

E-learning experience of health professional students before and during the war in Sudan

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ABSTRACT

Background: Amid conflict-induced displacement, which severely disrupts education, e-learning has emerged as a viable solution. This study investigates health professions students' experiences with e-learning during the ongoing war, focusing on sex differences, displacement status, digital platforms, and educational continuity.

Methodology: This was a prospective descriptive study conducted in, Aljazeera, Sinar and Kordofan universities in Sud during the period from April 2025 to June 2025. Data regarding this study was gathered using online questionnaire.

Results: Despite widespread conflict-related disruptions, students reported modest improvements in their e-learning experiences (50%). Female learners comprised the majority of participants (64.3%), and paradoxically, those displaced outside Sudan (32.7%) enjoyed more reliable connectivity and greater access to digital resources. Telegram emerged as the most popular platform (85.7%), prized for its low bandwidth demands and intuitive interface. **Conclusion:** Although e-learning has provided a vital alternative to the collapse of education, significant barriers remain, including poor infrastructure, psychological stress, and institutional fragmentation. The findings underscore the need for targeted interventions to ensure inclusive, sustainable, and resilient digital education for conflict-affected populations.

Keywords: E- learning, Sudan war, health professional students,

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INTRODUCTION

The rapid integration of e-learning into health professions education has revolutionized how students acquire knowledge, develop clinical reasoning, and interact with faculty. By leveraging digital platforms, simulation modules, and asynchronous content, e-learning offers flexibility, scalability, and personalized learning pathways that complement traditional face-to-face training.

In Sudan, before the eruption of armed conflict in April 2023, e-learning was gaining traction through initiatives such as the Master of Health Professions Education (MHPE) program at the University of Khartoum and the National E-Learning Ecosystem

Project coordinated by the Association of Sudanese Universities (ASU). These efforts focused on enhancing digital infrastructure, expanding simulation-based modules, and engaging the Sudanese diaspora to support remote teaching and curriculum development [1]. However, with the beginning of the war between the Sudanese Armed Forces and the Rapid Support Forces, educational institutions suffered widespread damage. Medical schools and teaching hospitals were looted or converted into military bases, leading to the displacement of students and faculty and the suspension of licensure exams for interns [2]. Internet blackouts and the destruction of physical infrastructure further disrupted e-learning continuity,

forcing educators to scramble for alternative delivery methods amid safety concerns and resource scarcity [3].

Health professional students in this environment face multifaceted challenges that hinder the effectiveness of e-learning: Infrastructure breakdown: Frequent power outages, unreliable internet connectivity, and damaged computer labs impede synchronous and asynchronous learning. Faculty shortages: The exodus of teaching staff and suspension of academic appointments lead to reduced course offerings and mentorship gaps. Psychological stress: Elevated rates of anxiety, depression, and distraction undermine students' motivation and cognitive engagement. Resource inequity: Displacement to rural or underserved areas restricts access to textbooks, simulation tools, and stable learning environments. Institutional coordination: Fragmented responses across universities and limited national leadership compound logistical barriers to cohesive e-learning strategies [4].

Despite adaptive efforts—such as leveraging mobile learning, asynchronous webinars, and diaspora-led mentorship—the literature reveals a significant gap in systematically examining health professional students lived experiences with e-learning before and during conflict in Sudan. While case studies document institutional resilience and high-level strategic initiatives, little is known about frontline challenges from the learner's perspective, particularly in clinical disciplines where hands-on skills are paramount [1].

This study will examine the e-learning experiences of health professional students in Sudan across two phases: the pre-war period of expanding digital education and the acute conflict period marked by infrastructural collapse. By identifying critical barriers, adaptive strategies, and psychological impacts, we seek to inform crisis-responsive educational planning and contribute evidence-based

recommendations for sustaining medical education under extreme conditions.

MATERIALS AND METHODS:

This was a prospective descriptive study conducted at Aljazeera, Sinar, and Kordofan universities in Sudan during the period from April 2025 to June 2025. Data regarding this study was gathered using an online questionnaire. The questionnaire was distributed to students of medical sciences (including medicine, dentistry, and laboratory sciences). Besides the demographic characteristics of the study subjects, the questionnaire included questions related to the availability of e-learning tools, the methods used, and the difficulties that students face in practicing e-learning.

Data analysis:

Data related to this study was initially prepared in a data sheet, then entered into a computer software statistical package for Social Sciences (SPSS). Frequencies, percentages, means, and cross-tabulations were obtained. The chi-square test was also calculated considering a 95% confidence interval. A p-value less than 0.05 was considered statistically significant.

Informed ethical consent:

Each participant student was asked for virtual consent before starting the questionnaire.

Ethical Approval: The human research ethics committee at Prof. MRCC has approved the protocol of this study.

RESULTS AND DISCUSSION

This study investigated 98 health professional students aged 19 to 28 years old with a mean age \pm Std = 23.95 \pm 1.98.

About 78.6% of the study students resided in urban areas. 52% of them were females, 26.5% were males, and about 32/98 (32.7%) were displaced outside Sudan due to the ongoing war, most of them female (21/32, 65.6%). (Table 1) (Figure 1)



Table 1 distribution of the study subjects by sex and demographic data

Variable	Males	Females	Total
Residence:			
Urban	26	51	77
Rural	9	12	21
Total	35	63	98
Financial support			
Dependent	27	57	84
Independent	8	6	14
Total	35	63	98
Current living status			
Living in my home as usual	13	24	37
Displaced but staying within home city/town	4	2	6
Displaced to another city within Sudan	7	16	23
Displaced outside Sudan	11	21	32
Total	35	63	98

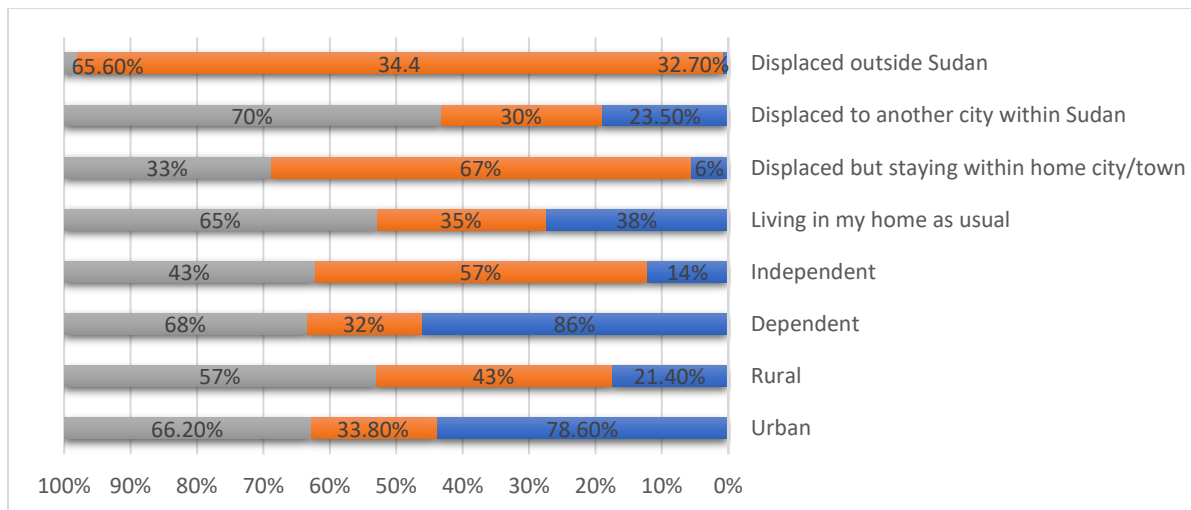


Figure 1 Description of demographic and displacement cross by sex.

About the participants' experience of e-learning 24/30 (80%) have experience with basic tools, 26/30 (86.7%) have regular internet access, 24/30 (80%) of those who show experience have no technical training

support from their universities, and the most usable mode of e-learning is recordable material, 54/98 (55%). (Table 2)

Table 2 Distribution of the study subjects by e-learning experiences.

Variable	No experience	Limited experience	Some experience	Experienced	highly experience	Total
Confidant on basic tools						
Yes	15	10	22	24	6	77
No	8	6	1	6	0	21
Total	23	16	23	30	6	98
Regular net access						
Yes	12	6	14	26	5	63
No	11	10	9	4	1	35
Total	23	16	23	30	6	98
University training support						
Yes	8	4	9	6	3	30
No	15	12	14	24	3	68
Total	23	16	23	30	6	98
Mode of E-learning during war						
Synchronous online	8	7	6	5	0	26
Recordable	9	4	16	20	5	54
written PDF	6	5	1	5	1	18
Total	23	16	22	25	6	98

During war the Telegram application was shown to be the most commonly used one, with improved experience in use 84/98 (85.7%) and 29/84 (34.5%). Specialized applications like Moodle and university platforms show less used experiences: 2/98 (2%) and 1/98 (1%). (Table 3) (Figure 2)

Table 3 distribution of the study subjects by e-learning experiences during and before the war and the application tools.

Variables	Much worse	Slightly worse	About the same	Slightly better	Much better	Total
Google meet						
Used	1	5	6	7	2	21
Not used	4	25	7	26	15	77
Telegram						
Used	3	27	9	29	16	84
Not used	2	3	4	4	1	14
Moodle						
Used	0	4	1	2	2	9
Not used	5	26	12	31	15	89
University platform						
Used	0	0	1	1	1	3
Not used	5	30	12	32	16	95
Zoom						
Used	0	6	2	10	4	22
Not used	5	24	11	23	13	76
Other applications						
Used	1	2	0	3	0	6
Not used	4	28	13	30	17	92
Total for all	5	30	13	33	17	98

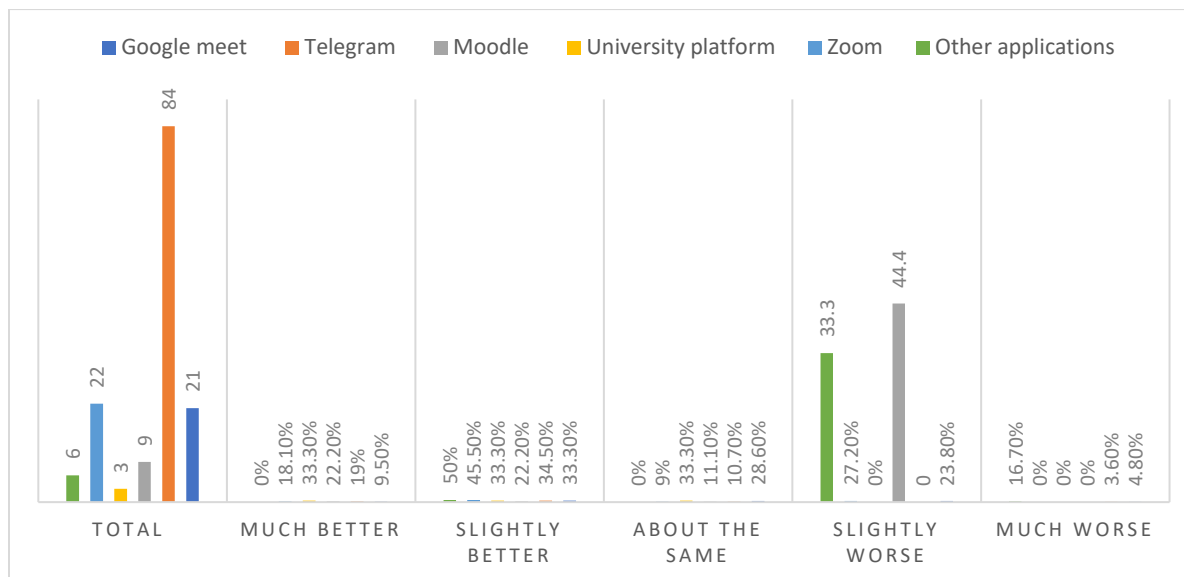


Figure 2 Description of e-learning application tools based on experiences during the war.

DISCUSSION:

Resorting to e-learning was one of the first strategies to get out of the crisis and continue the educational process in all medical colleges, which was facilitated by its adoption by most universities as a new auxiliary educational method before the war period. Some studies conducted during the early period of the war on medical colleges in Khartoum State, the first region to emerge from the conflict, showed that 60.3% (35 out of 58) of the colleges included in the study sought to restore the educational process. This aim was achieved through e-learning (48.6% (17 out of 35)), collaboration with other universities inside and outside Sudan (8.6% (3 out of 35)), or both strategies (e-learning and collaboration) (40% (14 out of 35)) [2].

The current study examined the e-learning experience among medical students at Sudanese universities during the ongoing armed conflict, with a particular focus on gender disparities, displacement, technological tools, and the continuity of the learning process.

The study showed that the females predominated over the males by 64.3% and 35.8%. The percentage of those who remained in their homes is slightly higher than that of those who were displaced outside Sudan (37.8%, 32.7%), because the study included only the

University of Kordofan, which is in a besieged area. Compared to a previous study, the percentage of females is close to what was found in our study (65.6%), except that displacement outside Sudan was greater (53.6%), and its validity is stronger because it included a larger study sample and areas of war confrontations [5].

The data in this study indicate that students' experiences with e-learning have improved slightly (50%), which may seem counterintuitive given the ongoing conflict. However, this improvement is partly attributable to the transfer of a proportion of students outside Sudan, where access to digital infrastructure and internet connectivity is more stable. It also reflects the applications used and the methods of delivering educational content. Regarding the technological tools and applications used, the analysis revealed that Telegram was the most widely used platform for e-learning (85.7%). This finding is significant, as it confirms students' preference for easy-to-use, lightweight, and adaptable tools over institutionally supported platforms such as Zoom, Moodle, and Google Classroom. What makes Telegram practical in this low-resource, high-mobility context is its low bandwidth requirements, its ability to communicate across large groups, and its ease of file sharing. This use also signals a shift toward informal and decentralized learning delivery

methods, often facilitated by peer-led communities rather than formal institutional structures.

Despite the resilience and adaptability demonstrated by students, fundamental challenges still hinder the sustainability and inclusiveness of e-learning in this context. These include unreliable access to devices and the internet, the lack of standardized curricula, the psychological stresses associated with displacement and conflict, and weak institutional coordination. Furthermore, the lack of formal accreditation mechanisms for e-learning may limit students' long-term academic and career prospects.

In conclusion, using hybrid, low-bandwidth, gender-sensitive platforms with built-in psychosocial support can help keep education going in times of crisis. However, these findings demonstrate that e-learning remains a fragile and unequal solution, despite its pivotal role in ensuring the continuity of the educational process. The war has created a situation in which digital education has become both a necessity and a compromise, exposing deep structural inequalities in access to education, participation, and educational governance.

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