ORIGINAL ARTICLE

Enablers and barriers of online learning among adolescents visiting outpatient pediatric clinics of secondary and tertiary care hospitals in Karachi, Pakistan

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ABSTRACT

Background and Objective: Online learning has evolved significantly and has been widely adopted during the COVID-19 pandemic to maintain educational continuity for school-going children. Despite its flexibility and accessibility, several barriers, including technical challenges, reduced interaction, and health-related concerns, affect students' learning experiences. This study aimed to explore the enablers and barriers to online learning among adolescents visiting secondary and tertiary care hospitals in Karachi.

Methods: This six-month descriptive cross-sectional study included 370 adolescents aged 11–17 years attending pediatric outpatient clinics at two secondary and one tertiary care hospital in Karachi. Participants were recruited by convenience sampling and interviewed using a structured, English/Urdu questionnaire covering sociodemographic characteristics, online-learning practices, perceived enablers and barriers. Enabler and barrier items were assessed on a three-point Likert scale (agree, neither agree nor disagree, disagree). Data were analyzed descriptively in the Statistical Package for the Social Sciences version 21.0 using frequencies and percentages; 95% confidence intervals (CIs) for selected proportions were calculated from the reported counts.

Results: The study showed that 52.7% of students had five to six hours of online schooling every day. The enabling factors included frequent class participation (54.1%), finding online teaching software easy to use (88.4%), having sufficient technological skills (85.1%), receiving sufficient technological assistance from teachers (73%), good internet connection (59.2%), backup electricity (68.9%), availability of a backup device (83.0%), availability of a family member for assistance in understanding a lesson (77.6%), and addressing any disruptions during online classes (82.2%). The factors identified as barriers to online learning included fatigue/sleepiness (67.3%), back or neck pain (54.9%), headaches (48.6%), struggling to concentrate during lessons (60.8%), and feeling distracted (45.4%) during online classes. Most participants preferred classroom-based schooling (72.2%; 267/370).

Conclusion: A supportive home environment and online learning space coupled with adequate technology and IT skills were found to be the major enablers of online learning during the pandemic. The major barriers identified were feeling distracted, neck or back pain, fatigue, sleepiness, headaches, and a feeling of disconnection from their teachers and peers.

Keywords: Adolescents, online learning, classroom-based learning, barriers, enablers.

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Introduction

For more than a century, distance learning has been possible through printed manuals, and afterwards, at the turn of the twentieth century, through radio, audio and video recordings. However, at the end of the 20th century, this method of education became prevalent with the advent of the World Wide Web [1]. Distance learning is based on Transactional Distance Theory, which emphasises the interplay among physical, cognitive, and communication distance and identifies these domains as factors that affect distance learning [2]. Open online courses, recorded lessons, online live engagement, tutorials, short messages, and conferences are a few examples of online educational activities. The flexibility and accessibility of online learning have opened up new opportunities for lifelong learning and skill development for a larger audience [3]. This is evident in

the increasing acceptance and popularity of online degree programs and courses offered at colleges and universities worldwide [4]. During the COVID-19 pandemic, online learning became a valuable resource for teachers and students globally to address disruptions in regular schooling. This was especially true for school-going children, as many of them were affected by the closure of educational institutions and were missing out on their early childhood education and care. Post-pandemic, online learning strategies have been adapted to keep pace with rapidly advancing technologies. Despite this, the shift to online learning has come with its own set of challenges, as some students and teachers oppose using online teaching/learning methods regularly [5,6]. Among these administrative challenges, feeling disconnected from peers and teachers, varying academic abilities, lack of technical expertise, student interest, time, assistance for studies, technical problems, and expense for equipment and Internet connection have all been identified as barriers to online learning [7,8]. Additionally, the amount of time children spend on screens has always been a concern, exacerbated by the shift to online learning. Studies indicate that young children should not be exposed to online learning because it does not adequately prepare them socially and emotionally for school and may affect their health and development [9,10]. However, some researchers have concluded that online learning can assist children in grasping abstract concepts by engaging them in collaborative learning, thinking, and problem-solving tasks [11,12]. Despite these concerns, online learning now plays a large role in the field of education by catering to diverse educational needs. Factors affecting online or distance learning can be categorized into two broad categories: enablers or drivers, which facilitate learning, address practical learning, and facilitate the integration of e-learning into the curriculum, and barriers or challenges, which can include poor motivation, lack of information technology (IT) skills, lack of resources, and being unsuitable for certain disciplines [13]. Like other countries, Pakistan adopted online learning strategies during the pandemic, especially for school-going children. However, the social and emotional impact of isolation, enabling factors, and barriers to online education have been poorly understood in the adolescent age group, especially in low- and middle-income countries such as Pakistan. Understanding the impact of these factors on online learning and educational approaches on school-aged pupils' performance in the post-pandemic era is vital for addressing the challenges associated with this mode of learning. Therefore, we aimed to understand the enablers and barriers of online learning among adolescents visiting tertiary and secondary healthcare hospitals in Karachi, Pakistan.

Methods

A descriptive cross-sectional study was conducted over a period of 6 months (1 September 2022 to 28 February 2023) in the pediatric outpatient clinics of two secondary hospitals (Aga Khan Hospital for Women and Children; Garden and Karimabad) and one tertiary care hospital in Karachi (Aga Khan University Hospital, Stadium Road). The study was completed 6 months after obtaining approval from the Aga Khan University Hospital Ethical Review Committee. A non-probability convenience sampling technique was used to recruit 370 children aged 11-17 years of age who were visiting the designated hospitals' pediatric outpatient departments. This age group was selected because they would have been better able to express their experiences compared to those aged younger than 10 years. Since the pediatric clinic where the study was conducted caters to children up to 17 years of age, we set this as our upper age limit. Those who understood English or Urdu and were enrolled in school or any educational program that had online classes only or hybrid learning programs that combined online and on-site learning were included in our study. Physically challenged children who may encounter difficulty in using online tools, such as those who are visually impaired, have a hearing defect, have a physical disability in which they are unable to use their hands, or have any mental disability, were excluded. Parental written informed consent was obtained after ensuring assent from the adolescents.

The sample size was calculated separately for enablers and barriers. For enablers, we used a population proportion of 0.68, a confidence interval (CI) of 95%, and an absolute precision of 0.05 14. This resulted in a sample size of 335. For barriers, we used a population proportion of 0.86, a CI of 95%, and an absolute precision of 0.05. This resulted in a sample size of 186. We used a larger sample size of 335 to account for refusals. This was inflated by 10%, thus giving us a sample size of 370 for our study. Data collection was performed in a designated area to ensure privacy and confidentiality. The questions were explained to the child if they had difficulty understanding them. The questionnaire was translated into Urdu and used as an alternative if the child had difficulty understanding the questions. At the end of each interview, the questionnaire was assessed for completeness before the participant left. If any questions were found to be missing, they were asked again, and the questionnaire was completed at the time of the interview. Therefore, no issues related to missing data were identified. We used a structured questionnaire consisting of two sections. Section A included sociodemographic characteristics such as age, gender, monthly income, family structure, education and occupation of parents, area of residence, number of siblings, and number of gadgets at home. Section B included questions about

general satisfaction, structure and organization of online learning, overall learning experience, technical skills, and equipment availability at home. Questions regarding interest in learning, interaction in class, behavior, physical discomfort, screen time, outdoor activity time, sleep time, and schooling style preference were also included. Participant responses to items identified as potential enablers or barriers were recorded using a 3-point Likert scale ranging from agree to neither agree nor disagree to disagree.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences version 21.0. Frequencies and percentages were reported for sociodemographic characteristics, online-learning practices, perceptions, enablers, and barriers. Responses to the three-point Likert items were presented separately as agree, neither agree nor disagree, and disagree. For selected key proportions, 95% CIs were calculated using the Wilson score method from the reported numerators and the total sample (n = 370).

Results

The findings have been summarized under four domains: sociodemographic characteristics, perceptions and practice related to online learning, enabling factors, and barriers to online learning. The largest age group was 17 years (19.7%) and were predominantly female (56.2%). Most mothers were housewives (76.8%), and most parents were graduates (36.5%). Mobile phones were the primary device used for online classes (49.5%) (Table 1).

While exploring perceptions and practices related to online learning, it was found that most students (52.7%) engaged in five to six hours of online schooling daily. Most of the students received one break (55.4%) between online classes, and most of the students (68.6%) found the number of breaks sufficient for having a snack or going to the washroom. A large proportion of students (60.8%) struggled to concentrate during lessons if the class lasted more than 45 minutes, and most of them preferred classroom-based schooling (72.2%) (Table 2).

To understand the factors influencing online learning, we categorized the enablers and barriers into three key areas: technological, personal, and support system factors. High levels of technological skills, access, and support were reported in our sample population**.** Technological factors included having sufficient IT skills (85.1%), sufficient technological assistance from teachers (73.0%), good Internet connection (59.2%), availability of backup electricity (68.9%), and availability of backup devices (83.0%). However, since our study population was limited to hospitals that catered to a specific socioeconomic stratum, technological enabling

Table 1. *Sociodemographic characteristics (n = 370)*

Variables	Categories	N (%)
Age	11 years	65 (17.6)
	12 years	67 (18.1)
	13 years	49 (13.2)
	14 years	54 (14.6)
	15 years	29 (7.8)
	16 years	33 (8.9)
	17 years	73 (19.7)
Gender	Male	162 (43.8)
	Female	208 (56.2)
Number of school-going siblings	No sibling	69 (18.6)
	1 sibling	95 (25.6)
	2 siblings	85 (23.0)
	3 siblings	73 (19.7)
	4 siblings	41 (11.1)
	5 siblings	7 (1.9)
Mother's education	No education	19 (5.1)
	Primary	11 (3.0)
	Secondary	63 (17.0)
	Intermediate	76 (20.5)
	Graduate	135 (36.5)
	Postgraduate	66(17.8)
Mother's Occupation	Housewife	284 (76.8)
	Working woman	85 (23.0)
	Died	1 (0.3)
Father's education	No education	6 (1.6)
	Primary	9 (2.4)
	Secondary	37 (10.0)
	Intermediate	60 (16.2)
	Graduate	142 (38.4)
	Postgraduate	111 (30.0)
	Other	5 (1.4)
Father's occupation	Unemployed	5 (1.4)
	Government job	54 (14.6)
	Private Job	193 (52.2)
	Business owner	115 (31.1)
	Died	3 (0.8)
Type of device used for online learning	Laptop	107 (28.9)
	Desktop	46 (12.4)
	Tablet	34 (9.2)
	Mobile Phone	183 (49.5)
Monthly household income	Less than 50,000	70 (18.9)
	50,000–100,000	151 (40.8)
	100,000–200,000	93 (25.1)
	Greater than 200,000	56 (15.1)

Table 2. *Perceptions and practices related to online learning (n = 370)*

Variables	Categories	N (%)
How long are the school hours for online learning each day?	<5 hours	133 (35.9)
	5–6 hours	195(52.7)
	>6 hours	42(11.4)
How many breaks do you get between online classes?	None	13 (3.5)
	One	205 (55.4)
	Two	83(22.4)
	More than two	69 (18.6)
How long is the outdoor activity time each day?	<1 hour	195 (52.7)
	1–3 hours	163 (44.1)
	>3 hours	12 (3.2)
How long is your sleep time every day?	<7 hours	55 (14.9)
	7–8 hours	255 (68.9)
	>8 hours	60 (16.2)
Which school style do you prefer?	Online schooling only	26 (7.0)
	Classroom-based only	267 (72.2)
	Blended learning (online plus classroom-based)	77 (20.8)
If the duration of an online class is longer than 45 minutes, it makes it difficult for me to concentrate on the lesson	Yes	225(60.8)
	No	145 (39.2)
The number of breaks I get in between classes is enough for me to do tasks like having a snack or going to the restroom	Yes	254(68.6)
	No	116 (31.4)

factors may not be representative of the general population. (Table 3)

Personal enabling factors included easy transition to online learning (46.5%), frequent class participation (54.1%), and ease of use of online teaching software (88.4%). The personal factors identified as barriers to online learning included fatigue/sleepiness (67.3%), back or neck pain (54.9%), and headaches during online classes (48.6%). (Tables 3 and 4)

Support system factors primarily examine the support provided by families and teachers during online classes. These included strong family involvement, characterized by minimal disruptions from family members during classes (70.5%), availability of a family member to assist in understanding the lesson (77.6%), and addressing any disruptions during online classes (82.2%). These determinants, coupled with effective support from teachers, such as clear instructions and guidance (64.1%) and constant engagement during lessons (66.8%), were identified as enabling factors. Despite these enabling factors, students felt that their understanding of lessons during an online class was not like that of classroom teaching (52.4%), and most of them attended online classes less frequently (51.4%), which were identified as barriers to learning. (Tables 3 and 4)

Descriptive precision of selected findings: Wilson 95% CIs for key reported proportions are presented in Table 5. These intervals describe the precision of sample proportions and do not establish associations or causal effects.

Discussion

This study provides important insights into the enablers and barriers of online learning among adolescents attending secondary and tertiary care hospitals in Pakistan, a lower-middle-income country where disparities in educational and technological access continue to influence learning experiences. The rapid transition to online education during and after the COVID-19 pandemic transformed traditional educational practices worldwide and exposed substantial differences in students' adaptability, access to resources, and learning outcomes [15]. Although online learning ensured continuity of education during school closures, its effectiveness among adolescents remains variable and dependent on social, technological, and environmental factors.

A study conducted in India among college students reported that 87.1% of students and 86.9% of teachers preferred conventional classroom teaching over online teaching modalities[16]. Similar concerns have been reported globally, with students citing reduced motivation, difficulty understanding learning materials, limited interaction with teachers, and feelings of social isolation as major

Table 3. *Enablers of online learning (n = 370)*

Categories	Variables	Agree N (%)	Neither agree nor disagree N (%)	Disagree N (%)
Personal factors	I found it easy to transition to online learning	172 (46.5)	53 (14.3)	145 (39.2)
	I participate in online classes with questions and comments, similar to classroom lessons	200 (54.1)	41 (11.1)	129 (34.9)
	I find gadgets and online teaching software (Zoom, Google Classroom, Microsoft Teams etc.) easy to use	327 (88.4)	12 (3.2)	31 (8.4)
Technological factors	I have sufficient technological skills to participate in online classes independently	315 (85.1)	22 (5.9)	33 (8.9)
	I receive sufficient technological assistance from my teachers in case of any problems or disruptions during online classes	270 (73.0)	46 (12.4)	54 (14.6)
	I have a good internet connection at home, which enables me to participate in an online class without interruption	219 (59.2)	71 (19.2)	80 (21.6)
	I have backup electricity available in case of any disruption	255 (68.9)	7 (1.9)	108 (29.2)
	I have a computer at home that I can use without interruption for online class	230 (62.2)	65 (17.6)	75 (20.3)
	I have other equipment at home, besides a computer, as a backup	307 (83.0)	7 (1.9)	56 (15.1)
Support system factors	I face minimum disruptions from my family members while attending online classes	261 (70.5)	39 (10.5)	70 (18.9)
	In case of difficulty in understanding a lesson, a family member is available to help me	287 (77.6)	12 (3.2)	71 (19.2)
	In case of any problems or disruptions during online classes, a family member is available to help me	304 (82.2)	13 (3.5)	53 (14.3)
	The instructions given by most teachers (*e.g.*, about participation in lessons, modes of examination, solving tasks) are clear and easy to understand	237 (64.1)	72 (19.5)	61 (16.5)
	Teachers make sure that we have understood the lessons by asking us questions and keeping us engaged throughout the lesson	247 (66.8)	41 (11.1)	82 (22.2)
	I find the duration of online classes suitable	270 (73.0)	31 (8.4)	69 (18.6)

Table 4. *Barriers toward online learning (n = 370)*

Categories	Variables	Agree N (%)	Neither agree nor disagree N (%)	Disagree N (%)
Personal factors	Do you play games or chat with friends during online classes?	168 (45.4)	32 (8.6)	170 (45.9)
	Do you feel fatigued or sleepy during online classes?	249 (67.3)	29 (7.8)	92 (24.9)
	Do you experience back/neck pain during online classes?	203 (54.9)	20 (5.4)	147 (39.7)
	Do you experience headaches because of long screen time for online classes?	180 (48.6)	34 (9.2)	156 (42.2)
	My understanding of a lesson in online classes is like that during classroom learning	95 (25.7)	81 (21.9)	194 (52.4)
	Compared to classroom lessons, I attend online classes less frequently	190 (51.4)	59 (15.9)	121 (32.7)
	I feel less connected with my colleagues and teachers during online classes	267 (72.2)	23 (6.2)	80 (21.6)
	My queries are not addressed adequately in online classes	208 (56.2)	64 (17.3)	98 (26.4)
	I miss in-person communication with teachers	289 (78.1)	18 (4.9)	63 (17.0)
	I feel classroom lessons make me learn better	347 (93.8)	7 (1.9)	16 (4.3)

disadvantages of online education [17]. Comparable findings were observed in a Pakistani study among medical students, where nearly three-quarters of participants expressed dissatisfaction with online classes and preferred not to continue with this mode of learning in the future [18]. Although our study focused on school-going adolescents rather than university students, the findings were largely consistent. A substantial proportion of students preferred traditional

Table 5. *Selected descriptive outcomes with 95% confidence intervals (n = 370)*

Selected finding	n/N	%	95% CI (%)
Five to six hours of online schooling	195/370	52.7	47.6–57.7
Preferred classroom-based schooling	267/370	72.2	67.4–76.5
Software/devices easy to use	327/370	88.4	84.7–91.3
Sufficient IT skills	315/370	85.1	81.1–88.4
Good internet connection	219/370	59.2	54.1–64.1
Family member available to help with lessons	287/370	77.6	73.0–81.5
Fatigue or sleepiness	249/370	67.3	62.4–71.9
Back/neck pain	203/370	54.9	49.8–59.9
Headache with prolonged screen time	180/370	48.6	43.6–53.7
Gaming or chatting during online classes	168/370	45.4	40.4–50.5
Less connected to peers and teachers	267/370	72.2	67.4–76.5

Note: Wilson score 95% confidence intervals were calculated from published aggregate counts.

classroom environments, and most perceived that they learned more effectively during face-to-face sessions. Difficulties with maintaining concentration during prolonged online sessions were also frequently reported and may partly explain the preference for in-person instruction.

The preference for classroom-based learning observed in our study highlights the broader developmental importance of physical learning environments during adolescence. Classroom settings provide opportunities for collaborative learning, peer engagement, teacher supervision, and social interaction, all of which contribute to cognitive, emotional, and behavioral development. In-person educational environments also facilitate immediate feedback and allow teachers to identify attention deficits, behavioral concerns, and learning difficulties more effectively than virtual platforms. Previous literature has similarly demonstrated that prolonged online learning may negatively affect engagement, academic motivation, and social connectedness among adolescents, particularly in settings where structured supervision is limited [19].

A similar study conducted among school-going children in China reported that only 37.7% of students were able to interact effectively with teachers and classmates during online classes, while most students denied becoming distracted by gaming or social media activities during lessons [3]. In comparison, interaction levels in our study appeared relatively higher, with over half of the participants reporting classroom-like participation during online sessions. However, distraction remained a considerable concern, with many students acknowledging engagement in non-academic activities such as chatting or gaming during lessons. Reduced attendance and participation further indicate that the online learning experience among adolescents is heterogeneous and influenced by multiple behavioral and contextual factors. These findings support previous evidence suggesting that online learning environments require individualized and age-appropriate strategies to maintain student engagement and learning effectiveness [20].

Technical barriers have consistently emerged as a major challenge in online education, particularly in low- and middle-income countries where digital infrastructure remains inconsistent. Prior studies from India identified internet instability, electricity outages, software malfunction, poor audio-visual quality, and login difficulties as significant obstacles to effective online learning 16. In contrast, most participants in our study reported relatively stable technological access, including backup electricity, internet availability, and access to digital devices. Social support from family members and teachers with adequate technological knowledge may also have contributed to smoother adaptation to online learning platforms. Nevertheless, the setting of our study in private-sector hospitals may have introduced socioeconomic bias, as participants from relatively privileged backgrounds were more likely to possess the financial and technological resources necessary for successful online learning. The high proportion of students with access to additional backup devices further supports this interpretation. Existing evidence has shown that socioeconomic inequality significantly affects digital learning experiences, educational continuity, and academic performance among children and adolescents.[22]

Home environment and family support are additional determinants of online learning effectiveness. Studies among university students have shown that crowded households, lack of designated study spaces, and household distractions adversely affect concentration and academic performance during virtual learning sessions [23]. In contrast, most participants in our study described supportive home

environments with minimal family-related disruptions during classes. This may explain the relatively favorable perceptions regarding teacher interaction and accessibility observed among our participants. Family support has previously been recognized as an important protective factor in improving educational engagement and reducing stress associated with remote learning environments [24].

Despite these enabling factors, several personal and health-related barriers were identified in our study. Musculoskeletal complaints, including back pain, neck pain, and headaches, were commonly reported during online learning sessions. These symptoms are likely attributable to prolonged screen exposure, inadequate ergonomic arrangements, reduced physical activity, and insufficient breaks between classes. Similar findings have been documented internationally, where increased screen time during the pandemic was associated with sedentary behavior, visual strain, sleep disturbances, and musculoskeletal discomfort among school-aged children and adolescents [25]. The prolonged duration of online classes observed in our study, combined with limited physical activity and inadequate rest periods, may have contributed substantially to these physical complaints.

Although online learning presents several challenges, it also offers important advantages, including flexibility in scheduling, accessibility across geographical boundaries, cost-effectiveness, and opportunities for self-paced learning [20]. The future of education is therefore unlikely to involve a complete replacement of traditional classroom teaching with virtual instruction; rather, hybrid educational models integrating the strengths of both approaches may provide more balanced and effective learning experiences. Educational institutions should prioritize improving student engagement, promoting interactive teaching methods, ensuring ergonomic awareness, and addressing technological disparities while designing online educational programs for adolescents. As digital education continues to evolve in the post-pandemic era, evidence-based strategies are needed to optimize online learning experiences while minimizing adverse physical, psychological, and educational consequences. Policymakers, educators, caregivers, and healthcare professionals should work collaboratively to develop adolescent-centered educational frameworks that promote equitable access, healthy screen practices, meaningful engagement, and academic effectiveness in both online and hybrid learning environments.

Limitations of the study

This study has several limitations. Due to its cross-sectional design, causal relationships between enabling factors, barriers, and educational outcomes could not be established. Additionally, the study population was recruited from private-sector healthcare settings, which may limit the generalizability of findings to adolescents from lower socioeconomic backgrounds or rural regions with reduced access to technological resources. Future longitudinal and multicenter studies are needed to better understand the long-term cognitive, behavioral, psychosocial, and academic effects of online learning among adolescents in low- and middle-income countries.

Conclusion

A conducive and supportive home environment and online learning space coupled with adequate technological and IT skills were found to be the major enablers of online learning. Despite these factors, most students still preferred classroom-based learning. The major barriers identified were feeling distracted, neck or back pain, fatigue, sleepiness, headaches, and a feeling of disconnection from their teachers and peers. While online learning offers flexibility and accessibility, its effectiveness hinges on addressing challenges related to communication, engagement, technical proficiency, and students' physical well-being.

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List of Abbreviations

None.

Conflict of interests

None to declare.

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None to disclose.

Ethical approval

Ethical approval was obtained from the Ethics Review Committee (ERC) of the Aga Khan University Hospital, Karachi, vide Letter No: (2022-7673-22567.

Authors' contributions

FN and SM: Conceptualized the study and its design, data collection and interpretation, critical intellectual input, drafting of the manuscript.

DA and IQ: Acquisition of data, critical intellectual input, drafting of the manuscript.

ALL AUTHORS: Approval and full responsibility for the final version of the manuscript to be published.

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References

1. Merrell RC. Education and distance learning: changing trends. Stud Health Technol Inform. 2004; 104:141-6. PMID: 15747972.
2. Moore MG. The theory of transactional distance. In M. G. Moore (Ed.), *Handbook of Distance Education* (pp. 66–85). Routledge. https://simplebooklet.com/userFiles/a/5/3/1/0/7/lNT3v4CR3Eec796VFQRZos/XiyCzDQy.pdf
3. Zhang W.The impact of online learning on children's education and optimisation strategies. *Lecture Notes in Education Psychology and Public Media.* 2024;*41*(1), 283–9. https://doi.org/10.54254/2753-7048/41/20240818
4. Eom SB, Wen HJ, Ashill N. The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation. Decis Sci J Innov Educ. 2006;4(2):215–35. https://doi.org/10.1111/j.1540-4609.2006.00114.x
5. Zhou T, Huang S, Cheng J, Xiao Y. The distance teaching practice of combined mode of massive open online course micro-video for interns in emergency department during the COVID-19 epidemic period. Telemed J E Health. 2020 May;26(5):584–588. https://doi.org/10.1089/tmj.2020.0079.
6. Camargo CP, Tempski PZ, Busnardo FF, Martins MA, Gemperli R. Online learning and COVID-19: a meta-synthesis analysis. Clinics (Sao Paulo). 2020;75:e2286. https://doi.org/10.6061/clinics/2020/e2286.
7. Bacher-Hicks A, Goodman J, Mulhern C. Inequality in household adaptation to schooling shocks: Covid-induced online learning engagement in real time. J Publ Econ. 2021;193(2):104345. https://doi.org/10.1016/j.jpubeco.2020.104345.
8. Shearer, R., A. Gregg, and K. Joo, Deep learning in distance education: are we achieving the goal? Am J Dist Educ. 2015;29(2):126–34. https://doi.org/10.1080/08923647.2015.1023637
9. Muppalla SK, Vuppalapati S, Reddy Pulliahgaru A, Sreenivasulu H. Effects of excessive screen time on child development: an updated review and strategies for management. Cureus 2023 Jun 18;15(6):e40608. https://doi.org/10.7759/cureus.40608.
10. Swaran Singh CK, Wong WL, Chen MJ, Lee MC, Noor N, Jegir Singh JK, et al. Pre-School teachers' experiences and challenges of online teaching during the COVID-19 pandemic. AJATeL. 2022;12(1):98–108. Available from: https://ejournal.upsi.edu.my/AJATeL/article/view/6931
11. Niu SJ, Niemi H, Yang J, Wang J, Wang H, Li J, Liu F. From play to progress: student learning of social skills with a solution-focused approach. Educ Sci. 2025; 15(2):218. https://doi.org/10.3390/educsci15020218.
12. Garshasbi, Soheila & Yecies, Brian & Shen. Microlearning and computer-supported collaborative learning: An agenda towards a comprehensive online learning system. STEM Educ. 2021; 1(1): 225. https://doi.org/10.3934/steme.2021016.
13. Regmi K, Jones L. A systematic review of the factors - enablers and barriers - affecting e-learning in health sciences education. BMC Med Educ. 2020;20(1):91. https://doi.org/10.1186/s12909-020-02007-6.
14. Zhao Y, Guo Y, Xiao Y, et al. The effects of online homeschooling on children, parents, and teachers of grades 1-9 during the COVID-19 pandemic. Med Sci Monit. 2020;26:e925591. https://doi.org/10.12659/MSM.925591.
15. Panagouli E, Stavridou A, Savvidi C, Kourti A, Psaltopoulou T, Sergentanis TN, et al. School performance among children and adolescents during COVID-19 pandemic: a systematic review. Children (Basel). 2021;8(12):1134. https://doi.org/10.3390/children8121134. PMID: 34943330; PMCID: PMC8700572.
16. NambiarD. The impact of online learning during COVID-19: students' and teachers' perspective. Int J Ind Psychol. 2020;*8*(2), 783–93. https://doi.org/10.25215/0802.094.
17. Alawamleh M, Al-Twait LM, Al-Saht GR. The effect of online learning on communication between instructors and students during COVID-19 pandemic. Asian Educ Dev Stud. 2022;11(2):380–400. https://doi.org/10.1108/AEDS-06-2020-0131
18. Iqbal SA, Ashiq M, Rehman SU, Rashid S, Tayyab N. Students' perceptions and experiences of online education in pakistani universities and higher education institutes during COVID-19. Educ Sciences. 2022; 12(3):166. https://doi.org/10.3390/educsci12030166
19. Loades ME, Chatburn E, Higson-Sweeney N, Reynolds S, Shafran R, Brigden A, et al. Rapid systematic review: the impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. J Am Acad Child Adolesc Psychiatry. 2020;59(11):1218–39.e3. https://doi.org/10.1016/j.jaac.2020.05.009.
20. Siste K, Hanafi E, Sen LT, Christian H, Adrian, Siswidiani LP, et al. The Impact of Physical Distancing and associated factors towards internet addiction among adults in Indonesia during COVID-19 pandemic: a nationwide web-based study. Front. Psychiatry. 2020;11:580977. https://doi.org/10.3389/fpsyt.2020.580977
21. Mukhtar K, Javed K, Arooj M, Sethi A. Advantages, limitations and recommendations for online learning during COVID-19 pandemic era. Pak J Med Sci. 2020;36(COVID19-S4):S27–S31. https://doi.org/10.12669/pjms.36.COVID19-S4.2785
22. Korkmaz Ö, Erer E, Erer D. Internet access and its role on educational inequality during the COVID-19 pandemic. Telecomm Policy. 2022;46(5):102353. https://doi.org/10.1016/j.telpol.2022.102353.
23. Kapasia N, Paul P, Roy A, Saha J, Zaveri A, Mallick R, et al. Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India. Child Youth Serv Rev. 2020;116(9):105194. https://doi.org/10.1016/j.childyouth.2020.105194.
24. Dong C, Cao S, Li H. Young children's online learning during COVID-19 pandemic: Chinese parents' beliefs and attitudes. Child Youth Serv Rev. 2020;118(10):105440. https://doi.org/10.1016/j.childyouth.2020.105440.
25. Xiang M, Zhang Z, Kuwahara K. Impact of COVID-19 pandemic on children and adolescents' lifestyle behavior larger than expected. Prog Cardiovasc Dis. 2020;63(4):531–2. https://doi.org/10.1016/j.pcad.2020.04.013.