# Implementation of Computer-Aided Instruction in the Philippines

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**ABSTRACT**

*This study investigates the implementation of Computer-Aided Instruction (CAI) in K- 12 education, particularly focusing on its role in enhancing teaching practices and improving student learning outcomes, especially in science and remedial classes. The National Science Education Standards emphasize the importance of incorporating CAI to provide students with access to science tools and enhance learning experiences. DepEd order no. 78, s. 2010, mandates the integration of Information and Communication Technology (ICT) in public schools to support teaching and learning processes. Despite challenges in implementation and disparities in access to ICT resources, ongoing efforts like the GILAS project aim to enhance Internet literacy in Philippine public schools, promoting equitable access to technology and improving educational outcomes. Research highlights the effectiveness of Computer-Assisted Instruction (CAI), particularly in science subjects, where it helps students master challenging concepts and improve academic performance. This technology enhances understanding by offering instant feedback and personalized learning paths, catering to individual student needs. Studies reveal further that CAI fosters personalized learning environments, supports individualized pacing, and engages students through interactive simulations, animations, and educational games. The findings underscore the transformative potential of CAI in science education, emphasizing its role in bridging educational gaps and preparing students for future challenges in the digital world.*

***Keywords:*** *Computer-aided instruction, Science, Technology, Remedial*

## 1. INTRODUCTION

Computer-aided instruction (CAI) is a term used to describe a teaching or learning scenario where a student and a computer interact directly during instruction (Forcier, 1996). National Science Education Standards (1996) underscore the importance of incorporating computer-aided instruction, emphasizing that students have convenient access to science tools, materials, and technological resources. Moreover, DepEd Order no. 78, s. 2010, outlines a national plan for incorporating Information and Communication Technology (ICT) into Basic Education. This order requires public schools to integrate these technologies to enhance their teaching and learning processes. This initiative addresses challenges in the K to 12 basic education programs.

In the K–12 curriculum, which utilizes the spiral progression approach, teachers must identify the least-learned competencies to facilitate revisiting and making connections between previously taught lessons and new ones (Samala, 2017). This paves the way for remedial sessions to ensure that students have mastered the topic and are ready for succeeding lessons. According to Capuyan et al. (2019), students who attend remediation lessons tend to show improvement in their grades from before current grade levels. Remedial interventions by teaching advisers significantly improved students' final grades (Tseng et al., 2016). Most importantly for science subjects that students find challenging. A survey from most students revealed that science is a complicated, highly content-loaded, boring subject that requires passive observation rather than active participation in the learning process (Woolnough, 1994).

To address the complexity of science topics and bridge gaps in the K–12 curriculum, educators can enhance learning through engaging remedial teaching methods. They must improve teaching practices and resources in the classroom (Asio & Jimenez, 2020). Research indicates that incorporating technology in teaching enhances student

achievement and academic performance, offering highly personalized instruction and enabling students to learn at their speed (Lepper and Gurtner, 1989). Because computer literacy is a necessary 21st-century skill for learners, educators must use technology in the classroom to prepare students for their future careers. Innovative technological strategies aid in raising the standard of primary education and fostering student mastery. Barrow et al. (2007) explained that CAI allows more advanced students to progress more quickly at their own pace; however, it might be more advantageous for struggling students who cannot keep up with the speed of lectures in traditional classrooms. With the speed at which technology is developing and impacting the world, it is impossible for education in the 21st century not to be immersed in innovation (SEAMEO, 2018). Computer-aided instruction (CAI) offers advantages over traditional methods, making teaching techniques more effective. CAI uses multimedia components such as animations, interactive exercises, simulations, and videos to create dynamic and engaging learning environments. Likewise, these engaging and adaptable resources help students grasp the material more deeply by grabbing their interest and meeting the needs of different learning styles (Joseph, 2023).

Despite the recent utilization of CAI in the teaching and learning, the 2022 PISA results revealed that several countries are below international standards and statistically lower than the OECD (Organization for Economic Cooperation and Development) average. Thus, by evaluating the implementation of CAI, this study seeks to increase student learning outcomes by delivering a dynamic and engaging learning environment. Also, it can advance teaching strategies in science education, particularly in remedial classes, by incorporating innovative technology-based approaches to support students in mastering essential scientific principles.

**CAI Programs in the Philippines**

The Department of Education aims to provide best instructional materials with ICT integration to have quality basic education for Filipino learners. Its intention is to make appropriate and effective use of ICTs to foster the quality and efficient services the department could offer. The national agenda for ICT in Basic Education has been disseminated through DepEd Order 78, s. 2010- Guidelines on the Implementation of the DepEd Computerization Program (DCP).

**DepEd Computerization Program (DCP)**

The goal of the DepEd Computerization Program (DCP) is to equip public schools with the right technology to improve teaching and learning and prepare them for the challenges of the twenty-first century. Recipient public schools of DCP packages must make use of these technologies to upgrade the teaching and learning process. Moreover, the implementation of this DepEd Order brought ideas for strategies to both teaching and learning as the country embraces challenges towards K to 12 basic education programs.

DepEd order 42, S. 2016 on the Policy Guidelines on Daily Lesson Preparation for the K to 12 Basic Education Program affirmed the role of the K to 12 teachers as a facilitator of learning. This guideline empowers the teachers to prepare Daily Lesson Log (DLL) or Detailed Lesson Plan (DLP) that carry out quality instruction and allows the use of diverse instructional and formative assessment strategies which includes the use of information and communications technologies (ICTs). DepEd order 16, s. 2023 on the goal of the Department of Education's Revised Guidelines on the Implementation of the Computerization Program is to give public schools access to equitable, high-quality, and appropriate technologies that will improve their governance, operations, and teaching and learning processes to better prepare them for the challenges of the modern world. The DepEd central office, regional offices, and schools' division offices will be guided by these mechanisms, along with the monitoring and evaluation processes, to guarantee that the DCP objectives are implemented effectively and efficiently in accordance with the department's MATATAG curriculum.

**Gearing Up Internet Literacy Access for Students (GILAS)**

The Gearing Up Internet Literacy Access for Students or the GILAS project targets to connect all public secondary schools in the country to the Internet in five years. The GILAS project has been adopted and is receiving full support from the Philippine Department of Education (DepEd), in partnership with several influential figures in the business, government, and socio-civic community. In the next five years, all 5,443 public secondary schools in the Philippines are expected to offer basic Internet literacy programs and student access to the Internet through the multi-sectoral GILAS initiative.

In partnership with the DepEd, a group of private companies and community organizations oversee its mission. Project orientation, briefings, resource mobilization, sustainability trainings, ICT survey and validation, and other

validated activities are among the project's components. It is anticipated that Department of Education representatives will strengthen the Department's involvement by encouraging their respective school community and administrators to support the project. It is recommended that principals and other individuals responsible for assuming accountability for the schools actively participate in the GILAS orientation, local partnership development and resource mobilization, ICT survey and validation, project launch, and sustainable use of ICT facilities. The project is primarily expected to benefit public school senior high school students.

**Computer-Aided Instruction (CAI)**

The advancement of technology has transformed the teaching-learning process. Various approaches have been modified, and gadgets have been utilized to facilitate teaching and learning, catering to today's learners. Consequently, the term Computer- Aided Instruction (CAI) was coined.

The acronyms such as Computer-Assisted Learning (CAL), Computer-Managed Instruction (CMI), and Computer-Assisted Instruction (CAI), Computer-Based Education (CBE) and Computer-Based Instruction (CBI) are among the terms that describe how computers are used as instruments in education. CAI, as defined by Furo (2015), refers to computer-based instruction or remediation. It involves presenting the lesson materials and keeping track of student learning through the interactive use of computers in the classroom (Buabeng & Vander Bosscher, 2023). The teacher is ultimately responsible for instruction in the classroom. To enumerate:
(1) the teacher sets up the learning environment through careful selection and analysis of the instruction materials, (2) ensures that each student has the necessary entry- level knowledge, skills, and attitude to engage in a particular activity, (3) monitors the learning activities, (4) adjusting them according to the student's needs; and (5) following up with activities designed to promote retention and transfer of learning (Forcier, 1996).

Digital and hybrid computers didn't gain significant popularity as teaching tools until the 1980s. Computers were initially employed in training and education much earlier. Researchers at International Business Machine Corporation (IBM) authored the first Computer-Assisted Instruction (CAI) author language. They created one of the first CAI programs to be used in public schools, contributing significantly to the early work on computers in education during the 1950s. According to behaviorist theories, students followed the instructions on the computer screen and received rewards for providing accurate responses (Osokoya, 2013).

**Uses of CAI in the Classroom**

The use of computers in instruction is categorized by Dori and Yochim (1990) and Piciano (1994) according to Taylor's classification as follows: 1) tutor, 2) tool, and 3) tutee. As a tutor, the computer first presents information, then provides practice questions, and finally, receives responses from the learners. In the tool mode, tasks are accomplished using the computer. It assists or acts as a tool in the learning environments. In the tutee mode, the computer acts as a student. It receives instruction from the learner and performs specialized tasks. Computer-Assisted Instruction (CAI) as a tutor application is categorized into: (1) drill and practice, (2) tutorials, (3) simulations, and (4) instructional games and problem-solving. In the tutorial, new subjects or materials are presented to the learner in an expository style, followed by questions to which the learner will respond. The computer analyzes the responses and gives appropriate feedback. In drill and practice, learners assume they have already acquired a prior knowledge of the subject matter.

The Department of Education directed teachers to utilize ICT equipment in teaching. Guidelines on the use of computer laboratories in teaching and learning were elaborated through DepEd Order 23, s. 2004. This enforced teachers to integrate ICT into the teaching and learning processes across all subject areas. The implementation of this DepEd order mandated the school heads to make sure that teachers and students utilized the ICT equipment efficiently and effectively.

Currently, in the classroom setting with computer technology, the computer collects directions and performs the tasks. The research of Prensky (2010) recognized the rapid pace of digital technology entering the classrooms and making students' learning accurate, active, and valuable for their future. Schools nowadays have been implementing and improving computer technology with the goal of increasing students' achievement (Patterson, 2005). In efforts to improve all students' performance, Patterson (2005) confirmed that additional study was required to support the use of CAI as a potential strategy for raising student achievement.

According to Banik & Biswas (2017), computer education has been implemented in schools, and instructors used computers as a teaching tool. Students seemed to be motivated by learning via computer-based teaching. Through

this medium, students produced positive effects in the classroom (Forcier, 1999). In addition, Saldon-Eder (2014) emphasized that the purpose of Computer-Aided Instruction is to supplement academic achievements, present visualizations of images, and enhance mental skills. It will lessen the teachers' preparation and will fulfil the needs of the students. Learners will have interactive communication through computer-programmed instruction such as animation, sound, and educational games. Using CAI is advantageous for students because they can learn the subject at their own pace and achieve personalized learning (Peng et al., 2009).

**Impact of CAI on Teaching Sciences and Student Achievement**

Suleman et al. (2017) revealed that Computer-Aided Instruction (CAI) in Physics has a significant positive effect on students' academic achievement and was found more useful in different levels of the cognitive domain. Furthermore, the same study found that CAI is more effective in the retention of learning and in remediation to clarify concepts of difficult topics.

CAI provides more significant opportunities for the learner to learn by serving individual differences. It can be used for drilling and practice, as a virtual lab to carry out diverse types of experiments during learning and has much scope as a learning service in distance education (Gupta et al., 2014). This is proven to be better than the traditional method of learning among teacher trainees. Further, it brings an enhancement in achievement and provides new multisensory learning experiences.

In teaching Physics and with the need to create a student-centered classroom, Chinwendu and Patience (2017) revealed that the application of computer technology to all aspects of human endeavour had necessitated CAI. It improves sustainability and better holds the interest of learners as a viable alternative to conventional lecture teaching methods in Physics. Moreover, it provides powerful tools to support the shift to a more interactive and engaging student-centered learning environment.

Overall, Tambade and Wagh (2011) explained in their study that the utilization of Computer-Aided Instruction (CAI) is an excellent way to focus on students' conceptual understanding of physics principles. CAI, through the positive intervention of computer animations and simulations in the classroom, makes a real difference in student learning, such as in the interpreting verbal, vector, and diagrammatic representations in physics. The same study revealed that students in the experimental group substantially reduced their misconceptions in electrostatics and developed a functional understanding of physics.

**CAI on Remedial Classes**

Remedial classes are significant strategies to help students catch up with their mates and establish mastery of the lessons. It is said that at-risk students' common characteristics are: (1.) Poor test answering skills, (2.) Low attainment, (3.) Test performance under average, (4.) Assignment not submitted, (5.) Lack of the elder's oversight and encouragement on academic achievement, (6.) Lack of awareness about the correlation between educational achievement and career paths (McLaughlin & Vacha, 1992; Chou, 2017). With the help of remedial instructions, students will overcome these characteristics and surmount learning difficulties.

Several studies have been conducted to prove the importance of remedial classes. Instant and assistive remedial instruction and immediate feedback for errors are significant advantages to help students learn (Hsiao et al., 2016; Chou, 2017). Dai and Huang (2015) used a quasi-experimental design and applied three different teaching models of remedial instruction to vocational high school students with poor performance in mathematics. It has been found that among the three teaching models, the e-learning instruction model is more effective than the blended learning and traditional instruction models. Moreover, several meta-analyses have shown that technology can enhance learning (Schmid et al., 2014) and that video can be a valuable educational tool (Brame, 2016). Videos may have value for student preparation in science classes because students may find them more engaging (Stockwell et al., 2015) and because they can illuminate abstract or hard-to-visualize phenomena (Dash, 2016).
Though much research has pointed out various advantages of computerized adaptive remedial instruction system, its instructional usage was still limited. Audio-video presentations, as an example of Computer-Aided Instruction (CAI), are not inherently effective on their own. Guo et al. (2014) argued that students often disregard large segments of educational videos, while MacHardy and Pardos (2015) demonstrated that some videos contribute little to students' performance. Meanwhile, it has been observed that there were a limited number of computer laboratories in actual locations of instruction. Chou (2017) argued that teaching Natural Science could not be accommodated within the computer laboratory's schedule and could not effectively implement remedial teaching in the regular classroom setting. Therefore, it is the focal point around which this research aims to inquire.

## 2. CONCLUSIONS

In general, Computer-Aided Instruction is described as providing instruction or remediation using computers to teach, learn, and assess students' comprehension. Teaching performed with Computer-Aided Instruction is a more productive approach. The interactive instructions with CAI materials motivate and cultivate students' interest in learning science and produce superior academic achievement. By utilizing innovative approaches like CAI, educators can provide students with personalized and interesting learning experiences, leading to better comprehension of scientific principles and increased academic performance. The importance of integrating technology, such as multimedia components and interactive tools, caters to diverse learning styles and bridges gaps in the K-12 curriculum. Furthermore, the guidelines provided by educational authorities underscore the necessity of incorporating Information and Communication Technology (ICT) in teaching practices to prepare students for the digital age. Despite challenges and limitations in implementing CAI, ongoing research and efforts are focused on maximizing the benefits of technology in education to design dynamic and captivating learning spaces that support the achievement and mastery of students.

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