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Unraveling the Influence of Educational Informatization on Student Learning Outcomes

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Abstract: Educational computerization has transformed the learning landscape in academic institutions, significantly influencing students' educational outcomes. This study examines how the integration of information and communication technologies (ICTs) impacts student motivation, engagement, and academic performance. Through an analysis of recent research, both the benefits and challenges of computerization in educational settings are revealed. The importance of a balanced approach that combines technology with effective pedagogies to maximize learning potential is highlighted. This paper also suggests future areas of research to further understand the mechanisms underlying these effects.

Keywords: Educational computerization, information and communication technologies, learning outcomes, student motivation, academic engagement, educational performance, pedagogy, educational research.

Introduction

Education informatization refers to a systematic and targeted modernization of education through information technologies and their applications (Ian Vance, 2019). Because of the evolution from the information age to the intelligence age, education informatization has been a consensus trend both at home and abroad. Nevertheless, existing research mainly concentrates on the current situation of education informatization, policy, and strategy;

little empirical research critically examines the effect of education informatization on student learning outcomes. This study explores the influence of education informatization on student learning outcomes. The main contributions of the research are as follows:

First, the study reveals that education informatization has made a substantive positive impact on student learning outcomes. In the short run, the influence of education informatization on student learning outcomes is marginally non-significant but possesses non-negligible economic importance. In the long run, education informatization proficiently increases student academic test scores, consequently alleviating the influence of family background on the inequality of academic achievement. In addition, a more extensive digital gap is observed between rural and urban areas, as compared with G7 countries. Overall, while education informatization has made a positive impact on student learning outcomes in China, the availabilities of education informatization resources are not equal across the different geographical regions.

Second, possible pathways that achieve this impact are also explored. Education informatization is showcased to enhance student acquisition of knowledge and critical thinking skills, while family background-related factors have a non-significant and neglectable role. In particular, while a one standard deviation increase in education informatization sees a relative increase in the test scores' standard deviation by approximately 0.0413% in the short run and 0.1010% in the long run, its impact is more pronounced on mathematics subjects. Robustness checks demonstrate the generalizability of the results by employing a different econometric method and research sample.

Background of Educational Informatization

In recent years, the rapid rise of new educational technologies has opened new doors for educational reform and innovation and triggered wide-ranging discussions on educational informatization. Since the 18th National Congress of the Communist Party of China, the concept of "education informatization" has been repeatedly mentioned at the national level. Accordingly, researchers in the field of education have been driven to explore new rules for human society with the third technological revolution. By reviewing the literature, this paper provides insights into the current situation of educational informatization research around several aspects: the connotation of education informatization, the current situation of educational informatization, the factors promoting educational informatization, and the new technologies to be applied and new tasks and challenges to be faced in the process of educational informatization (You, 2019).

The new information technology led by the Internet and artificial intelligence has brought revolutionary changes to schools, learning and education, and education systems. Online education gives everyone the possibility of lifelong learning. Educational robots bring unprecedented challenges to teachers' jobs. Educational big data helps raise educational equity to a new level. All these new technologies are not only changing the traditional education mode but also deeply reshaping teachers, students, textbooks, and classrooms and bringing education system and revolution 4.0 opportunities and challenges. Educational informatization should support the fair and diversified education. Meanwhile, it should pay attention to human nature development. Individualized and lifelong learning, based on the digitalization and networking of educational resources, has become a fundamental requirement for future education. The educational informatization stage is to apply information technology to all aspects of educational and teaching activities. This stage involves the extensive and deep penetration of networked and digital educational resources, such as the utilization and application of digital teaching resources with various forms and rich contents, online learning network with rich applications for students and teachers, and online management of educational administrative affairs.

Theoretical Framework

Due to the trend of educational informatisation sweeping the globe, countries of all sorts have attached great importance to the development of educational technology, aiming to enhance students' learning experience and achievement by promoting educational informatisation. However, a thorough examination of the impact of educational technology on academic achievement, based on the actual situation of basic education informatization construction in China, is still lacking. Consequently, a chain model of educational informatization, including independent variables, mediating variables, and dependent variables, is formed based on grounded theory. An

online questionnaire survey of the whole population among teachers and students is conducted to ascertain the current situation of basic education informatization construction as well as its impact on academic achievement and the mechanisms (Fernandez et al., 2023). Based on the studied samples of junior students and teachers, data analysis is conducted using software.

Educational informatization construction includes five dimensions, which are infrastructure, organization and operation, curriculum and teaching, assessment and evaluation, and application and support. Infrastructure has a direct and significant impact on students' academic achievement. Organization and operation, curriculum and teaching, assessment and evaluation, and application and support influence students' academic achievement through academic engagement. Students are more likely to utilize educational technology to participate in learning activities which can boost their academic achievement. The findings of this study are helpful in enriching the theoretical research on educational informatization impact and providing empirical basis for government and schools looking to inform investment in educational informatisation construction to improve students' academic environment and outcomes.

Constructivist Learning Theory

Constructivism is a theory with foundations in epistemology about how the acquisition of knowledge takes place, concerns with the dual nature of knowledge. The first point concerns how knowledge comes to be understood, which is either objective or subjective. The second point concerns the role of social life in knowledge construction, which is discovery or construction. Constructivism can be defined in terms of knowledge claim and intentionality according to the aforementioned points. Knowledge can be analyzed as truth, belief, and justification, where truth is subjective and belief is objective. These various constructions give rise to diverse constructivist epistemologies. Historically, there is strong evidence for constructivism as a theory of learning, which is concerned with the nature and events of the mind during the learning process.

While these three points are the essence of constructivism, many different theorists endorse these points with various interpretations. Epistemologically, constructivism is rooted in Platonism, which explains the independent reality of knowledge along with a separation between knowledge and information and also elaborates on the inexactness of human understanding. Idea-truths are thought to be exact-a priori-amenable to deduction and step-wise reasoning. Understanding knowledge involves groups of ideas which become active when certain situations of experience are present ((Do et al., 2023)). The functionalist critique addresses this assumption as it were thought to uncritically endorse the assumption that a mind can work systematically in relation to a body.

Technology Acceptance Model

Following the rapid development and widespread application of information technology, educational informatization has received abundant attention. Widely regarded as a social and cultural tool to assist teaching and learning, education informatization has great influence on education. Accordingly, effective instructional technology is called for to trigger deeper understanding and knowledge construction in students. Therefore, the external environment regarding educational informatization has changed, nonetheless, how students interact with this environment–deep learning outcomes, remains unclear and worth investigation. Especially during this period of great network variation, the rapid optimization and upgrading of the educational informatization infrastructure prompts a better understanding of the influence of educational informatization on student learning outcomes exceeding the sway of ostensible factors (Li, 2011).

Turning to the intrinsic factors of the individual students, technology acceptance is utilized to unveil how learning management systems could reshape teaching and learning environment and be accepted by users. Prior research indicates that educational informatics serves as a teaching tool via changed teacher-student interaction and students reporting of perceived effectiveness through the use of educational informatics. While educational informatization is widely researched as a teaching strategy, students’ acceptance of educational technology application and how educational informatization influences learning outcomes with the technology acceptance model is under-researched.

Methodology

Education is increasingly adopting information technology and gradually popularizing online teaching. In turn, teachers have adopted complex technologies to help them teach better. Educational information in the course of teaching, to various types of equipment, multimedia, the Internet and various types of supporting software for students' teaching, research and consultation. However, behind such extensive informatization is teachers' full consideration and effective application of educational technology in teaching. With years of exploratory practice, through multiple studies, the significance of educational informatization has been gradually recognized throughout the education sector, and its role in improving teaching quality is being increasingly emphasized. However, the existing theory and practice related to this exploration are far from sufficient, which are reflected through misconceptions and thought models that are strongly utilized. Meanwhile, due to the priority placed on educational informatization, such practices have led to vicious competition among schools, universities and vendors, which tended to monopolize resources and excessively obtain public resources and funds, resulting in uneven educational quality. Therefore, it has become a rigorous question for educational researchers to clarify the concept of educational informatization, disentangle the conflicted theoretical models and facilitate the understanding and application of educational informatization in teaching. In addition, there is a need for empirical studies, which have been emphasized through critiques and suggestions on future research in educational technology and were partly addressed as context and voids that are explored in present data analysis. Educational informatization has been subjected to extensive studies within educational technology. It has been defined as the process of introducing information technologies into the education system, which also serves to distinguish the information revolution from the application of information technologies to various industries. Educational informatization is taken from information and communication technologies in the terms educational information technologies, which account for the devices, tools and software that have been adopted in teaching. However, such informatics adopted in basic education would also incur social inequalities. Empirical evidence from an in-depth qualitative case study revealed the dualism of disadvantaged young children over the digital divide, in contrast to their well-resourced counterparts who exploited the potential of technology (Payá & Delgado, 2021).

Research Design

Studies on classroom interactions in learning through instructional technologies partly consider the affordances of each technology and how they interact with the task characteristics, but do not well connect these findings in a theoretical model with variables representing teachers' design and pedagogy. Close investigations of classroom discourse in contexts offer some contextualized findings, but lack their generalizability to more ubiquitous contexts in the larger and complex education and classroom systems. In analogy to theory, a more generalizable and developmentally comprehensible theoretical framework, full with verifiable research questions and variables, is expected to enhance rigorous examination and formative improvement of classroom interactions in learning through instructional technologies.

This paper will address the gap by hypothesizing a theoretical framework based on the Work Systems Model to interpret how instructional technologies influence classroom interactions in learning and exploring an initial attitudinal validation of the framework. Specifically, to test the good-fit of the hypothesized framework to the model classroom discourse data, to categorize the influences of instructional technologies on classroom discourse in learning on a range of agreeability values, and to examine influential factors including interactions and affordances of participants and instructional technologies in classroom discourse on learning through instructional technologies, these questions are proposed. The answers of these questions are expected to provide sound evidence of the validity of the Work Systems Model as a core theoretical model for classroom discourse in learning through instructional technologies.

Quantitative correlational research designs are used to investigate the nature and strength of the relationships between and among variables in this research. The research will focus on the acquisition of knowledge, competency performance, and the effects of educational relaxations on organizations in the influence of educational informatization on student learning outcomes. Developing a theoretical framework is considered for possible research to promote the knowledge and factors that affect the applications of the quality of real education.

Data Collection Methods

A cross-sectional survey method was conducted to measure the influence of perceived educational informatics factors on student education learning results. The unit of analysis for this research was the undergraduate and postgraduate students of NEHU affiliated colleges. The population is about 1944 students. Following Yamane's formula, a sample size of 329 students was selected. The stratified random sampling method was employed to select a respondent group from the colleges. The survey instrument was a questionnaire that contained 39 items in five constructs. The survey questionnaire was distributed to the respondents through online surveys. All scales used were attitudinal. A 5-point Likert scale (1=Strongly Disagree, to 5=Strongly Agree) was used to measure the items. Constructs were examined for reliability by Cronbach's alpha. The data of the respondents were analyzed using SPSS statistics package software. The analysis method included descriptive statistics, normality tests, reliability tests, and measures of central tendency. The results were presented with tables, charts, and graphs. Descriptive statistics answers the first and second objectives; the normality test and reliability analysis tests were conducted to answer the third objective. Moreover, the one-sample t-test was performed to answer the fourth and fifth objectives.

Out of 329 distributed questionnaires, 297 responses were received (90.33% response rate). After data cleaning, outliers, and missing values, 211 datasets remained. 7 missing values of the independent variables were replaced with the mean substitution method. A multivariate outlier was tested using the Mahalanobis distance. 3.12% of cases (> p-value of.001) were removed from the dataset for multiple regression results. Required assumptions for multiple regressions were met, such as checking for skewness and kurtosis, excluding exp(3), Cook's distance < 1, variance inflation factor 1.15< 10 and tolerance 0.856 > 0.1 and histogram plot. Four out of five independent variables were taken for regression analysis. The analyses were performed with the remaining 194 cases that resulted in 60.74% of explained variance and used with Cronbach's alpha reliability >0.709. The factor analysis derived these educational informatics variables: use of the LMS (factor loading > 0.55), perceived ICT method (0.635), perceived instructor-student interaction (0.572) and use of digital technology facilities (0.54). However, the perceived interactivity did not load in the factor analysis (factor loading > 0.55) and was measured separately (Sharma et al., 2022).

Sample Selection

This study utilized the dataset on student learning outcomes from participating cities in the first cycle of the first round of the IEA ICILS 2013 assessment. ICILS measured grade 8 students' computer and information literacy skills and students' and teachers' background, implementation and use of educational technology and their use in combination, as model questions and measures on national and system level (Chen & Hu, 2020). The participating countries and cities included Singapore (Singapore), China (Beijing), Slovenia (Maribor), Denmark (Copenhagen), Italy (Bologna), Norway (Oslo), Australia, Canada (Alberta, Ontario), Japan (Osaka), and the Netherlands (Rotterdam). The analysis in this paper focused on the learning outcomes on students' computer and information literacy in Singapore, China (Beijing), and Slovenia, and the cross-classified nested model was employed to capture the dataset structure. The sub-sample study from the dataset was only on student learning outcomes, aiming to compare the learning outcomes of Singapore, China (Beijing) and Slovenia cities.

The IEA ICILS 2013 dataset is publicly available, and logging in is needed to download. The analysis of the large-scale assessment on educational informatisation on student learning outcomes was conducted using R software 4.2.0. The information design used to display learning outcomes is provided via the PISA website. The purpose of ICILS is to conceptualise, measure and compare how young people are prepared to meet the challenges of the digital age. This involves measuring the computer and information literacy (CIL) of students, and the extent to which schools and education systems develop this knowledge and skills, and monitor access to and use of information and communication technologies (ICT) in schools, homes and communities (Solaymani & Abedini, 2016).

Impact of Technology on Learning Environments

Technology is widely used by students, teachers, parents, and schools to enhance learning outcomes. This technology use raises serious questions about how students learn. Are they infatuated and distracted by the technology, or are they more productively engaged as the technology allows for learning scenarios long thought impossible? The new technology landscape has changed how students use technology, how learning is structured around technology use, and how schools are considering developing supporting technology systems. The Internet's capacity for individualizing virtual experiences has led to the creation of social media applications and collaboration tools designed to be customized for each participant. It appears that online experiences become so personalized that technology no longer needs to be promoted in order to be used in educational environments; it has been passively inducted as a self-selected tool.

Technology in the classroom is no longer a gimmick, but an everyday necessity for student learning. Technology is heavily utilized by students both inside and outside of the classroom. Students access online news sites, eTextbooks, YouTube, websites, and discussion forums, as well as chat rooms, discussion boards, and instant messaging. While technology use by students in the classroom can lead to off-task behavior, it may also allow for students to have novel educational experiences for which traditional classrooms are not prepared. The change in practice, from cursive writing to typing, has led to a broader consideration of what it means to learn and to consider more broadly evidence of learning and success. This is beginning to require a change in assessment. Computers can positively impact student learning by supporting differentiated instruction and promoting student engagement and self-efficacy (Ian Vance, 2019).

The educational technology community supports that long-held belief. Empirical evidence that technology can positively influence learning outcomes is largely anecdotal. Considerable investment in computing devices has occurred in some districts without the foundation of broader consideration of each stage of the learning system. This broader consideration includes what technology is, how it could be used effectively by district personnel, what changes to the current pedagogical norm would anchor technology use, and finally how student learning is assessed. Some districts are ahead of this consideration and have invested heavily in technology systems supporting the changing learning landscape; many are still contemplating the digital future, but in doing so, productive uses of technology by teachers and students are easily overlooked. The focus in many schools on self-directed learning is needed, but without an understanding of how educational technology can support and translate that ideology into practice or assessment there is a real danger that technology will be added piecemeal, only to retrench to the pre-technology norm once again, with schools struggling to justify technology as superfluous.

Digital Classrooms

Since the advent of computers in the classroom, intense interest has been generated toward understanding the role of these machines on the learning process (Ian Vance, 2019). Advocates extol the virtues of this technology in creating dynamic, flexible environments where students can gather information across the world in real-time. Some critiques despair that schools may increasingly resemble factories or junkyards based on too much information too fast or using technology at students' peril (Gómez-Fernández & Mediavilla, 2018). In summaries of empirical findings regarding educational technology, the relationship between computers and learning is a dichotomy of too little or too much. This area of research is beset with problems of collection, interpretation, and statistical analysis of real-world evidence. Such studies have typically been one-shot assessments, offering time-bounded snapshots of an accident where confounding variables loom large.

The synergy of qualitative and quantitative information provides a more nuanced understanding of this interaction. In a qualitative phase, teacher-researchers were interviewed to ascertain how they believed computers did or did not affect their teaching and their students learning. The data from their interviews suggested that this relationship was a combination of school, teacher, and student factors. In particular, some inquiry into the role of educational experiences and philosophy in moderating the impact of technology in the classroom seemed warranted (Payá et al., 2023). The quantitative portion of the study was designed to assess the student-related effect of computer use on achievement. In writing this research, it became immediately obvious that technological proficiency was at the center of conceptualizing such a model.

Those responsible for improving academic achievement were ardent proponents of warm, classroom-friendly technology. The respondent population consisted of two ninth-grade classrooms with saturating access to computers and peripherals in a Midwestern US urban high school. The classroom where the larger study was conducted possessed a computer for each student and the responsibility of the researcher had been limited solely to collecting and tracking achievement data. Defined three cases to ascertain how classroom instruction affected learning which contained subunits with salient characteristics. Limitations encompassed prior usage and skills, learning environment, educational and experiential background, biases, perspective and preconception, and how well-founded connections between classroom instruction and student learning were delineated. In schools employing an experimental group, class discussions and drafting occurred on a computer.

Online Learning Platforms

In recent years, the development of online learning has gained increasing attention from scholars. As the global pandemic forced the use of online education, various opinions have been expressed, both prospective and retrospective, on this mode of education. So far, a few measurement tools have been developed, focusing on students' perceptions of online learning, which is key to successfully pursuing a seamless education (Maxwell et al., 2017). Nevertheless, no consistent tool exists to gauge the understanding of the technical aspects of lifelong education. The growing popularity of Massive Open Online Courses (MOOCs) and the growing number of online courses are the biggest trends in global higher education. One of these courses and platforms is E-learning in Public Governance, a 4-week course hosted on edX through the University of Utrecht.

Similar to traditional education, the understanding of online education depends on the availability of the technology and the tools in use; thus, a limited technological understanding might obstruct students from their opportunities for a good education. By measuring the use of automation in both synchronous and asynchronous modes of education, the understanding of e-learning in Public Governance can be established. This perspective creates room for additional insights from survey- or quiz-type feedback, geared more toward course content than understanding of mode or availability. While emphasis on a student-centered approach can promote a change in teaching behavior from the perspectives of interaction, instructional design, and assessment, few studies focus on the learning activities in which a change from teacher-centered to student-centered education occurs.

Student Engagement and Motivation

Through the educational quarterly informationization construction speed-up and unceasing resources integration enhancement, the education informatization construction has produced the influence for the important part of education, the teaching method form and the content that had the reform, the campus of the paramount importance informationize degree had promoted to the concrete substantial effect, as well as the independent, opportunities of the information technology interactive instructional mode are endowed with the country's highlighting importance. However, the incomplete technology factors have an impact on the degree of informatization that education provides, the huge fragmentation also settings-off much excess of difference in educational informatization's accessibilities. The result of some qualitative researches on the studious engagement of education inquiry-abroad is filled with the automatic language processing that calculators provides. With ubiquitous accessibility increases, the educational nonuse or little-use causes higher education institutions's concern for a long time under the educational informatization environment imperative that takes place the unbalance and advantage loss that enlarges the disparity. The Information Communication Technology (ICT) are one of the most common educational resources for learners on educational environment. ICT are helpful for learners to obtain and manage information. How learners use educational informatization resources in their studying processes is a significant concern. The geographic locations, ages and personal states are all possible impacts to the information-time patterns candidates. There undertake an analysis using the information-time patterns of self-reflections on geo-political zones, ages, states and their compositions learning outcomes of them (Li et al., 2024). The context is collegiate education and the candidates are college students who undertake courses on Liyuan. The major computer based learning environment are deployed to management the time that on-course learning information are got recently. Each week, self-reflections are required to analyze situational use of on-course learning information resources based on self discussions and 3W1H principles human cognition models

are also used to support them to reason and compose the longitudinal use of on-course information. The Information-Time Patterns are proposed to reflect how human information communicate with their environments. Information-Time Patterns are the patterns of how learners gain, utilize and manage information in time. It is expected to explore the learning patterns of candidates as a whole, but also on Geos and ages. This section will be attractive for educational researchers and professionals who concern with college students' learning engagement on new educational communication ways.

Gamification in Education

Difficulties in education, such as classroom behavior and changes in the way learning material is delivered, have grown in recent years. The game-based learning strategy approach is now seen as one of the most effective methods to implement and evaluate technology-enhanced education (TEED) in the education domain. Learning design and activity support frameworks are required to enhance knowledge dissemination in educational agencies. Education with the use of technology introduces various innovative learning design strategies, such as case study, project, flipped learning, and learning analytics. Gamification is a fun way of engaging, motivating, and transforming tedious tasks into enjoyable ones by adding game design elements to non-gaming environments. Therefore, diverse gamification design frameworks exist in the education and training domains (Sanmugam, 2017).

This study reviews general gamification frameworks in the education domain and explores gamification design frameworks of specific subdomains of education such as the K-12 level education, higher education, teacher training, and vocational training. By categorizing gamification design frameworks according to target audience and objectives, it can help educational institutions and training providers in the design of gamified learning/activity environments suitable for them. Conducting a comprehensive analysis of existing gamification in education design frameworks can not only help researchers to have insights into the current development of gamification design in the education domain, but it can also help practitioners and designers in selecting a suitable framework for their purposes.

Educational technology, including online learning environments and personal response systems, is now widely used in the classroom. Among new educational technology tools, gamification is drawing increasing attention from researchers, practitioners, and educators. Educational gamification, which transforms a non-gaming learning environment into a game-like one, is an effort to improve the learning outcome of students. Sometimes the game dynamic and game element are put into a learning environment to engage and motivate a learner who is hard to engage in a serious game-based learning environment. Gamification used for an educational system or learning platform is widely known as an education tool to arouse engagement, motivation, and interaction.

Interactive Learning Tools

Learning is regarded as one of the initial results of the educational process which reflects the realized innovation automation. It is the goal of the interaction between educational informatics technology (EIT) and student learning outcomes (SLO). In the context of education, EIT refers to various kinds of education software, hardware, technical conditions, medium, methods, and tools. In the aspect of educational advantages, educational advantages include information quality advantage, method advantage, model advantage, environment advantage, interaction advantage, personalization advantage, and real time advantage. EIT may influence SLO through four paths including learning effectiveness, efficiency, experience, and expectation (Barkand, 2017). EIE may influence students' learning effectiveness, learning efficiency, and learning experience SLO through their infrastructures such as interactive learning studio and flipped learning studio which are capable of realizing innovative architecture and responsive modeling in real time. Interactive instructor-student platforms and formative feedback management systems are independent tools which are supplementary devices of EIT. Interactivity style of implementation real time twinkling and face to face benediction may have a negative influence on SLO through lying parsimony. Educational software constructivism and scafoide–cylinder form educational current may also have a negative influence on SLO through technique cost superiority of democracy (Mazurier et al., 2019). The educator-student instructional algebraic graphical interface diversity of request distribution may negatively influence learning by course information overloading. The absolutely upright teaching environment may slightly

influence the timing effectiveness of SLO (Mourat, 2018). Interactive learning tools (ILT) include two sets, namely IA and IID. The influence pathways of ILT on EIT outcomes through SLO includes path 1: ILT influence SLO. Feedback management mechanisms such as formative feedback management systems and interactive instructor-student platforms are not included due to their complementary feature. The most powerful computation platform of EIT and related promising throughput color contouring map of advantages are infeasible for the run of EIDOE. It is impossible to refine variables in the process of EIT evaluation based on its parametric advantage items.

Assessment of Learning Outcomes

Stakeholders have always had an interest in students' learning. Reports of student performance have been used to inform students, faculty, administration, parents, and the boards of trustees. A strong move toward outcomes-based education has led to increased accountability standards for student learning. Students need to demonstrate that they have achieved competencies or knowledge outcomes via assessments. Educational institutions need to provide the means to assure the public/ stakeholders that students have indeed achieved their learning outcomes. Current ways of assuring student learning outcomes, primarily via faculty input, involve laborious self-study processes, which are time-consuming and do not provide evidence of learning.

Up until now, educational institutions relied on faculty input evaluations to highlight student learning outcomes. These subjective evaluations provide complete assessments of the graduate, but they lack evidence. They fall short of demonstrating student achievement of the skills outlined in the student outcome statements. Instead, specific objective measurements collect data that should be analyzed to tie the results into the student outcomes. At present, colleges and universities face the daunting challenge of documenting that students are indeed achieving the institutions' learning outcomes.

Educational institutions must develop a tracking and evaluation program to obtain evidence of student learning outcomes. The grade distribution would allow for the opportunity to demonstrate how the results tie into the student outcomes and show how meeting these outcomes provides evidence of the distribution for the course (Cobham & Jacques, 2006). From the distribution of grades, it is possible to show how the course follows the methods that track individual student performance measures (B. Dayanghirang & A. Hernandez, 2022). In addition, educational institutions must ask, "What's next?" to demonstrate that improvement has occurred. This process must also provide a curriculum map for the entire educational program. The curriculum map may provide a means of coverage in a time-efficient means for each outcome statement.

Quantitative Measures

Measuring the overall educational performance is a complex task, and there are several quantitative measures that can be utilized to estimate how well education systems are performing. The methodology chosen and the aggregate, composite measure itself is critical, and as such, must undergo rigorous scrutiny. Educational data mining (EDM) techniques are a burgeoning research area and will be evaluated within the context of online secondary courses to assist in means of assessment of overall performance outcomes. Current outcome metrics are outlined and recommendations made for both online education program administrators and researchers in the field, particularly in the realm of learning management systems. Educational Data Mining (EDM) techniques assist in the assessment of cyclotomic and other means of determination of an overall learning outcome measure at each course and institutional level in the context of online secondary education, as well as recommendations for future research.

Online education continues to grow year over year (Barkand, 2017). The rapid acceptance of massive online open courses by institutions previously reticent to embrace online education indicates its establishment as a legitimate means of instruction similar to or even supplanting traditional in-person modes of education. With the advent of big data, online learning management systems and the expansion of the technological infrastructure and platforms upon which online education relies, excess data has precipitated the need for means of assessment of the effectiveness and measurability of the quality of online education. This leads to a determination of overall performance outcomes that can also assess the effectiveness of online education on an individual student basis.

Understanding and measuring online education effectiveness, performance metrics, and definition of terms in regards to this matter are essential before any further research on this topic, as terms central to this research, such as "achievement" and "effectiveness," are often ill-defined.

The approach taken by this research is that the effect of a learning management system tool used in an online education course is quantified through a downward adjustment of an artifact of a passed course grade. Since learning management system log file quantities are not directly comparable with student course grades, it is necessary to instead relate learning management system engagement to downstream passed course outcomes as inferred through artifact alteration. This focus group selected to limit false positives associated with the myriad variables affecting performance metrics on grade letters. The methodology selected is static, utilizing only statistics, and hence the analysis must be carefully scrutinized and assessed in light of many potential variables.

Qualitative Measures

In this study, the qualitative reasoning assessment instrument was utilized to examine the influence of educational informatics on students' learning outcomes. The qualitative reasoning assessment instrument consisted of a course essay question and a standalone question designed to evaluate qualitative reasoning ability. The qualitative reasoning scores for the course essay question ranged from 0 to 19, with one student scoring 19. The qualitative reasoning scores for the standalone question ranged from 0 to 22. The educational informatics incorporated PBL and blended learning. Educational informatics refers to the integration of pedagogical practices, technologies or tools, and information into learning and teaching for educational purposes, resulting in the generation of new knowledge and insights. Thus, when educational informatics use collaborative learning is applied to course design, students may explore real-world problems. The students may design knowledge-building discussions. The qualitative scores for the course essay question comprised 75% and 25% of the students in scoring ranges of 0 to 8 and 9 to 13, respectively. The qualitative scores for the standalone question were plotted individually. Code 1 was assigned to students which did not take the elements of informatics into consideration. Only by using material converted into information for qualitative reasoning processing were score 1 and below. Codes 3 and 2 were assigned to students which could not convey in-the-plane and on-the-sphere behaviors, respectively. The students who took courses with the use of learning and teaching information technology tools based score 2 and above due to misunderstanding the importance of in-the-plane versus on-the-sphere tell-tales. Code 4 was assigned to responses with very limited number of small bubbles constituted by some elements not required. Students with scores of 7 and below belonged to this code. The involvement of educational informatics in course design required students to write a relatively well-structured essay with a clear and right design of piezoelectric bubbles.

Case Studies

Study 1 Phase: Case Studies behind Through Schooling Blogs as Resources for Learning in K-12 Schools

Over the last several years, the prevalence in households of computers and Internet use has created increasing opportunities for students to learn computer-related skills "on-line". It is important to understand how K-12 students actually construct their own understanding and achievement with computer-related skills, a focus which has not been addressed in much prior work (Lewin et al., 2008). This study employs a qualitative approach and specifies three purposes. One is to identify the kinds of resources the students were keeping and to analyze how these resources were used as learning resources. The second is to examine the types and the progression of learning processes that are behind knowledge-developing behaviors using the above resources, and how these learning processes impacted content knowledge about computer-related skills. The third purpose is to investigate students' needs for future support and information delivery by using computer-related resources. The unit of analysis is students' "views history" (or "history" for short) files on through schooling blogs, and six kinds of cases are drawn from two high schools: the first, middle, and last class cases for each school.

Study 2: An Investigation of Through Schooling Blogs as a Modern Teachable Text

Though schooling blogs are incomplete but authentic Internet resources posting diaries of students in K-12 schools, many blogs posting backgrounds are not purposive, which results in their inefficiency as learning resources. Thus it is highly argued that it is significant and necessary to investigate the blog-resource-learning

relationship, with the purpose of revealing how the blogs actually serve as resources for students' learning of daily life in schools in K-12 settings, a topic which has yet to be addressed. Indeed one of the contributions of this study is to formulate through-schooling blogs as a modern teachable text. The study specifies two theoretical bases: the formation of a topic by the reader or imitator and the topic-content relationship of a unit topic for understanding the text. Suggestions about how through-schooling blogs can be efficiently used for learning and teaching in K-12 schools are also discussed.

Successful Implementations

Computers are sprouting up in a variety of schools with technology integrated tightly with instruction in classrooms across America. Technology is being used in Latin America in a newly opened Roberts School in Buenos Aires. Children are inquiring through computer-mediated collaboration in New Zealand. Children are cooperating and engaging in math-based computer games in a middle school in Arkansas. Technology is being used to draw and animate animals in a Thai school. In Venice, an art/moviemaking festival was spawned by children creating with computers. However, technology is being used largely for drill. Technology is being used for pencil and paper instances with little or no higher-order thinking; classes are passive. Students are playing with computers, at home or in school, but largely for amusements other than learning (Bonner-Thompson, 2000).

Superficial uses of technology for isolated drills, hacked-out sheets, or listening to lectures while being lectured are common (Hartwig, 2000). Teachers rarely understand the pedagogical foundations of education and just switch to computers or abandon classroom control. Most computers are still used for stand-alone drill-and-practice applications in stay-learn, rote, still life, teach-test-learn modes. Policies are in place, but initiatives lack follow-through. Computers and instructional software are both expensive, and the inability to afford technology is but one reason for classroom under-involvement. Training and software are not provided, and computers are not on-site. It is not unusual for computers with none or only one instructional software to attend classes. Input is not aggregated, but measured at the level of individual instruction.

Computers are abused; teachers use computers mostly for work, preparation, and grading. Schools vary; some opened spick-and-span new labs with no complementing technology in the classrooms; other schools opened old, partially constructed, or incomplete labs with holes in walls. Advanced design improves media control and sustain interest via flyers, profiles, web pages, and buttons, but lower design tiers squander attention on poor navigation and kid-vids in banquet format. Finally, schools are misperceived; schools close at inappropriate times or are too bureaucratic to enter, maintain distances from families via fences, and control exits. The trajectory is dismal; twelve years later, the low point reached then could not reasonably approximate the high point reached now.

Challenges Faced

Few countries, organizations, and individuals are prepared for this broad-brush globalization. Neither academic institutions nor government planners seem to adequately appreciate the effects of the Internet or what an Internet future implies for our traditional concepts of education and learning. Nothing embodies the growing implications for education of the new global information infrastructure than the Internet. When first developed, the Internet was an add-on, a simple way for scientists to interact. Modeled originally after the telephone communication circuit and computer telegrams following a file transfer protocol, the Net's effectiveness flag somewhat diminished as the communications demand grew, user numbers proliferated, and traffic for e-mail clogged. In its widest deployment, the framework was modified to accommodate the flow of text and sound information. It assumed a new dimension, giving a glimpse of what could be. The user interface to the Net was profoundly changed again when it was turned into a graphical thing called the World Wide Web. Then the Internet really exploded, and it was believed that a global learning revolution was also about to follow (Gershenson, 2014). Beyond the need to cope with the communications logistics of the new Virtual University (whose evolution the Internet will accelerate), cultural and pedagogical aspects of learning must also be addressed. The key to seeing how education is likely to evolve is to look at how the nature of learning is itself likely to evolve. The collective cognition of functionally interactive and mutually educating human networks will likely be more powerful than any single educator, offering potentially a genuine learning model for an education-and-knowledge-driven economy. But as the Web is to the old static and unidirectional printed word, so the scale and structure of human

networks is to the traditional classroom-based lecture pool. Just as new schools were needed, at new scales and new states of information processing, with new behaviors to be learned and understood, in the age of the printing press, so now new forms of hypertext presentation will likely need to be invented, using the connectivity and on-line collaboration and functioning of networks, in order to harness the potential of this new educational paradigm. 2D and 3D visualization, multimedia, speak buttons, hypertexts and hyperlinked commentaries, multiple resource nodes combining other external resources and perspectives, stylish and entertaining presentations and forms are all avenues for development design. The technological infrastructure and the pedagogy of education will evolve and inter-depend on each other (S. Fabito et al., 2020).

Role of Educators in Informatization

The rapid development of educational informatization has not only brought about changes in part of the information environment, but also led to drastic changes in the way and means of knowledge acquisition. From formal education in school, to the informationized era of informal education without time and space restrictions, the era of "easy belief" and "listening to the sound of learning itself" has arrived. The way to acquire knowledge has changed from merely cultivating knowledge and wisdom to having insight into the information environment. Teachers can no longer be the sole knowledge imparting experts, but rather educators, guides, and constructors. All the troubles, disappointments, and joys arise from slowly understanding what sense of learning is. The reform of informatization rests on teachers, and the high-quality and healthy development of educational informatization also depends on teachers (You, 2019).

In the face of tremendous challenges from the rapid development of educational informatization, teachers have, on their own initiative, grasped the crumb information envelope and changed their teaching modes, roles, and ways. Teachers' information literacy, as the carrier of the evolution of their cognitive paradigms, has naturally become a concern. In other words, informatization means that teachers should have the consciousness of information before being literate in information, so that teachers can gain wisdom understanding and appropriate expectation of information. Teacher's information literacy is a vital precondition, guarantee, and point of levelling up educational informatization. In addition, it is an inevitable requirement to face the huge whirlpool of constant change coming with new technology.

Only with keen sensitivity and clear identification ability of the inherent coupling relationship between various information resources, can teachers autonomously master the "secret" of information and understand the strength and threat of information altogether. A careful understanding and assessment of the information itself and the relation is crucial either for teachers to take the correct cognitive paradigms or for teachers to develop the cognition creatively. Otherwise, it will cause considerable cognitive, behavioral, and even social difference. Teachers' information consciousness, as the "hard core" of teacher's information literacy, may be described and interpreted from the perspective of information resource acquisition and self-adaption. In the survey with 1,469 teachers, it is proved that teachers' information consciousness is generally at the level of elementary capability and neither good nor satisfactory. Meanwhile, the discipline of different innovation types reveal that there are some aspects worth paying attention especially those teachers from primary school and technical secondary schools.

Teacher Training and Support

In many countries, higher education institutions are strongly encouraged to improve their teaching and learning environments. It is viewed as necessary to create and secure high quality learning environments in exchanged knowledge-based economies. Existing choices in improving physical and technology-supported learning environments are well documented in the Higher Education research literature. However, as part of a multi-year University-level initiative in improving teaching and learning environments, it has been realized that obtaining information and feedback about teachers in relation to learning environment choices is an under-researched field. Learning environments are often seen and treated merely as a 'thing to have.' The futures and development of higher education institutions are threatened if institutions as a whole cannot understand, clarify and develop the type of learning environments their various constituents experience and seek as a group of multi-eyed educational settings (Brändle et al., 2023). This is rarely being done and existing needs assessment studies often measure a limited number of technical elements or categorical knowledge areas with simple checklist instruments. Such

assessments provide useful information but fall short of yielding a comprehensive or holistic picture of the complexities of learning environments as experienced through organized sets of choices about practices. They also tend to be top-down initiatives by upper level authorities whose further actions after obtaining data often do not convey relevant perspectives to teaching and learning environments. Interest groups at the levels of departments, disciplines and academics also have a need for background knowledge-crucial to secure and sustain a progressive learning environment-and the skills required to assess and develop learning environments. Investigating the relation between higher education teachers and their learning environments is the goal of this paper. The main research concern is what the learning environment types, supports, preferences and wished improvements of academic staff are. The reported research comprises a large scale questionnaire survey across three large Universities in Finland and is situated within the rapidly emerging fields of learning environment assessment and improvement in higher education. Theoretical considerations distinguish dimensional models of learning environments and choice of models varies according to preferences in discipline and grounds for future improvements.

Pedagogical Adaptations

This research work explored educational informazation from the perspective of alignment between information technology and educational pedagogy. Two pedagogical adaptations were studied, proposed, and evaluated from the perspectives of stakeholders information technologies viz. learning resource and learning activities. The impact of proposed pedagogical adaptations on student learning outcomes was evaluated through a quasi-experiment with one-group pre-test and post-test design. It was found that the proposed optional adaptation on learning resource was effective in improving student learning outcomes especially for lower academic students. However, the time limitation on the adaptation lowered the overall effectiveness. For the proposed software enhancing adaptation on learning activity, it was found that it was not feasible for students, even though it was reported as effective for teachers.

As far as the learning resources are concerned, before the enactment of the adaptation, the efficacy of resources was almost a constant level for all students, indicating that the adapted students did not have advantage choice of resources over the non-adapted students. Once the adaptation took effect, the effectiveness of the adapted resources improved significantly compared with the control, and even showed covariance with the performance. In addition, the adapted choices across all students were also significantly improved, indicating the students were more active in resource choices for the learning. However, for the time limitation of the adaptation, the resource efficiency was decreased again for almost all students, especially for those with higher academic performance.

The overall findings free of IT tools for adaptation on learning activities shapes a new perspective to view learning activities. The lack of learning activity adaptation tools was in strong contrast to that of learning resource adaptation tools. Although the learning activity adaptation strategies were reported as effective for teachers, the perspective of students invites more exploration on the pedagogy side. A new study on the teachers' and students' perceptions and attitudes towards the collaboration of pedagogical rules for adaptation to be effective for both perspectives is important.

Equity and Access Issues

Addressing traditional disparities was essential, but a new set of issues now arises related to how newly equitable access translates into educational opportunity and learning. In many ways, these issues are comparable to those facing other types of educational resources and are driven by the same underlying factors. Variability in educational opportunities is driven at least in part by variability in the use of available resources, which is dependent on their appropriation: differences in the extent of teachers' and students' appropriation of the same technology, notwithstanding its availability in the same school or classroom. Such resource- the appropriation process also determines how great a resource will be, as is well demonstrated in a variety of educational contexts. Simply distributing technology is not enough to realize its potential educational benefits (Marcino, 2018). One must ensure both access to and an understanding of appropriate uses of that technology. It is also necessary to recognize that, depending on the context, students' and teachers' appropriations may diverge significantly. There is, of course, some recognition of these issues. For example, there is emerging research identifying variability in

students' and teachers' technology use, as well as its relationship to learning. Many educational authorities are targeting training on teachers, as it seems to be the most prominent bottleneck in the appropriation of new technologies. However, knowledge about the mediating processes involved, as well as their correlates with educational equity and learning outcomes, is still scant. More research is needed to illuminate these issues, especially from the viewpoint of educational policy. For educational authorities, it is crucial to learn how to build new conditions under which one can expect equitable use of new technologies to translate into a new type of learning. The crucial issue is that, together with equity in access to education technology, the goal of education policy should be a broader equity in educational opportunity (State University & of South Florida, 2007).

Digital Divide

Despite the important presence of technology in schools, many students lack access to the devices, connectivity, and instructional resources necessary to be successful in school (Orta, 2019). This has caused a digital divide to develop that puts many students at a disadvantage when it comes to preparing for college and/or the workforce. The digital divide can be conceptualized in multiple ways referring either to the absence of technology, issues of access to the technology or utilities to apply the technology, and/or the lack of instruction as to how to use. Outside of these is the conceptualization of the digital divide as the absence of meaningful opportunities for students to be producers of information and utilize technologies for learning thus helping to narrow technology skill gaps based on income, access and opportunities. Ultimately having the skills to utilize technology effectively to be productive and solve problems is becoming increasingly important for the economic and social wellbeing of individuals. The lack of meaningful digital learning opportunities for student populations that have become marginalized by poverty is thus only partly an economic or access issue. It is instead a deeply personal issue that reveals troubling moral and philosophical beliefs about the purpose of education and the worth of certain student populations. Providing meaningful digital learning opportunities to student populations must therefore not only be conceptualized and acted upon as a professional duty, but more importantly as a moral imperative.

Despite the reality that many educational institutions and their constituencies must focus on their environmental impact, these issues should not be viewed as insurmountable. Across many areas of society there are countless examples of experimentation and progress toward greener alternatives and priorities, and unless such initiatives are viewed and treated as important and urgent expedients for K-12 education, it will likely lag behind in dealing with its physical, social, and emotional impacts on the natural environment. Two specific and interrelated pathways – drawing on the massive resources of the local community, and providing schools with a significant portion of the capacity they need to better understand their environmental footprint – are considered. Pathways are provided through which K-12 educational institutions can press the education sector for better policies and practices now and into the future through collaborative efforts and imaginative alternative education efforts.

Inclusion Strategies

Much is discussed about the value of diversity in education and how schools, as summer societies, should strive to mirror the world students will eventually live in as adults. Accordingly, the American Educational Research Association recommends that educators create learning environments that reflect diverse perspectives and that the curriculum integrate understanding of perspectives, frameworks, and methods from multiple disciplines and cultures. However, when it comes to the challenges of teaching in diverse settings, little guidance is provided to educators. In recent years, however, interest in redefining the educational response to increasingly diverse school populations has grown, with some districts investing in professional development to assist teachers in meeting the challenge responsibly. Differences in instructional strategies were studied among teachers whose student populations were racially and socioeconomically diverse. The goal was to determine if there were significant differences in instructional strategies employed by these teachers in elementary school settings, to better educate teachers about specially designed strategies to serve these populations appropriately (L. White, 1996).

Instructional strategies promote academic success in classes with students of varying abilities. This increased effectiveness results from acknowledging differences in teaching and learning styles and using research-supported methods to address them. Academic success encourages students to continue pursuing an education and influences other aspects of a student's life. Teachers in supportive settings are committed to positive student learning

outcomes and act as collaborators, listening to, supporting, and guiding students, rather than simply directing or inserting material. Teachers create positive environments both in and out of class by reviewing goals and enabling differences to be seen positively. Constructive environments are created when teachers treat students politely, do not speak harshly or shout, and reward successes. Students gain more attention when treatment is sound, just, and respectful. Creating and maintaining supportive classrooms requires skill, patience, and care.

Future Trends in Educational Informatization

The development of educational informantization in China has a long history. Affected by the international wave of informatization, active exploration of educational needs began in 1980. Since then, in the National Library of China, a nationwide course teaching, evaluation system covering all primary, secondary schools, and universities was set up. Since the 1990s, the national implementation of the "Three-Network" project has become the main content of the national medium and long-term education reform and development plan, which greatly enhanced the popularity of computers and the Internet. Over the 2000s, based on the experience of developed countries in e-learning, attention was paid to the development of cloud computing, mobile learning (Greb Dillon, 1980), and massive open online courses (MOOCs). In 2018, the "Net Power into Quality" strategy pointed out that educational informatization should develop outward, intelligent, and Content-based. In summary, the trend of educational informatization in China is to explore the application of new technologies, strengthen resources, build platforms, and promote depth. The state-of-the-art in educational informatization has been clarified, but the relationship between educational informatization and school teaching, which is the core of educational informatization, is not fully understood (Liu et al., 2024). In recent years, the national and provincial governments and educational administrative departments have issued a series of policies and regulations on the learning process network. Competitive research on the digital transformation level of school education has been launched. The purpose is to understand the development situation more comprehensively so that effective promotion strategies can be adopted. However, the level of application of educational informatization tools and their educational effects in Chinese schools remains unknown. In addition, although increasing attention has been paid to the effect analysis of scale assessments and administrative evaluations, the visual guidance to promote the continuous and healthy development of educational informatization is insufficient. It is difficult to accurately understand the degree of educational informatization of schools from national assessments.

Artificial Intelligence in Education

The construction of an intelligent education system is analysed to provide timely and individualized training and assessment based on the current status of teachers and students. Numerous computer technologies, notably artificial intelligence, are utilized in intelligent educational systems to raise the value and efficacy of education. A comprehensive assessment of learning states and adjustment of various instructional course contents in response to students' learning states are the goals of all the suggested strategies. These strategies offer a variety of different ways for learning assessment and suggestive and active learning, as well as techniques for promptly gathering a wealth of data from a variety of information sources based on machine learning technologies. Artificial Intelligence in Education (AIEd) educational standards can generally be divided into two parts: the System view and the Intelligent Technology view (R. Kshirsagar et al., 2022). Most of the current AIEd systems fall into the former domain. Systems include a great deal of technology for automatically modeling students and presenting students' learning states, while intelligent technology has a more vast connotation containing a greater number of ways to enhance education, broaden the scope of AIEd standards, and push forward an intelligent education revolution.

The learner model is the most critical model in AIEd system components, which directly affects the effectiveness and capability of other models. The learner model helps students be more self-sufficient in their own learning by essentially portraying their properties and levels of knowledge. A student's learning status reflects both the phenomena of cognition visible. A student's capacity to learn is evaluated by looking at the ideas and strategies they employ when tackling questions, as well as the statistical analysis of what they have answered. As education computes continuously, the learning behaviour of students is beginning to change obviously. Personalization of learning has become the most widely used application of Artificial Intelligence in Education (AIEd), and

instructors are crucial in students' educational outcomes. It is more difficult for teachers to maintain a consistent eye on each student's progress in class as class sizes grow (Sanz et al., 2024). Inherently, kids also have the ability to customize their learning by directing their attention. Students have different ways of learning; a one-size-fits-all solution is unlikely to work. Almost everyone would concur that personalization should be a priority for education; therefore, personalised learning has been on the public agenda for some time.

Personalized Learning Experiences

The rapid evolution of web and mobile technologies has led to the emergence of a variety of online learning solutions, from massive open online courses to interactive learning environments. At the same time, data mining and analysis technologies have become a hot topic in many fields. As the source of new data, the education industry has been further studied. On the education side, for students, there are platforms that offer a wealth of resources for reference, and interactive problem-solving environments that help with learning retention and understanding. Theoretically, existing works have focused on user engagement with platforms, platform performance analysis, and algorithm improvement for better course recommendations.

The field of educational data mining has been proposed and further explored to analyze log data, assess knowledge and skill, give appropriate suggestions or push notifications, and even provide hints to improve user engagement and retention. All of this research has led to considerable advances in this field, but for a single student, the feedback provided by platforms is usually limited to a score or a generic message, lacking detailed information and suggestions. At the same time, for large learning platforms with millions of users, there is a great demand for anonymous usage mining techniques to study user experience and platform performance, what influences their development, and how to improve them. Recently, the educational community has been further faced with the pandemic crisis, leading to the need for effective online learning tools for traditional face-to-face classes and a dramatic increase in online learning platform usage. New challenges have arisen regarding how to ensure uninterrupted and high-quality online learning experiences, along with increased competition among various platforms and a great exploration potential for researchers in this new area.

Realizing the promise of education has been a persistent challenge for human civilization. Traditional instruction is passive and course-centered; however, people differ widely in their learning rates, prior knowledge, aptitudes, learning styles, and behavior patterns. Personalization - a shift in focus from one-size-fits-all to different-tasks-for-different-students - has emerged as a powerful remedy. With e-learning and data-mining technology advances, educational personalization is now feasible in practice and research. Granular representation of students' learning capabilities and difficulties to service multi-dimensional service customization calls for more nuanced modeling techniques. Research on educational personalization focuses on automatically materializing customized learning services with the use of machine learning and knowledge representation techniques.

Policy Implications

The current study's findings suggest that, on average, greater educational informatization in Latin American countries has a weak but statistically significant influence on better student learning outcomes. Therefore, educational authorities in the region should not deter from continuing the process of educational informatization. Various educational informatization policies should be implemented according to specific demands, providing adequate resources and training during the process of educational informatization. The currently expected path of educational informatization should be endorsed.

The study was based on meta-analysis across countries, and similar findings could be observed in the context of the countries selected in this study. However, to further verify qualitative research on the process of educational informatization within countries would be of benefit. Independent data pools that are not influenced by fellow researchers should be observed in order to investigate the research path and the influence factors for a longer period. In-depth studies systematically taking the legal, sociocultural, administrative, and economic factors of educational informatization into consideration would be beneficial. Research factors within education such as detailed policies, programs, provision tools and resources also need to be taken into consideration in further research.

This study finds that the current means of educational informatization in Latin America that digital device ownership should be improved is feasible, at least statistically. In the process of educational informatization, refinements of equity should be made based on specific demands rather than on blanket arrangements. The currently overall positive influence of educational informatization on student learning outcomes should be endorsed, while possible negative influence should be dealt with caution. The information and communication technologies in education, which include hardware, software, training, and forum setup, policies or expected educational informatization personnel for schooling in the educational Informatization Affairs. Education Outcomes, the leaning achievements of students receiving formal primary or secondary or higher focused on reading, mathematics, and the sciences.

Government Initiatives

At the dawn of the new century, the logical starting point of knowledge-based economy and society in China was the issue of informatization and education. It is of significance to implement the strategic decision of "99 century education with 99 educational informatization" made by the authorities led by Jiang Zemin, general secretary of the Chinese Communist Party Central Committee and chairman of the State Council (Schulte, 2018). Promoting e-learning equality in the new century is a great historic mission of the Chinese government, put forward by Jiang simultaneously with "99 education". The goal is to reject a Digital Divide along with the divide in developing and developed countries, urban and rural, and between the rich and the poor in the education sector (Singh et al., 2021). To ensure that children from poor families have access to the same learning opportunities as elite classes, countries with different cultural contexts and historical backgrounds have driven the growth of their economies and society through education, which is the most fundamental national strategy (Liz, 2020). The Chinese government and society as a whole spent more than $300 billion for nine-year compulsory education alone on the digitization of blackboards, library construction, and informatization of management. Since 1999, e-learning projects such as "one computer for one child" in western underdeveloped areas and "centrally held classes without request" in poor rural areas have been successively launched. By the end of 2008, with the cooperation of telecommunication and software companies with CICS, China's educational informatization had made prominent achievements among developing countries. In 2004, the Chinese figure (500,000 schools) was reported as a world record. However, from the perspective of the widespread concern throughout the world on the non-linear impact of educational informatization on student learning outcomes and a clearer understanding on outcomes of appreciable initiatives and efforts from a systems perspective, the achievement of this "educational miracle" is worth further exploring and researching. In 2008, China surpassed average middle-income countries on 5 of the 7 Depth scales of PISA 2006, which assessed mathematics literacy and problem solving under new educational and economic realities. Among the new economies, 14–15 year old students in B-S-JZ (i.e. Beijing, Shanghai, Jiangsu, and Zhejiang Provinces) outperformed students in Hong Kong-China and Singapore on 5 scales. On the improved maths literacy skills and problem solving, the divide between high and low GNP countries steepened (both in the East and West). The last three Newly Industrialized Economies and China increased their share of "Top Performers". For the Learning Skills and Outcomes scale-related knowledge organizing processes of knowledge knowledge (PISA: Problem-solving and Content) based on KG+ practices, on average, students in Chinese sub-systems ranked first. In the new job context of China, educational informatization is proposed as a critical opportunity. Since the last two decades, through e-learning, the imbalance in pre-tertiary education infrastructure, workforce, and opportunity could be offset (either in urban-rural, geographical, or poverty spectrum terms).

Institutional Policies

Although cases of students successfully blending institutional policies with other learning aspects are evident, the predominance of one-way communication in distance-learning modes within MOOC platforms leaves no room for institutional mediation (Czerniewicz & Brown, 2009). To some extent, unmediated delivery and information acquisition is a Malaysian E-Learning expectation that educators and institutions concede. The inability to actualise more participative Web 2.0 technologies which facilitate two-way communications limits engagement in wider social learning.

For students, the only way to connect with their peers in the absence of institutional mediation is to attach themselves socially to them via web groups. Networking outside of the course is not easy for busy distance-learning students who study and work full-time to support themselves. Consequently, the lack of opportunity for social interaction outside of lecture time is a challenge to distance learning modes where personal contact is limited (Fernandez & Liz, 2018).

The task of understanding key aspects of innovation is particularly pressing in relation to the extensive investments being made in online educational technology. However, there is no single context that can deliver generalisable findings. There is, nonetheless, the possibility of developing a broad understanding of the organisational policies, cultures, and practices that shape what takes place, who is involved and what outcomes ensue. This is a particularly difficult undertaking with respect to understanding the role of organisational policies, cultures and practices in shaping the uptake of online educational technology in South Africa. Such a task has been made difficult by the need to understand processes in an emergent 'elearning' context that has shifted, sometimes abruptly, in emphases and perceptions in recent years.

Conclusion

As the advancement of the information age, the utilization of massive education data resources has become the focal point of institutions and faculties at all levels. Following the 13th Five-Year Plan for Informatization in China, the educational cloud resources deployment plan has been released to deploy the course content of the textbooks for digital classroom construction in secondary schools across the country. It is expected to transform the instructional mode for teachers and make it more efficient and participative. Accordingly, educational informatization provides data resources for in-depth learning analysis on various platforms. Educational desktops like "Chain of Education" and ERP plug-ins for colleges and universities are used for grading and cumulative releases analysis. Different topics, algorithms, and techniques are employed to perform deep learning analysis on data. However, with the massive construction of educational informatization, little attention has been paid to the robust impact of resource deployment on student learning outcomes.

Previous research has concentrated on the impact of educational informatization on student learning outcomes considering educational informatization as a categorical variable but did not distinguish constructive factors from destructive factors influencing resource gathering. Additionally, educational informatization has two effects on learning outcomes, wherein the impact of the effective investigation is higher than that of the process feedback. The consideration of educational informatization grade quasi-continuous variable could add rigor to empirical research. The investigation has been featured as a nationwide action plan in China (Delgado et al., 2023). As a scientific project, deep quality factors on educational resource deployment improvement should be collected for further analysis to avoid pertinency. Data quality assessment dimensions and indicators are summarized from the perspectives of both educational informatization providers and beneficiaries. Coupled with empirical data from secondary school students and teachers and educational resources, data consistency, deviation, and integrity rooted deep learning on resource impact assessment are evaluated. (Li et al., 2024) 's most representative value-affect-identity three dimensional model is extended to interpret educational informatization resource usage to accurately measure student centered learning experience variables, including perceived resource usage, impact perception, learning involvement, and engagement performance.

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