceived benefits from home confinement (e.g. increased quality time with family members) and school closure (e.g. respite from schoolwork, exam stress and school-related bullying) that seemed to positively correlate with life satisfaction.

Based on the secondary review, operational definitions of digital learning and mental health were developed. Digital learning should be considered a broader/umbrella term to encompass use of digital technology for imparting/teaching and/or self-learning purposes. The different methods include-Teaching imparted through live (online) video classes on virtual platforms such as zoom/google meet, and students attending these online classes. E-content, lessons plans and assignments received/downloaded using web portals/links or mobile apps (WhatsApp) over smartphones/ tablets/ laptops/desktops for offline learning. Watching pre-recorded classroom programs/lessons on television channels (free-to-air), YouTube, or listening over radio. Use of projectors, smart boards and smart televisions for teaching or learning.

In short, any teaching or learning which uses a digital medium to supplement and complement or in lieu of in-person classroom teaching is to be considered as a digital learning.

Mental health, as per the bio-psycho-social model approach, should broadly look into three domains-personal well-being; interpersonal well-being; and skill and knowledge of the students. This will help to assess and understand the impact of digital learning on different attributing factors of mental health, both positive and negative.

Positive elements include, increased quality time with family members, respite from schoolwork, no exam-related stress or school-related bullying, increased self-esteem due to confidence in use of digital platforms or helping peers to use digital platform or resolve their technological disruptions.

Negative aspects capture depression, fear and anxiety, external behaviour factors, alcohol and substance abuse, external behavioural problems and lifestyle behavioural changes.

MEASURING FRAMEWORK-DIGITAL LEARNING AND MENTAL HEALTH

The measuring framework was developed to capture the seven elements of mental health, namely, stress, anxiety, depression, which reflect the negative mental health of a person, while positive mental health elements were assessed through inter-personal relationships (IPR), adaptability, skills and knowledge, and well-being. Key references were made from the prior research studies and were adapted to contextualize it with digital learning.[17,18]

Subsequently, experts and professionals were shared the first few drafts of the questions and afterwards on the basis of their expert perception, the items were finally chosen in the different areas of negative and positive mental health. The next step was to go for face validity and content validity of the statements. Only those statements were retained on which the experts had 100 percent concurrence with each other.

Scoring and weightage method

The 5-point Likert scale-based statements were developed

to capture the effect of digital learning on the mental health of students.

Subsequently, these statements be given weighted scores to calculate the levels of positive and negative mental health of the students due to access or non-access to digital learning mediums.

Table 2: Scoring and weightage method.

Statements	Extent of agreement				
	5	4	3	2	1
Negative elements					
Stress					
Enjoyed the experience of learning on device and attending classes online					
Sometimes feel irritated during the online class					
Find self-learning through you-tube or other mediums stressful					
Concerned that the school closure due to COVID will impact/has impacted my career plan/growth					
Get tired and don't feel like doing anything else after online class or watching learning videos or learning digitally					
Anxiety					
Usually nervous about switching on camera during an online class					
Sleeping habits got disturbed					
Unable to concentrate on learning due to slow internet connection speed					
Sometimes experience difficulty in breathing during online classes					
Depression					
Don't feel like talking to anyone after online class					
Mostly don't feel like eating or mostly eat more during or after learning digitally					
Don't feel like or have lost interest in doing other day to day activities during online learning					
Lost interest in studies after learning through digital medium					
Positive elements					
Interpersonal relationship					
Comfortable asking my friends for support in online learning when I get stuck with a problem					
Go out of way to help family and friends in understanding digital/ online issues					
Able to ask questions to my teachers in online classes similar to how used to ask in the class					
Find it easy to collaborate with friends online similar to how used to do it in-person					
Adaptability					
Find it easy to learn and adapt to new technologies for digital learning					
Enjoyed digital/online learning					
Able to troubleshoot any technical difficulties faced during online learning					
Skills and knowledge					
Continuously try to improve digital skills to prepare for future					
Feel confident about ability to use digital technology to learn new things					
Feel that I am able to learn more online/digitally than used to learn in the classroom					
Well-being					
Enjoy the fact that family and friends look up to me in most of their problems related to digital/online issues					
Satisfied with progress in handling digital/online mediums for learning purpose					
Fairly competent with digital/online learning which facilitates studies					

*Where '5' is strongly agree and '1' is strongly disagree

A weighted score can be calculated individually for each statement/element and each respondent. Next step is to use median score for categorising the students into three categories, mild, moderate and severe, on negative mental

health elements and in two categories, high and low for elements to capture the positive mental health of the students. Students scoring two points less than the median score for each negative mental health parameter were considered as 'normal' i.e., not reflecting any signs of negative mental health.

DISCUSSION

Reviews of literature on the time children spend using digital technology and its impact on their mental well-being, social relations and physical activities shows that the evidence is largely inconclusive with respect to the impact on children's physical activity. However, the review indicate that digital technology seems to be beneficial for children's online social relationships.[19] In terms of the impact on children's mental well-being, the most robust studies suggest that the relationship is U-shaped, where no use and excessive use can have a minor negative impact on their mental well-being, while moderate use can have a small positive impact.[19,20] COVID-19 has had a severe impact on education sector, leading to long-lasting consequences on the economic and social development. The closure of schools and the move to remote learning highlighted the digital divide and further widened this gap between the advantaged and the disadvantaged members of society.[21] However, digital learning has emerged as the most significant substitute for the face-to-face physical classroom that helped millions of students during the COVID pandemic. Among key limitations on usage of digital learning, include, limited access to digital tool or medium for children of economically marginalized families, families residing in remote locations, internet connectivity issue, extent of tech-savvy teachers and students. Designing accessible and appropriate teaching activities for digital learning and flexibly applying technology tools are key issues emerging for current information technology integrated education. Parents faced varied types of barriers in their endeavours to assist their children with distance learning during the pandemic. These barriers were personal, technical, logistical, and financial.[22]

CONCLUSION

The operational definition and measuring framework will be helpful for policy makers and other stakeholders. The tool can be administered objectively and in a standardized way by mental health professionals, researchers, academicians and clinicians alike in their everyday practice to assess students' mental health outcomes vis-à-vis digital accessibility for curriculum and non-curriculum purposes. Digital learning and its extent of effect on mental health measured through cross-sectional research, to understand the change over a period, is relevant and critical. Future research should capture the impact on mental health of children left out from the learning process, as they do not have access to digital learning. Similarly, statements can be developed to obtain opinions and observations of parents, guardians and teachers on the effect of digital learning on their wards/students' mental health.

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