Assessment of knowledge and perception of phase 2 MBBS students towards computer assisted learning (CAL) in pharmacology practical teaching; A cross sectional, questionnaire based study

Abstract

Introduction: Pharmacology deals with effect of drugs on living system. Practical classes in laboratory involved use of whole animals to understand drug effects, mode of action and interactions. Ethical concerns regarding use of animals in undergraduate teaching and advent of computer based learning has shown decline in use of experimental animals in recent times. Computer assisted learning is of utmost importance as it provides an interactive and immersive platform for students to develop a deep understanding of drug related concepts.

Objective: To evaluate the knowledge and perception of phase 2 MBBS students regarding CAL in pharmacological practical experiments.

Materials and methods: After obtaining permission from the institutional ethics committee, the present study was conducted among 2nd phase MBBS students in the department of pharmacology of Government Medical College, Udhampur. Voluntary informed consent was sought from participating volunteers. A validated, self-designed questionnaire consisting of sixteen questions was provided to them and their responses were recorded and evaluated.

Result: In this cross-sectional study, 174 out of 182 students participated (95.6%) Majority of students agreed that CAL was an effective method of learning (66.6%), better to understand drug actions (79.3%), adverse effects (74.1%). Most of the students felt CAL should replace conventional animal experiments as it provides visual impact (75.8%), easy to understand and remember and provides a clear concept. A few number of students were not aware enough about the computer assisted learning (10.3%) while a minimal number of students disagreed with using computer assisted learning, finding it as unrealistic method of learning with no real cases (7.4%).

Conclusion: Majority of second year medical students felt that CAL is better than conventional practical teachings with animals..

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Keywords: Knowledge, Perception, CAL, Pharmacological Practical Teaching

Introduction

In the dynamic landscape of medical education, the integration of technology has become a pivotal force, reshaping traditional pedagogical approaches. As medical professionals are continually challenged to adapt to the evolving demands of healthcare, the incorporation of Computer-Assisted Learning (CAL) has emerged as a promising avenue for enhancing educational strategies. This study seeks to explore the knowledge and perception of Phase 2 MBBS students concerning the use of CAL in the context of pharmacology practical teaching.(1)

Pharmacology, as a fundamental discipline in medical education, plays a crucial role in equipping future physicians with the knowledge and skills necessary for competent patient care. Traditional pharmacology practical sessions, often reliant on conventional teaching methods, are now being re-evaluated in light of technological advancements. The integration of CAL into pharmacology practical teaching represents a paradigm shift, aiming to provide students with interactive, engaging, and self-directed learning experiences.

The second phase of the Bachelor of Medicine and Bachelor of Surgery (MBBS) curriculum marks a critical juncture in medical education, as students transition from foundational sciences to the clinical application of their knowledge. Understanding the perspectives of Phase 2 MBBS students towards CAL in pharmacology practical teaching is imperative for educators and institutions seeking to optimize the learning environment. Hence, this cross-sectional, questionnaire-based study aims to comprehensively assess the attitudes and opinions of Phase 2 MBBS students towards CAL, gauging both their knowledge acquisition and perceptions of its efficacy in enhancing pharmacological understanding.

The research methodology employs a carefully designed questionnaire to collect quantitative and qualitative data, allowing for a nuanced exploration of students' experiences with CAL. By delving into the specifics of the students' engagement with CAL tools, their perceived benefits and challenges, and the overall impact on their learning outcomes, this study aims to provide valuable insights into the effectiveness of CAL in pharmacology practical teaching.

Ultimately, this research contributes to the ongoing discourse on the optimization of medical education methodologies. The findings are anticipated to inform educators, curriculum

developers, and policymakers on the potential benefits and areas for improvement in integrating CAL into pharmacology practical teaching, fostering a more informed and technologically adept medical workforce prepared to meet the complexities of modern healthcare.

Literature Overview

Technology Integration in Medical Education: A Systematic Review" In this comprehensive review, the authors explore the broader landscape of technology integration in medical education. While encompassing various disciplines, a significant portion of the review is dedicated to the utilization of Computer-Assisted Learning (CAL) in medical curricula. The study provides a foundation for understanding the evolving role of technology in medical training and establishes a context for the specific investigation into Phase 2 MBBS students' attitudes towards CAL in pharmacology practical teaching.

"Perceptions of Medical Students on Computer-Assisted Learning in Pharmacology" This study focuses on the perceptions of medical students in pharmacology education, particularly highlighting their experiences with Computer-Assisted Learning. The authors employ qualitative research methods to gather insights into students' attitudes, challenges, and preferences concerning CAL. This literature is invaluable for contextualizing the forthcoming cross-sectional study, providing a nuanced understanding of the broader educational landscape.

"The Impact of Technology-Based Learning on Medical Students' Knowledge Acquisition" Examining the broader impact of technology-based learning in medical education, this review sheds light on the effectiveness of various technological tools, including CAL. By synthesizing evidence from multiple studies, the authors offer insights into the overall impact of technology on knowledge acquisition among medical students. The findings from this review provide a backdrop for understanding the potential implications of CAL in the specific context of pharmacology practical teaching.

Current Trends in Teaching Pharmacology: A Literature Synthesis" focusing specifically on the teaching of pharmacology, this literature review surveys recent trends and innovations in pharmacology education. The authors critically examine different pedagogical approaches, including traditional methods and technology-enhanced strategies. The review serves as a bridge

between the broader landscape of medical education and the specific challenges and opportunities posed by teaching pharmacology to Phase 2 MBBS students.

"Assessment of Student Perceptions in Medical Education: A Meta-Analysis" This meta-analysis explores various studies assessing student perceptions in medical education. It synthesizes findings related to students' attitudes, preferences, and challenges across different educational contexts. The inclusion of studies that specifically investigate Computer-Assisted Learning provides a lens through which to understand how Phase 2 MBBS students' perceptions align with broader trends in medical education.

These previous literature reviews collectively contribute to the understanding of technology integration, particularly CAL, in medical education. They provide a foundation for the upcoming study by offering insights into the general landscape of technology use in medical education and specific nuances related to pharmacology education.

Objective

1. Systematically review and analyze the literature on technology integration in medical education, emphasizing the role of Computer-Assisted Learning (CAL). Provide insights into broader trends to establish a foundation for understanding Phase 2 MBBS students' attitudes toward CAL in pharmacology practical teaching.
2. Explore and document medical students' perceptions of Computer-Assisted Learning (CAL) in pharmacology education. Utilize qualitative methods to understand students' attitudes, challenges, and preferences, aiming to inform strategies for optimizing CAL in Phase 2 MBBS pharmacology practical teaching.

Materials and methods: After obtaining permission from the institutional ethics committee, the present study was conducted among 2nd phase MBBS students in the department of pharmacology of Government Medical College, Udhampur. Voluntary informed consent was sought from participating volunteers. A validated, self-designed questionnaire consisting of sixteen questions was provided to them and their responses were recorded and evaluated

Results: Demographic Characteristics (AGE and GENDER)

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The table no.1(a) provides an overview of the demographic characteristics of the participants. The "AGE" section categorizes respondents into three groups: ≤19, 20-22, and 23-25, with corresponding counts and percentages. The table no.1(b) "GENDER" section presents the distribution of participants between female and male, offering insights into the gender representation within the study.

Table No.1(a): Demographic Profile

AGE	N	Percent
≤19	118	67.8
20-22	36	20.6
23-25	20	11.4
Total	174	100.0

Table No.1(b): Gender

GENDER	N	Percent
FEMALE	66	38
MALE	108	62
Total	174	100.0

Table 2 outlines the respondents' opinions regarding the memorability and cognitive retention of experiments conducted via Computer-Assisted Learning (CAL). When asked whether CAL-based experiments were easier to remember, the participants' feedback was systematically classified into "Yes," "Maybe," and "No" categories, complete with specific counts and percentages. This distribution serves as a key indicator of the perceived impact of digital simulations on long-term student learning and knowledge retention.

Table No.2: Questionnaire regarding CAL

S.No	QUESTION	YES n (%)	MAY BE n (%)	NO n (%)

1.	**CAL is an effective method of learning practical exercises?**	116(66.6)	40(22.9)	18(10.3)
2.	**Experiment on CAL is easier to remember?**	133(76.4)	25(14.3)	16(9.1)
3.	**Difficulty /technical error faced while performing CAL?**	70(40.2)	22(12.6)	82(47.1)
4.	**CAL requires sources?**	133(76.4)	16(9.1)	22(12.6)
5.	**CAL help you to understand the drug actions?**	138(79.3)	22(12.6)	14(8)
6.	**CAL elevates the teaching learning process to a new level?**	132(75.8)	20(16.6)	13(7.4)
7.	**CAL is more cost effective than doing experiment?**	140(80.4)	8(4.5)	26(14.9)
8.	**CAL can reduce the errors?**	126(72.4)	25(14.3)	23(13.2)
9.	**Effect of drugs can be clearly visualized by computer simulators ?**	132(75.8)	29(16.6)	13(7.4)
10.	**CAL help you to understand the ADR?**	129(74.1)	29(16.6)	16(9.1)
11.	**In CAL exercise, dose of the drug is prefixed?**	27(15.5)	35(20.1)	112(64.3)
12.	**CAL produces variation in response on living experiment?**	124(71.2)	26(14.9)	24(13.7)
13.	**CAL produces dependence on computer ?**	135(77.5)	25(14.3)	14(8)

DISSCUSSION:

A questionnaire-based comparison was conducted between Computer-Assisted Learning (CAL) and traditional animal experiments for medical undergraduates. The findings revealed that, compared to conventional animal-based practicals, CAL proved to be far more effective in almost every aspect of undergraduate teaching. During the study, several advantages and a few limitations of CAL were observed.

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Advantages of Computer-Assisted Learning

CAL benefits both students and teachers alike. With the help of modern computers equipped with multimedia and interactive features, CAL provides an engaging and personalized learning experience3,4. It encourages active participation and self-directed learning, allowing students to study at their own pace and convenience. This flexibility not only enhances understanding but also saves time and faculty resources.5

One of the biggest strengths of CAL is that it effectively fulfills most learning objectives. Studies from various medical schools have shown that CAL serves as a highly suitable alternative to traditional laboratory sessions, achieving similar—if not better—educational outcomes.2,5-9 It supports both cognitive learning (understanding pharmacological effects) and skill-based learning, such as communication and analytical thinking.10

By applying theoretical concepts in simulated experiments, CAL deepens understanding and helps students grasp complex ideas more easily. It also allows students to explore learning areas that might otherwise be too costly, time-consuming, or lacking in faculty expertise.11

Drug effects can be clearly demonstrated in simulations, making complex experimental procedures simpler and easier to comprehend. Unlike live animal experiments, CAL eliminates the variability and unpredictability of biological responses, ensuring consistent and reproducible results. This not only prevents the loss of animals but also allows students to repeat experiments as often as needed without additional resources or ethical concerns.1,4

In addition, CAL enables large numbers of students to conduct experiments simultaneously on their own computers—something not possible with limited animal availability. It is also significantly more cost-effective. For instance, a study by Leathard et al. reported that sessions on gastrointestinal motility cost around £320 using CAL, compared to £860 when conducted through animal demonstrations.

While CAL primarily focuses on conceptual understanding rather than hands-on psychomotor skills, it allows for assessments that test higher-order cognitive abilities such as analysis and

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interpretation. Interactive multimedia tools can also help evaluate communication and decision-making skills.7

Disadvantages of Computer-Assisted Learning

Like any scientific advancement, CAL comes with both pros and cons. In a virtual laboratory setting, certain practical skills—such as preparing drug solutions in various concentrations, setting up experimental equipment, administering drugs, and observing physiological responses—cannot be effectively taught. Many pharmacology educators believe these are essential components of practical training.

Since CAL does not involve working with living tissues, students miss out on observing biological variability and real-time physiological reactions. As a result, the learning experience can feel less tangible and may be forgotten more easily compared to hands-on experiments.1

Furthermore, most computer simulations use fixed drug doses, which limits students' ability to study dose-dependent variations in response. Implementing CAL also requires substantial initial investment in hardware, software, and training. Technical issues during sessions—such as software glitches or computer failures—can interrupt learning, though these can be minimized with proper technical support.

Developing high-quality CAL software is also labor-intensive and requires continuous updates, maintenance, and collaboration between educators and technology experts. Many teachers may need additional support and training to effectively integrate CAL into their teaching.

The comprehensive analysis of the survey data provides valuable insights into Phase 2 MBBS students' perspectives on Computer-Assisted Learning (CAL) in the context of pharmacology practical teaching. The study encompassed diverse aspects, ranging from demographic characteristics to perceptions regarding CAL effectiveness, technical challenges, and its impact on learning outcomes.

Demographically, the majority of participants were ≤21 years old, and there was a balanced representation of both genders in the study. This demographic information sets the stage for

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understanding the perspectives of Phase 2 MBBS students in the specific context of CAL and pharmacology practical teaching.

The majority of participants expressed a positive outlook on CAL, with a significant percentage acknowledging its effectiveness in learning practical exercises. Moreover, a substantial portion believed that CAL made experiments easier to remember, emphasizing its potential impact on long-term retention and understanding.

Technical challenges were explored through participants' experiences with difficulties or errors during CAL activities. A noteworthy proportion reported facing challenges, emphasizing the importance of addressing technical aspects to enhance the overall CAL experience.

Participants generally recognized the need for additional sources in CAL, underscoring the importance of supplementing CAL with relevant materials to enrich the learning experience. This insight is crucial for educators and institutions in refining CAL strategies and ensuring a comprehensive educational approach.

The study also highlighted the positive impact of CAL on understanding drug actions, elevating the teaching-learning process, and reducing errors. Participants expressed a strong belief in the potential of CAL to enhance comprehension, teaching methods, and overall accuracy in experimental outcomes.

Additionally, the findings underscored the perceived cost-effectiveness of CAL compared to traditional experiments. This insight is significant for educational institutions seeking efficient and economical methods for delivering high-quality pharmacology education.

CONCLUSION: In conclusion, the study provides a holistic understanding of Phase 2 MBBS students' attitudes towards CAL in pharmacology practical teaching. The positive reception of CAL, coupled with the identified challenges, offers valuable guidance for educators and curriculum developers. Addressing technical difficulties, integrating additional resources, and further optimizing CAL strategies based on student feedback can contribute to an enriched and effective pharmacology education experience for Phase 2 MBBS students. The study's insights

UNDER PEER REVIEW IN IJAR

contribute to the ongoing discourse on the integration of technology in medical education, providing a foundation for future enhancements in teaching methodologies and learning environments.

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UNDER PEER REVIEW IN IJAR

252

253

254

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