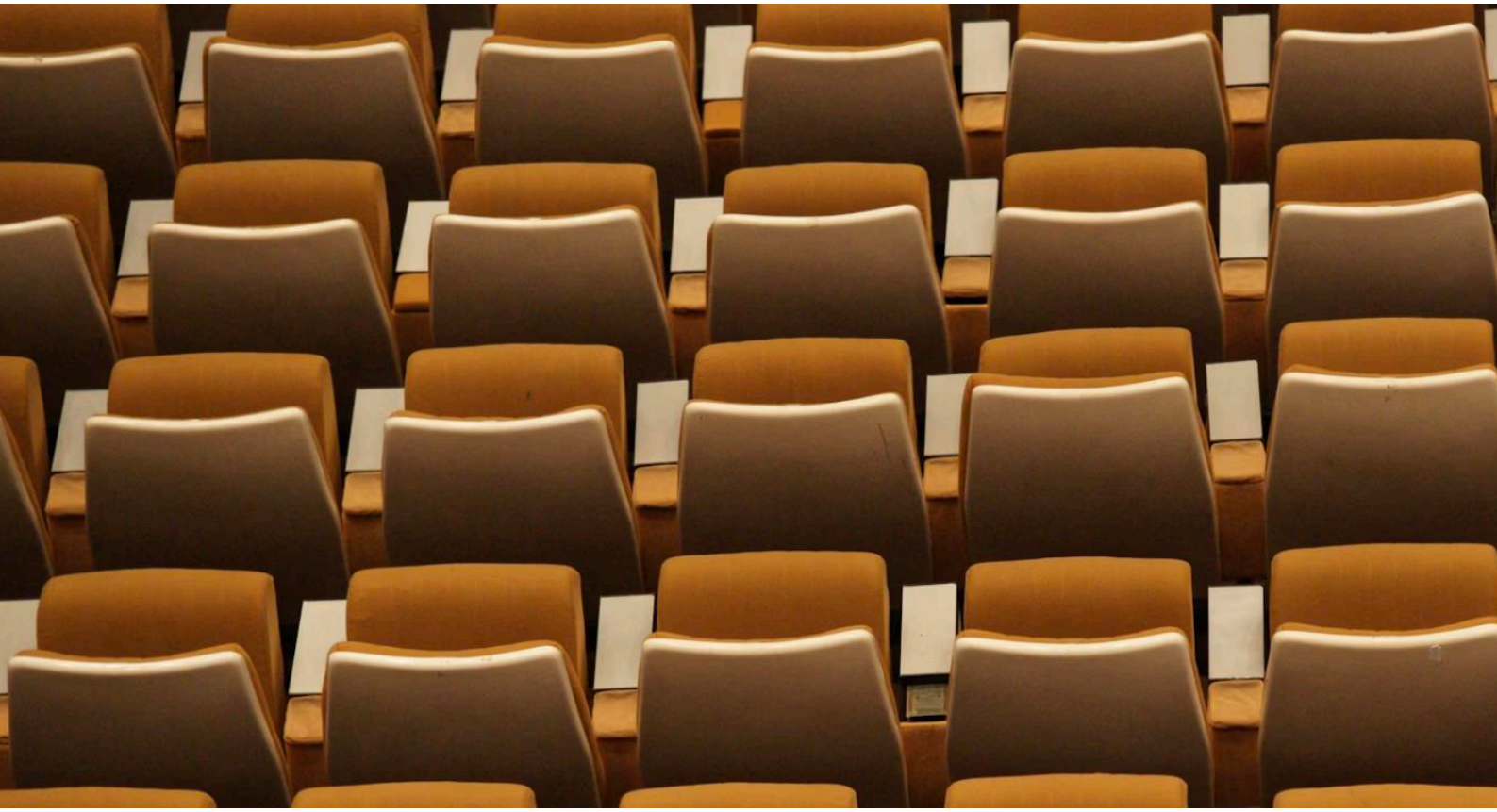
ISSN 2621-5799 (Online)
ISSN 2657-215X (Print)

Asian Institute of Research

Education Quarterly Reviews

Vol. 8, No.4 December 2025



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Asian Institute of Research
Education Quarterly Reviews
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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 1-16
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.226

Factors Influencing Teaching Career Choice Among Student Teachers in Cambodian Teacher Education Colleges

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Abstract
An education system should strive to attract well-qualified teachers and teacher candidates who have a high degree of professional commitment to meet society requirements such as teacher shortages, increasing numbers of schools and students (MoEYS, 2023), teacher policy adjustments (TPAP: 2024--2030, 2023) and Cambodia's socioeconomic status (ESP: 2024--2028, 2024) toward country development. This study aims to investigate the factors influencing teaching career choice among fourth-year primary and lower secondary school student teachers at Teacher Education Colleges (TECs). The study uses a quantitative paradigm with the survey method in the form of a structured questionnaire, which was adapted from Sardana et al. (2021) and Martinez-Moreno & Petko (2023), to collect the data. A simple random sampling method was used to select a sample of 223 participants, including both primary and lower secondary student teachers, whose ages ranged from 22--25 years (71.3%), 26--29 years (24.2%) and 4.5% of the other ages. This study uses descriptive and inferential statistics to analyze the validity, reliability, mean, standard deviation, and significance of the collected data through a one-sample t test. The study revealed four main factors that influence the decision to choose teaching as a career, such as the influence of others, including family, friends, teachers and mass media; extrinsic, intrinsic, and altruistic motivational influences; and teaching as a fallback career and sociocultural factor. Altruistic motivation had the most significant influence on teaching career choice, with the highest mean score (M=4.26, SD=0.59), whereas teacher influence had the second greatest influence (M=4.20, SD=0.65), followed by intrinsic motivation (M=4.17, SD=0.62), while teaching as a fallback career had the least influence on all four factors, with the lowest mean score (M=2.37, SD=1.12). This study will help relevant people and institutions, such as the Cambodian ministry of education, parents, administrations, teachers, students and other researchers to be aware of the factors influencing career choice so that they can refine recruitment policies, increase their actions and efforts, and enter preparation programs for teaching careers in the Cambodian context today and in the future.

Keywords: Student Teachers, Teaching Career, Teacher Education College (TEC)

1. Introduction

Teaching is a noble profession and has helped shape many societies and nations. As explained by Richardson and Watt (2006), governments worldwide recognize that quality teachers and teaching are central to the development and maintenance of intelligent people. They also mentioned that working as a teacher may not be a profitable profession, but it has been regarded as the noblest mission, vocation and profession that contributes mainly to the nonmaterial satisfaction of individuals who are engaged in it. The ideology for someone to choose teaching as a career is based on working lighthouse image, their previous knowledge, self-perceptions in different areas related to the profession, and the aspirations of the profession.

The education system in Cambodia has undergone a remarkable transformation owing to considerable efforts by the Cambodian government and relevant stakeholders. In general, education has improved across the subsector. For example, there have been many efforts to improve the quality of teachers and school principals as well as their educational infrastructure. The Royal Government of Cambodia (RGC), through the Ministry of Education, Youth and Sport (MoEYS), has introduced several projects, such as the Secondary Education Improvement Project and the General Education Improvement Project, to improve the general education subsector (Heng & Sol, 2022; Tao & Kao, 2023). In 2014, a major reform to the Grade 12 national examination was introduced to combat corruption and cheating during exams (Bredenberg, 2022). In 2016, another reform to general education was undertaken: the introduction of a school improvement initiative known as the new generation school (NGS). This important initiative aims to create a new model of Cambodian public schools to improve the quality of general education (Bredenberg, 2022).

1.1 Problem Statement

In the modern world, many people want to work in professional fields such as engineers, pilots or doctors to earn a large amount of money or to obtain a better career for their future. Teaching seems to be a less attractive profession because of low salaries and poor employment conditions (Kyriacou & Coulthard, 2000). Although education still competes with other types of careers, teaching careers are altruistically motivated in Cambodia (MoEYS, 2023).

Furthermore, according to MoEYS (2023), over the past decade (2013--2022), there has been significant progress in the development of educational infrastructure, student enrollment, and education access. For example, the number of kindergarten and general education schools increased from 14,852 in the 2013--2014 academic year to 18,830 in the 2022--2023 academic year. Additionally, the number of HEIs increased from 110 from 2013--2014 to 132 from 2021--2022. Moreover, the number of education staff also increased from 112,704 in 2013 to 125,597 in 2022. Therefore, this study examines the factors influencing the career decisions of teachers in Cambodia. The researchers are intrinsically motivated to start this study since they are seeking those factors that explain why people in Cambodia choose teaching as their career.

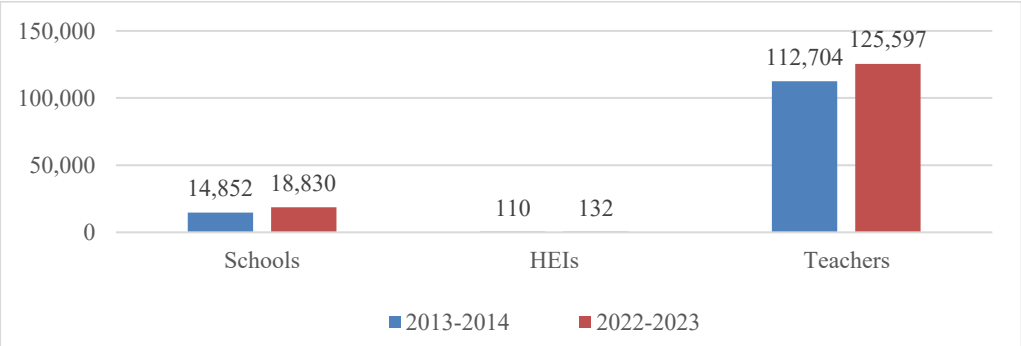

Figure 1: Increases in the number of schools, HEIs and teachers

1.2 Purposes of the Study

This study investigates the factors that influence the career decisions of primary and lower secondary school teachers and student teachers from teacher education colleges. This study was also conducted to analyze the significant differences between each factor that influences the respondents' decision to choose teaching as a career as well as to understand the student teachers' perceptions of teaching career decisions from both teacher education institutions. Moreover, this research aims to provide useful insights into the factors that influence teaching career choice and to provide useful and relevant information, which is required by the following sectors: administrations, parents, teachers, students and other researchers.

1.3 Research Objectives

There are three research objectives. The main objective is to identify key factors influencing student teachers' choice of teaching as a career. The second objective is to explore which factor is the most influential in choosing teaching as a career. The final objective is to provide recommendations for policy and teacher education reforms.

1.4 Influence of Others on Teaching Career Decisions

Previous studies have shown that several sectors are related to the influence of others on career choices. For example, one study conducted in Ghana revealed that teachers do not significantly influence the career aspirations of students, while parents' influence is a major determinant of the career aspirations of students, and peers influence the career aspirations of male and female students differently. The influence of peers on the career aspirations of students does not vary on the basis of age or program of study (Owusu et al., 2022). However, in a study of 1249 secondary school students in Hong Kong (Lai et al., 2005), the influence of others included several sectors, such as the family, friends, teachers, and mass media. In one of several studies that reported on the career goals of secondary school students, Lai et al. (2005) reported that the influence of others had both a negative influence and a positive influence on the choice of teaching as a career.

1.4.1. Family influence on teaching career choice

Research on family influence has increased rapidly during the last few years, but the understanding of family influences on career choices remains limited. Many studies on family influence on career choice focus on individual parents' careers; for example, mothers or fathers influence children to generally take up a certain career as they do. This research revealed that family members, which include parents, siblings and extended family members, influence career decisions. The first interactions of a child with other people occur with his home's family members, including his parents, siblings and other relatives (Bollu-steve & Sanni, 2013). A child is influenced by a number of family-related factors, such as the marital relationship of the parents, the socioeconomic status of the family, the home atmosphere, whether parents are warm or hostile, the environmental condition, the occupational status of the parents and the number of siblings in the family (Bollu-steve & Sanni, 2013:92). Family dynamics, therefore, play a pivotal role in the career readiness of students. Several studies provide evidence that parental involvement influences high school students' career choices, for instance, in Romania (Marinas, Igret, Marinas & Prioteasa, 2016) in the Philippines (Aguado, Laguado & Deligero, 2015). These studies showed that parents influence the choice of career among high school students. A study conducted in Kenya revealed that when adolescents required information on topics such as career planning, they consulted their parents (Edwards & Quinter, 2012). Supportive parents are important for their children's career decision-making and for the success of their careers (Clutter, 2010). If an individual always observes his or her mother and admires her teaching skills, that may influence the pursuit of a career in education. Wright, Perrone-McGovern, Boo, & White (2014) reported that support from the most influential people is likely to have more direct influence on career decision-making self-efficacy than other contextual factors.

Kniveton (2004) reported that parents have much more influence on students' career decisions than teachers do. The study indicated that young children begin to identify with their parent's occupation as soon as they can pronounce their job title. Peterson, Stivers, & Peters, as cited in Clutter (2010), indicated that although adolescents

begin to demonstrate their independence actively from their parents in their high school years, they are still very much dependent on their parents for their career development. In fact, parents tend to create the strongest impression of their children's career choices rather than any other group, such as counsellors, teachers or even friends (Bardick, Berns, Magnusson, & Witko, 2004). Additionally, Jungen (2008) noted that choosing a career is often a major change in a person's life, and this decision alone has the potential to open the door for having success or closing the door of opportunity. While often perceived to be an individual choice, the study suggested that a variety of influences, such as family, school, community, social and economic factors, are likely to manipulate one's final career decision. Among these factors, students report that parents have the greatest influence on which career they choose.

1.4.2. Friend influence on teaching career choice

According to Abdulla (2024), a senior career development specialist at the Qatar Career Development Center (QCDC) mentioned that friends and peers significantly influence individuals' lives, including their future career choices. Having friends who share the same interests and ambitions can influence a person's career choices, guiding them toward a specific professional way, as people generally feel comfortable and confident when they are surrounded by friends with similar interests. Peer influence also extends to expanding knowledge and learning opportunities. When individuals have friends with similar interests, they can always communicate and discuss things related to their shared interests. Abdulla's study was conducted in 2015 with 220 high school students in Qatar about the most influential factors in career decisions. The study revealed that friends were the factor with the most influence on others, as 180 students chose the same career path as their peers did. While some students were influenced by their peers and parents, others were influenced by different factors. However, friends were the most significant factor in these students' career decisions.

There are various ways in which peers can influence individuals' career choices. One of the major ways in which friends influence people is their ability to provide them with a sense of comfort and acceptance. People mostly find it easier to accompany their old friends and make new friends with them in the future. This, along with developing a sense of belonging to the group by following the group's preferences, is one of the main reasons why people choose to pursue careers that their peers are following as well (Rosenqvist, 2017). Others, who are confused about their future and do not have much exposure to what all they could pursue, tend to follow the general trend they see among their peers (Rosenqvist, 2017). In addition, friends are often compared to, academically, the individuals making the decision.

According to Salvy, Haye, Bowker, & Hermans (2012), friends are great sources of motivation for each other. Lifelong friendships are made at schools, and friends are known to stand up for one another, sometimes even more than siblings. They help each other with school work and become mentors to each other in their personal lives (Salvy et al., 2012). Additionally, Ogutu, Odera & Maragia (2017) examined the influence of friends on students' career decision making. They reported that friend influence had a positive relationship with career choice. Naz, Saeed, Khan, Khan, & Sheikh (2014) explored the nature, level and extent of peer and friend influence in the career decision process of an individual. The study revealed that even though families primarily prepare and transform children's behavior in many ways, friend influence is a resource for developing career opportunities and decision making among youth.

1.4.3. Teacher influence on teaching career choice

According to Tira Nur Fitria (2023), teachers have the ability to inspire and motivate students. They can spark a love of learning, encourage students to try new things and push them to reach their full potential. Teachers, through their enthusiasm and dedication, can instill a love for a subject or a specific field, which can have a significant effect on a student's career choices.

Teachers are creatures who are given the mandate to educate humans to become human beings who have good character, have character, and are knowledgeable (Normawati et al., 2019). Teachers are professional educators with the main tasks of educating, teaching, guiding, directing, training, assessing, and evaluating students (Pianda,

2018). The teacher's role is very important in the teaching and learning process, as well as in advancing the world of education (Wijaya, 2018). Teachers who carry out their duties professionally will be able to provide great and dignified educational output (Octavia, 2019). Becoming a teacher usually begins with interest. Interest in the teaching profession is a person's willingness or desire to pursue the teaching profession, where the teaching profession has a professional role and competence and requires special skills as a teacher. Elements of interest in becoming a teacher can start from studying at the faculty of teacher training and education, seeking knowledge and information about the teaching profession, feelings of pleasure and interest in the teaching profession, and the willingness and desire to become a teacher.

Khan, Murtaza & Shafa (2012) investigated the role of teachers in career counseling in high schools in Gilgit-Baltistan, Pakistan. The findings showed that teachers voluntarily act as students' informal counsellors who guide them in their subject choices and career paths. Moreover, they indicated that students view their teachers as role models and attach high value to their advice and guidance related to career choice. Shumba and Naong (2012) determined the factors influencing career choice and aspirations among students in South Africa. They reported that the family is the ability of the student to identify his or her preferred career choice and that teachers are the main factors that influence the students' career choices and aspirations.

1.4.4. Influence of mass media on teaching career choice

Media and communication technology have affected modern life by influencing one's perception of the world and interfering with personal interactions with individuals and society (Hoag & Grant, 2017). Research has shown that mass media influences the career selection process by shaping personal decisions since it contributes to character development, language and habit formation (Noshina, Mian, Irfaan & Rao, 2014; Kazi & Akhlaq, 2017). Studies conducted in countries such as the United States of America, Australia and Nigeria have indicated that media such as TV, radio, internet, newspapers and social media sites have contributed to students' choices of careers in librarianship and journalism (Dana, 2017; Busayo, 2017). Further studies by Kazi and Akhlaq (2017) and Adedeji, Ojelabi, Lekan and Adefarati (2017) insist that high school students' career choices are influenced by notable personalities in certain professions, as seen on television, heard on radios and read in printed media.

1.5 Motivational Factors in Teaching Career Decisions

Motivational factors are most frequently found when searching for the decision to choose a teaching career, as they are divided into altruistic, intrinsic, and extrinsic motivations. While there is some overlap between these types of motivations, especially between altruistic and intrinsic motivation, these terms are broadly used in the literature. Altruistic behavior is described as human actions with no apparent benefits for the person who performs them but who benefits other individuals, shows a generous love of others, desires their discovery of happiness and expects nothing in return (Altruism/Psychology Today, n.d.). Some examples related to motivation for choosing teaching include things such as a desire to work with children and adolescents, to make a social contribution, or to make a difference. Intrinsic motivation consists of engaging in a behavior because it is personally rewarding, performing an action for the pleasure it conveys, and it is for internal reward, not for some external reward. Intrinsic motivation defines the work itself as its reward and arises from within the individual because the work is naturally satisfying, they enjoy an activity, or they see it as an opportunity to discover, learn and update their possibilities (Griggs, 2017). Some examples related to motivation for choosing teaching include enjoying the work of teaching, compatibility with other interests and activities, compatibility with family life, and self-education. Extrinsic motivation arises from outside an individual and happens when they are moved to engage in an activity to earn a reward or evade penalty; that is, a person behaves in a specific way, not because of mere enjoyment or satisfaction but rather to obtain a payment or avoid an unpleasant consequence (Griggs, 2017). Some examples of extrinsic motivation include money, fame, grades, and admiration. People who are extrinsically motivated continue to perform an action although they do not see the task rewarding. Another example related to this kind of motivation for teaching is having job security.

Moreover, Nesje et al. (2018) confirmed a Norwegian translation of the Factors Influencing Teaching Career Choice (FIT-Choice) scale and reported that the factors that Norwegian future teachers most strongly agreed with

were intrinsic motivation, shaping the future of children or adolescents, perceived teaching ability, making social contributions, and ensuring job security. Lin et al. (2012) examined similar and differing initial motivations to teach between 257 U.S. and 542 Chinese preservice teachers via the FIT-Choice scale. The highest-rated motivations, which are common to both the U.S. and Chinese samples, were within social utility values ("make social contributions" and "shape the future of children or adolescents"). Similarly, the lowest mean rating for both groups was chosen for teaching as a "fallback" career, followed by socialization influences such as people who had encouraged them to embark upon a teaching career. Goller et al. (2019) used the FIT-Choice scale to discover undergraduate students' motivations in Finland for choosing teaching as a career in comparison to student teachers in Germany. Compared with Finnish students, German students tended to choose their careers in more cases because they felt that their teaching abilities were high, judged the job as having high personal utility value, including strong job security and time for family, and were convinced by other people who the teaching career choice would be a good idea. Even though most students in both samples noted that they did not choose teaching as a fallback career, the German students scored significantly higher on this factor than did the Finnish students.

1.6 Teaching as a Fallback Career in the Teaching Career Choice

Australian research conducted with 1653 preservice teachers from three universities in Australia revealed that teaching is not typically considered a fallback career, chosen only because other options were not available or did not work out (Richardson & Watt, 2006; Watt & Richardson, 2007). However, some evidence suggests that teaching is a fallback career for some students who are aspiring to other careers. For example, Australian research involving more than 6000 primary and secondary school students shows that teaching is considered a second option by some students who feel that their first choice of career may be out of reach (Gore et al., forthcoming). Internationally, research has also indicated that teaching may be considered if other options do not work out (Akar, 2012; Dastidar & Sikdar, 2015; Gu & Lai, 2012; Klassen et al., 2011; Lawver & Torres, 2011; Topkaya & Uztosun, 2012). Recent research has indicated that teaching as a fallback career is not necessarily negative. Menzies et al. (2015) reported that both "accidental entry" and "getting attracted to teaching" (p.7) are important reasons for entering the teaching profession, whereas Wong et al. (2014) reported that teaching as a fallback career could be positive when it was seen as a reasonable career choice and connected with intrinsic and altruistic motivation.

1.7 Sociocultural factors affecting teaching career choice

Research within the last decade that has focused on the sociocultural influences surrounding the choice to enter teaching as a career has been limited. Much of the research pointing to this type of influence is international in nature and provides a point of comparison to influence the choice of teaching in Western countries. For example, a Nigerian Certificate in Education (NCE) may allow students' direct entry into university. As such, preservice teachers in Nigeria indicated that they had taken a teaching course to increase their chances of being admitted to the university (Ejieh, 2005). In China and Hong Kong, negative images of teachers, including the reported low status of teachers, discouraged Chinese students from choosing teaching as a career, despite teaching being viewed more favorably in Chinese society more generally (Gao & Trent, 2009; Lai et al., 2005), whereas in Oman, religion and social expectations have a strong role in influencing Omani preservice teachers (Klassen et al., 2011). Furthermore, research with African-American males in the United States has demonstrated how cultural understanding can influence students to not choose a career in teaching. These students identified three key reasons for not choosing teaching: (1) holding negative perceptions of teachers and teaching; (2) viewing schools as oppressive institutions where African–American males are stigmatized, labeled, and devalued; and (3) seeing teaching as "selling out" (p. 409), as it is believed that the curriculum represents black people inaccurately and unfairly (Graham & Erwin, 2011).

In Malaysia, cultural beliefs play a main role "in constructing favorable conditions in teaching and facilitating a positive image of the teaching career" (Azman, 2012), whereas English language (ELT) teachers in Turkey indicate that social influences, religious purposes, significant others and gender roles are key sociocultural influences on the choice of teaching as a career (Salı, 2013). Further research with 974 preservice teachers from Turkey illustrated how participant motivations and perceptions of teaching as a career were shaped by the sociocultural context of Turkish society (Akar, 2012), which included teaching as a suitable job for women and

identifying teaching as a low-status profession. In one of several studies that focused on ethnic background as an influence on teaching career choice, Butt et al. (2010) undertook focus groups and qualitative interviews with 18 British South Asian women. The findings revealed that intrinsic motivations to teach, including job satisfaction, a sense of achievement, love for the subject and enjoyment of working with children, were also influential. Additionally, the influence on teaching career choice for British South Asian women was the flexibility offered by a teaching career and its perceived fit with both present and future family needs and the acceptability of teaching as a career with respect to its status in the community. Furthermore, the authors also noted responses from participants that suggested that their presence in schools as role models for their ethnic group was crucial, even though there was also acknowledgment that this could add more pressure (Butt et al., 2010).

In Australia, social influences were found to be less important than other factors, including intrinsic and altruistic motivation (Watt & Richardson, 2007). However, one qualitative study with Indigenous Australian people noted that "emotional capital" influences the choice of a teaching career (Santoro, 2010). The findings suggest that the mothers of indigenous students have an important influence on the choice of their children to enter a teaching career. Teaching in this context can be understood to represent good chances for "upward class mobility" and opportunities for social change to Indigenous people more generally (Santoro, 2010). Furthermore, Gore et al. (forthcoming) reported that indigenous primary and high school students are 1.6 times more likely to express an interest in teaching as a career than nonindigenous students are over and above the influence of other demographic factors.

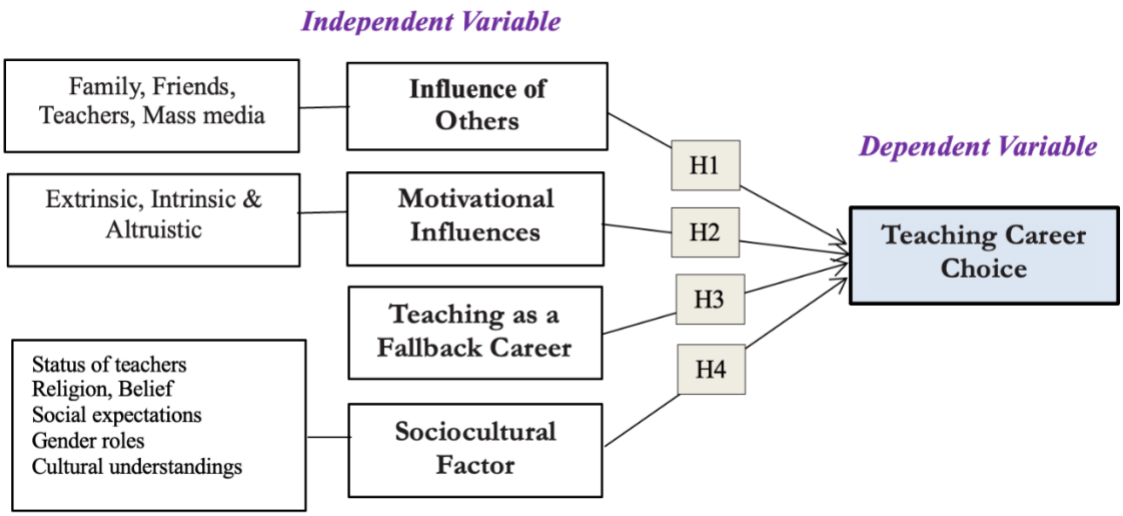

Figure 2: Conceptual Framework Model

2. Method

2.1. Research Design and Instrument

The study uses primary data collected in the form of participant responses through a structured questionnaire in line with the FIT-Choice scale, which was adapted from Sardana et al. (2021) and Martinez-Moreno & Petko (2023). This was followed by the employment of a quantitative cross-sectional research design. To avoid any misconception of the questions or factors, the questionnaire was designed in both languages—Khmer and English—and was distributed to student teachers from both TECs.

2.2. Sample size

The study was conducted with a sample of 223 preservice teachers in Cambodia, that is, year-4 student teachers who are educated to become teachers in the near future. A simple random sampling method was used to select the sample, and of the 223 questionnaires distributed in Google form, all were returned, representing a response rate

of 100%. The sample included 70.4% female and 29.6% male respondents whose ages ranged from 22–25 (71.3%), 26–29 (24.2%) and 4.5%, respectively.

2.3. Procedure

Phnom Penh and Battambang Teacher Education Colleges were visited to collect data from primary and lower secondary student teachers. After the aim of the survey was explained, the questionnaires were administered to the student teachers who were studying in their fourth year at both institutions through an online means—the Google form.

2.4. Data analysis

The study's quantitative data were analyzed via the exploratory factor analysis (EFA) technique via IBM's SPSS version 21.0 analytical software. This study uses descriptive and inferential statistics to analyze the validity, reliability, mean, standard deviation, and significance of the collected data through a one-sample t test.

3. Results

The purpose of this study is to determine the factors that influence the decision to choose teaching as a career among student teachers at the Teacher Education Colleges (TECs) in Cambodia. With respect to the respondents' participation, there were more females than males due to the greater proportion of student teachers at both TECs—29.6% males and 70.4% females. All the respondents were in their fourth year, ranging in age from 22--25 years (71.3%), 26--29 years (24.2%) and 4.5% of the other respondents, and only 20.6% held a bachelor's degree, whereas 79.4% held a high school diploma. The questionnaire item score ranged from 1 (extremely untrue) to 5 (extremely true), and the findings showed that the item scale was reliable because the four-factor solution had medium to high Cronbach's alphas for each of the factors, ranging from $\alpha = 0.711$ to $\alpha = 0.848$.

Table 1: Regression analysis

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	395.849	4	98.962	45.996	.000b
	Residual	469.039	218	2.152		
	Total	864.888	222			

a. Dependent Variable: Total_TCC

b. Predictors: (Constant), Total_IO, Total_MF, Total_FC, Total_SC

Through the table above, the ANOVA results show that the regression model with the four main factors, such as influence of others (IO), motivational factors (MF), teaching as a fallback career (FC), and social–cultural factors (SC), as predictors is a statistically significant predictor of teaching career choice (TCC) ($F(4, 218) = 45.996$, $p < .001$). The model explains approximately 46% of the variance in teaching career choice, meaning that these factors together have a strong influence on student teachers' decisions to become teachers.

3.1 Influence of Others

Table 2: Descriptive statistics and reliability analysis (M, SD, α) influence of other variables

Code	Items	M	SD	α
	Influence of Others	**3.95**	**0.79**	**0.785**
	Family Influence	***4.14***	***0.73***	***0.745***
Fa.1	I have discussed my future career with my family.	4.09	0.75	
Fa.2	People in my family explain to me about the importance and value of being a teacher, and motivate me to be a teacher.	4.19	0.73	
	Friend Influence	***3.47***	**1.03**	***0.848***
Fr.3	I have discussed my future career with my friends.	3.46	0.99	

Fr.4	My friends explain to me about the importance and value of being a teacher, and motivate me to be a teacher.	3.48	1.07	
	Teacher Influence	***4.20***	***0.65***	***0.720***
T.5	I found that all teachers I know are good role models for me.	4.29	0.64	
T.6	My teachers advice and encourage me to be a teacher.	4.13	0.66	
	Mass Media Influence	***3.98***	***0.68***	***0.714***
M.7	I have access to any media every day, and they provide adequate information for my decision making.	3.82	0.75	
M.8	Through the media, I see the value and dignity of teachers, that is why I am interested in teaching as a career.	4.15	0.60	

The study revealed, as shown in Table 2, that the first factor, "the influence of others", such as family, friends, teachers and mass media, influenced the teaching career choices of student teachers at TECs. The findings showed that "teachers" had the most significant influence on teaching career choice (M=4.20, SD=0.65), while "families" had the second most significant influence (M=4.14, SD=0.73), followed by "mass media" (M=3.98, SD=0.68). "Friends" had the least influence on teaching career choice (M=3.47, SD=1.03); however, it scored above the scale midpoint (3.00). This implies that most of the respondents agreed that what career they want to have in the future is influenced the most by their teachers, followed by their family, the mass media and, finally, the influence of their friends. Overall, the influence of others, such as family, friends, teachers and mass media, was perceived to be the most important to our preservice student teachers' decision to become a teacher.

3.2 Motivational Factors

Table 3: Descriptive statistics and reliability analysis (M, SD, α) of the motivational factors

Code	Items	M	SD	α
	Motivational Factors	**3.99**	**0.70**	**0.830**
Ex.	***Extrinsic Motivation***	***3.54***	***0.86***	***0.785***
Ex.1	I found that teachers get fairly good salary these days.	3.78	0.74	0.746
Ex.2	As a teacher, I can have more holidays due to school vacations.	3.35	0.98	0.705
Ex.3	For me, teaching is an easy job in the society.	3.16	0.98	0.703
Ex.4	Work security is one reason I choose a teaching as a career.	3.87	0.73	0.762
In.	***Intrinsic Motivation***	***4.17***	***0.62***	***0.738***
In.5	I like teaching.	4.25	0.58	0.671
In.6	As a teacher, I have a chance to upgrade my knowledge.	4.45	0.57	0.700
In.7	Being a teacher, I can have a comfortable life in the society.	3.91	0.70	0.682
In.8	Teaching is a respectable job.	4.07	0.63	0.659
Al.	***Altruistic Motivation***	***4.26***	***0.59***	***0.815***
Al.9	I love children and adolescents, and like working with them.	4.00	0.60	0.845
Al.10	I want to share and give proper knowledge to young people.	4.38	0.56	0.743
Al.11	I want to educate the next generation to become good people.	4.43	0.58	0.706
Al.12	I want to change young people's mind in the future.	4.26	0.64	0.763

Motivational factors, which include extrinsic, intrinsic and altruistic motivations, strongly influence teaching career choice. The mean score (M=3.99) is higher than the scale midpoint with the standard deviation (SD=0.70). The Cronbach's alpha value is equal to 0.830, which indicates that the item scale for this section is reliable for the survey (see Table 3). The findings revealed that altruistic motivation had the most significant influence on teaching career choice (M=4.26, SD=0.59), followed by intrinsic motivation (M=4.17, SD=0.62). This indicates that respondents love their children and adolescents, such as working with them, wanting to share knowledge with them, educating the next generation to become good people, and wanting to change young people's minds in the future. Additionally, all the respondents, as prospective teachers, believe that they will like teaching, have the opportunity to increase their knowledge and think that teaching is a respectable job. Surprisingly, the altruistic motivation score was the highest, whereas extrinsic motivation, including salary, vacation and job security, was the lowest (M=3.54, SD=0.86) among the three motivational factors. Thus, even though extrinsic motivation seems

to receive low scores, all motivations, especially altruistic and intrinsic motivations, are very important for decision making as well as in doing something.

However, the factor "teaching as a fallback career", as shown in Table 4, had less influence on teaching career choice among student teachers at TECs, with a mean score of low (M=2.37, SD=1.12), and this result is not different from that of a previous study conducted in India by Sardana et al. (2021), with a mean score of M=2.05, SD=0.88. This study revealed that most of the student teachers said statements such as "I was unsure of what career I wanted, there were no other choices besides teaching, and it was difficult for me to find other jobs so I decided to choose teaching." were not true to them. However, slightly more of them said they chose teaching to step stone to other careers (M=2.66, SD=1.12). Overall, all the mean scores were lower than the scale midpoint (M<3.00). This can reflect that they chose to be teachers for reasons other than teaching being their last choice.

3.3 Teaching as a Fallback Career

Table 4: Descriptive statistics and reliability analysis (M, SD, α) Teaching as a Fallback Career

Code	Items	M	SD	α
FC.	**Teaching as a Fallback Career**	**2.37**	**1.12**	**0.800**
FC.1	I was unsure of what career I wanted.	2.28	1.11	0.757
FC.2	There were no other choices besides teaching.	2.23	1.12	0.724
FC.3	It was difficult for me to find other jobs, so I decided to choose teaching.	2.31	1.15	0.690
FC.4	I chose teaching in order to step stone to other careers.	2.66	1.12	0.818

3.4 Sociocultural Factors

Table 5: Descriptive statistics and reliability analysis (M, SD, α) of sociocultural factors

Code	Items	M	SD	α
SC.	**Sociocultural Factors**	**3.89**	**0.75**	**0.711**
SC.1	Teachers contribute a lot to establishing and preserving culture.	4.30	0.56	0.719
SC.2	I found that in Cambodia nowadays, most people who have jobs, work as teachers, so I also want to become a teacher.	3.25	0.94	0.667
SC.3	Teaching is perceived as a worthwhile career in the society.	4.09	0.70	0.573
SC.4	I believe that working as a teacher will receive very much merit.	3.91	0.76	0.615

Sociocultural factors have also influenced teaching career choices among student teachers at TECs. The findings showed that teachers contributed greatly to establishing and preserving culture (M=4.30, SD=0.56), which was the highest in this factor, whereas "Teaching is perceived as a worthwhile career in society." This factor had the second lowest mean score for the following statement: "In Cambodia currently, most people who have jobs work as teachers, so they also want to become teachers" (M=3.25, SD=0.94). However, all the items were scored above the scale midpoint, which reflects that these factors also influence teaching career decisions.

3.5 Teaching Career Choice (Student Teachers' Satisfaction with Career Choice)

Table 6: Descriptive statistics and reliability analysis (M, SD, α) of teaching career choice

Code	Items	M	SD	α
TCC.	**Teaching Career Choice**	**4.26**	**0.57**	**0.893**
TCC.1	I am very happy with my choice of becoming a teacher.	4.26	0.57	0.854

TCC.2	I am very satisfied with my choice of becoming a teacher.	4.26	0.58	0.840
TCC.3	I am very determined with my choice to become a teacher.	4.26	0.56	0.873
TCC.4	I think this is my right decision of becoming a teacher.	4.25	0.56	0.880

The item scale for respondents' satisfaction with their career decision had high reliability, with Cronbach's alphas ranging from $\alpha = 0.840$ to $\alpha = 0.880$ (see Table 6). The following were the respondents' feelings after making the decision to be teachers and after passing three years of teacher education at TECs, and they said they were very happy, very satisfied and very determined with their choice of becoming teachers (M=4.26, SD=0.57), whereas they thought it was their right decision of becoming teachers (M=4.25, SD=0.56) that almost all of them chose number 5 (extremely true) to each of the statements in the survey. All the mean scores for each item are much higher than the scale midpoint, so it is good news for all levels in education sectors that student teachers, who become teachers, are highly satisfied with their career choices.

4. Discussion

In the context of the current study's sample from the Cambodian Teacher Education Colleges, the highest-rated factor was altruistic motivation, which included the willingness to develop society, the ability to share knowledge with young people, and the ability to provide education to the next generation, followed by influences from the teacher and family and intrinsic motivation, such as having an opportunity to improve knowledge and having comfortable lives with respectable jobs. However, sociocultural factors such as the willingness to preserve culture, religion, and belief were also the factors that influenced teaching career choice; however, teaching as a fallback career was rated the lowest of all the factors.

In terms of the influences of others such as family, friends, teachers and mass media, the teacher influence was rated the highest because teachers did as role models and always gave them good advice or encouraged them to become teachers. These findings are in line with those of the study conducted in Pakistan by Khan et al. (2012), who investigated the influence of teachers on career counseling in secondary schools in Gilgit, Pakistan, Brazil. Khan et al. discovered that teachers play important roles in guiding their students as well as their careers. They also stated that teachers did as informal volunteer counsellors to guide students in their subject decisions and career choices. However, these findings contradict the findings of research conducted in India that teachers do not significantly influence the career decisions of their students, but they at least pay special attention to students who have made career choices (Martinez-Moreno & Petko, 2023). With respect to family influence, this study revealed that children in Cambodia have been influenced by parents as well as their relatives because they mostly discuss with parents or relatives before doing something, and parents are always motivated and give advice to them, especially with respect to career aspirations. Similarly, Law and Yuen conducted research in Hong Kong and indicated that students greatly appreciate their parents' advice. This finding shows that parents can shape their specific careers in their children from childhood (Law & Yuen, 2004). Another report written in Canada indicated that Canadian adolescents tend to value their parents' opinions further than any other sources do in terms of career decision issues. Many parents influence their children's career development because they have observed, known their children's interests and strengths and developed a trusting relationship with their children (Law et al., 2011). Moreover, this finding showed that peers or friends also influence career choice because they usually provide motivation and discussion on difficult issues together to reach decisions. This finding was in line with the findings of other studies that specified different groups that can influence students' career decisions. They reported that career decisions are usually influenced by parents, peers, friends, relatives, role models, and career counsellors (Pummel et al., 2008). In addition, mass media has a positive influence on career choice among student teachers in Cambodia. The respondents were interested in teaching as a career because they recognized the value and dignity of teachers. This aligns with a study in Kenya, which revealed that mass media statistically and significantly influence career choice among secondary school students in Meru County, Kenya (Njogu et al, 2019).

In addition to the influences of family, friends, teachers and mass media, motivational factors such as extrinsic, intrinsic and altruistic motivations significantly influence teaching career choice. As mentioned above, altruistic motivation had the most significant influence on career decisions, followed by intrinsic and extrinsic motivations.

Similar to the findings of a previous study conducted in India, altruistic motivation, such as developing young people's minds, was rated the highest, whereas intrinsic and extrinsic career value motivations, such as working with youth, job security and salary, were not rated high (Sardana et al., 2021). Similarly, another study in Indonesia reported that intrinsic value motivation was rated high in terms of becoming civil servant teachers in Indonesia (Suryani et al., 2016). However, this finding seems slightly different from the research findings that intrinsic motivation, such as pedagogical interest, motives to work with children, and the self-concept of teaching ability, is rated higher than altruistic motivation (Keller-Schneider, 2019). Other studies also support the finding that altruistic motivation was rated the highest. It has been reported that altruistic motivations such as "contributing to society", "working with children" and "shaping the future of children or adolescents" are the most influential factors (Krecic & Grmek, 2005; Saban, 2003). Another study in Turkey reported results similar to those of this study, as in the Cambodian context, students in Turkey are encouraged to choose to teach for altruistic motives and wish to help contribute to society by being a part of young generations' growth and development (Moss, 2020).

Another discussion concerns the factor of teaching as a fallback career. The findings indicated that the respondents had entered the teacher education program as a positive choice, not because teaching was the last or second choice, and similar to a study conducted in India, only 16.5% of the sample agreed that they had chosen or would choose teaching as a fallback career (Sardana et al., 2021). Additionally, the findings of this study are similar to those of some studies conducted in Germany, the United States, Australia, Norway (Watt et al., 2012), Spain (Gratacós et al., 2017), South Korea (Lee et al., 2019), and Turkey (Kilinç et al., 2012). Other studies have focused on teaching as a fallback career; for example, Akpochafo (2020), Salifu et al. (2017), Jukovic et al. (2012) and Lin et al. (2012) reported that job transferability, social influences, and the fallback career were the least influential factors in career choice. Unlike teaching as a fallback career, sociocultural factors significantly influence the career choices of student teachers at TECs in Cambodia. This factor was scored high, ranging from M=3.25 to 4.30 above the scale midpoint, which means that student teachers considered culture preservation, belief and religion to be very important and valued them as living in society and led them to career choices as teachers. This result is similar to that of a study conducted in Oman, whose findings revealed that religion and social expectations had a strong role in influencing Omani preservice teachers (Klassen et al., 2011). Additionally, in Malaysia, cultural beliefs play a vital role "in constructing favorable conditions in teaching and facilitating a positive image of the teaching career" (Azman, 2012), whereas another study by Sali (2013) indicated that English language teachers in Turkey believe that social influences, religious purposes, and gender roles are key sociocultural influences on the choice of teaching as a career. This research is also consistent with the findings of Akosah-Twumasi, Emeto, Lindsay, Tsey, and Malau-Aduli (2018), whose work suggests that the family, the social environment, peers, and societal values affect students' career decisions. Another study reported that sociocultural factors play a significant role in shaping the career decisions of students (Oderinde & Adesina, 2024). This study indicates that all education sectors should consider sociocultural factors when providing career guidance.

The findings provide a basis for improving teacher education programs and teacher policies in Cambodia and are important for preparing future teachers and understanding teachers who have entered the profession. For example, do teachers take a second job while teaching, and does it affect their teaching commitments and teaching quality, particularly during early careers? Studies in the literature state that teachers have second jobs, mainly for earning extra money (Betts, 2004; Parham & Gordon, 2011), and that doing so truly impacts the quality of teaching because of a lack of time to prepare lessons and teaching materials, attend professional development programs, and undertake leadership roles in schools. As with other factors influencing teaching career choice study contexts, participants in Cambodia chose to enter teacher education due to positive motivations, not because of a lack of other options. Because Cambodia needs more teachers in rural and remote areas to evenly distribute placements across the nation, altruistic and intrinsic motivations had the greatest influence on career choice. If these teachers desire to benefit socially disadvantaged people, provide services to society and help children and adolescents, hopefully, this may attract them to teach in such locations. It certainly appeared that teaching was perceived as a career high in social status and attractive to secondary school graduates, who enter teacher education and plan to work as qualified teachers upon completion of their studies.

5. Conclusion

This research aimed to explore the major variables influencing the teaching career choices of primary and lower secondary school teachers in Cambodia and fourth-year student teachers at Teacher Education College. A thorough analysis of research and theoretical frameworks led to the identification of various predictor variables, demonstrating the intricate interaction between independent and predictive variables influencing teachers' and student teachers' career choices. The factor influencing teaching career choice is the influence of other factors, such as other teachers, friends, family and mass media. Another factor is the motivational factor, which includes altruistic, intrinsic and extrinsic motivation. The third factor is teaching as a fallback career, and teaching may be considered if other options do not work out. The fourth factor is the sociocultural factor, which includes the status of teachers, religion, social expectations, gender roles, and cultural understanding. In conclusion, the findings revealed that motivation, especially altruistic motivation, is the most influential factor in teaching career choice among student teachers at teacher education colleges in Cambodia, followed by other teachers; however, teaching as a fallback career is the least influential factor.

6. Recommendations

Researchers would intend to provide useful insights into the factors that influence teachers' choice of teaching as a career. The useful and relevant information from this study would benefit the following sectors: the ministry of education, policymakers, parents, teachers, students and other researchers as follows:
(1) The ministry of education should continue the reform to improve teachers' salaries, school infrastructures and facilities to improve the working environment for teachers as professionals. Additionally, the ministry of education should ensure high-quality training and pay more attention to good, smart and competent teachers, who can be role models for students, to retain them in schools as well as in education institutions.
(2) This study could help policymakers and school leaders in the Cambodian educational system refine recruitment policies and practices for teaching careers. Policymakers should prioritize teacher education scholarships for students with strong altruistic and intrinsic motivations.
(3) This study will inform parents about what possibly influences their children's career choices.
(4) The knowledge gained from such studies could be used to increase actions and efforts to recruit students with higher academic and social profiles for their teaching careers.
(5) This study could lead students to enter a preparation program for their teaching careers, and some actions could be taken to encourage more academically excellent students to pursue their teaching careers.
(6) This study can help future researchers consider other factors that might affect students' preferences for certain careers. Further qualitative studies should be conducted to better understand these motivational factors over time.

Author Contributions: All three authors contributed to the work on the paper as follows. Conceptualization: Huot.S. and Sam.R. ; Methodology, Huot. ; Software, Huot.S. ; Validation, Huot.S., Sam.R. and Nguon.T. ; Formal Analysis, Huot. ; Investigation, Huot.S. ; Resources, Huot.S. ; Data Curation, Huot.S. ; Writing – Original Draft Preparation, Huot.S. ; Writing – Review & Editing, Huot.S. Sam.R. and Nguon.T. ; Visualization, Huot.S. ; Supervision, Sam.R. ; Project Administration, Huot.S. ; Funding Acquisition, Huot.

Funding: This research received no external funding.

Conflict of interest: The authors declare no conflicts of interest.

Informed Consent Statement/Ethics approval: All the subjects provided informed consent for inclusion before they participated in the study. All participants participated anonymously and were fully informed of why the research was being conducted, how their data would be used and whether there were any associated risks.

Acknowledgments: In this context, we would like to extend our profound gratitude to the reviewers for their invaluable guidance and support, which were instrumental in the successful publication of this manuscript. Furthermore, we express our sincere gratitude to H.E. Khorn Sok, the Rector of the National University of

Battambang, and Dr. Chan Hum, the director of the postgraduate school of the National University of Battambang, for their kind support and encouragement in publishing this research article. Finally, we would like to express my heartfelt thanks to TEC directors for allowing us to conduct the survey with student teachers at both TECs and to thank student teachers for participating in this study and providing true data. This research would not happen and would be fruitful without support from them.

Declaration of Generative AI and AI-assisted Technologies: This study did not use any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 17-31
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.227

Artificial Intelligence Assisted Instructional Design Readiness Scale for Teacher Candidates: Development and Validation

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Abstract
Artificial intelligence technologies reshape instructional design processes not only technically but also pedagogically and ethically. In this context, determining the readiness levels of pre-service teachers for this process is critical for the development of contemporary teacher competencies. The aim of this study is to develop a valid and reliable scale to measure the readiness levels of pre-service teachers towards artificial intelligence-supported instructional design. In this quantitative research design, exploration and confirmatory factor analyses and reliability studies were conducted in line with the scale development process. The first application was conducted with 325 pre-service teachers and the confirmatory application was conducted with a different sample of 256 students. The developed scale consists of 32 items in total and four sub-dimensions: Cognitive Readiness, Affective Readiness, Technological Integration Competence and Perceptual Confidence. The construct validity was proved by exploration and confirmatory factor analyses and Cronbach's Alpha reliability coefficients were quite high in both samples. The findings show that pre-service teachers are highly prepared for artificial intelligence-supported teaching processes. This scale can be considered as a functional tool in restructuring teacher education programs, planning in-service trainings and evaluating teacher competencies.

Keywords: Artificial Intelligence-Supported Instruction, Readiness, Pre-Service Teachers, Scale Development

1. Introduction

The rapidly evolving technological dynamics of the digital age are profoundly affecting education systems, redefining the structure, actors and tools of the teaching process. Artificial intelligence technologies, which are at the center of this transformation, support personalized learning experiences in education, guide teachers' pedagogical decisions and radically change the nature of learning environments. The effective use of AI in education requires not only the integration of technological tools but also a multi-layered preparation including pedagogical, ethical and cognitive awareness. In this context, the extent to which pre-service teachers are prepared for AI- supported instructional design processes has become a determining part of contemporary teacher competencies.

Artificial intelligence assumes essential functions in teaching environments, especially in areas such as content presentation, monitoring student performance, providing individualized guidance, and automating feedback mechanisms (Faggella, 2022; Holmes et al., 2022). The fact that teachers assume not only a user but also a designer, selective and directive role in this process brings their artificial intelligence literacy and instructional design competencies to the forefront (Ulaş & Ayhan, 2023). It is known that increasing pre-service teachers' technology-related competencies is related to the extent to which they can evaluate artificial intelligence- based tools within a pedagogical framework (Sarı & Öztürk, 2023; Beden & Keleş, 2023). In this respect, it is critical for pre-service teachers to master not only technical knowledge but also digital pedagogical design principles to be able to use artificial intelligence effectively in different teaching scenarios they will encounter. In addition, the high level of awareness of pre- service teachers regarding ethical principles, student privacy and data security while using these technologies has become a factor that directly affects the quality of the teaching process (Kayaduman, 2022; Li et al., 2021; Zawacki-Richter et al., 2019).

Artificial intelligence-supported instructional design involves not only knowing technological tools but also the ability to integrate these tools into lesson plans in an appropriate context, effectively and ethically (Li et al., 2021; Yu, 2023). Accordingly, the readiness levels of pre-service teachers need to be addressed multidimensionally. Readiness includes cognitive, affective, and behavioral competencies related to an individual's capacity to perform a certain task (Yıldız & Arslan, 2022). Readiness is not only the state of having knowledge; it is also a dynamic structure that expresses the readiness to use this knowledge appropriately. In the context of education, it is related to an individual's openness to learning, predisposition to acquire new skills, and the ability to cognitively, affective, and kinesthetic in response to environmental stimuli. These statements are supported by the studies of Yıldız and Arslan (2022) as well as Lee et al. (2021) and Holmes et al. Before drafting the item pool, a comprehensive literature review was conducted focusing on active learning, instructional design, teacher competencies, and technology integration. Existing validated instruments and relevant theoretical frameworks were examined to ensure the construct validity of the scale (Büyüköztürk, 2012; DeVellis, 2017; Scherer et al., 2019). In terms of content validity, expert opinions were sought from four academics—two specializing in measurement and evaluation, and two from the field of educational sciences. Additionally, Turkish language experts were consulted to ensure linguistic clarity and consistency. Based on the feedback received, several items were either revised or removed, and the item pool was finalized accordingly.

In these studies, readiness is considered as a prerequisite for effective participation in the instructional process and the importance of planning according to the needs of the individual in instructional design processes is emphasized. In the light of this information, it can be said that the acquisition of targeted behaviors, especially in the instructional design process, becomes possible through the selection of content, methods, and tools appropriate to the readiness level of the individual. In this context, readiness should be considered as a pedagogical prerequisite for effective learning experiences. The equivalent of this multi-layered structure in instructional design is an integrated competence based on both pedagogical knowledge and technological application skills (Zawacki-Richter et al., 2019).

In the development of the item pool, four dimensions were conceptualized: Cognitive Readiness, Emotional Readiness, Technological Integration Ability, and Perceived Confidence. Each of these dimensions is grounded in a specific theoretical framework, which guided the item construction process and enhanced the scale’s content validity.

- Cognitive Readiness is framed within Bandura's Social Cognitive Theory, emphasizing the role of self-efficacy and cognitive awareness in preparing individuals for instructional tasks.
- Emotional Readiness is informed by Goleman's Emotional Intelligence Theory, which underlines the ability to manage and utilize emotions effectively during learning and teaching processes.
- Technological Integration Ability is based on the TPACK model (Technological Pedagogical Content Knowledge) developed by Mishra and Koehler, highlighting the capacity to integrate technology meaningfully into pedagogical practices.
- Perceived Confidence draws on Rotter’s Locus of Control Theory, particularly focusing on internal control beliefs related to trust in AI-supported instruction.

By anchoring each dimension to established theoretical models, the item development process gains a stronger conceptual foundation, ensuring alignment with the construct being measured.

The need for a valid and reliable scale to measure pre-service teachers' readiness for artificial intelligence-supported instructional design is frequently expressed in the literature (Chan et al., 2021; Lee et al., 2021; Aksoy, 2023). Existing studies focus on pre-service teachers' attitudes towards technology use; however, the lack of holistic measurement tools specific to artificial intelligence that relate the instructional design process draws attention (Gülbahar & Kalelioğlu, 2023). In this context, the scale to be developed has the potential to influence both micro-level instructional planning and macro-level teacher training policies for the integration of artificial intelligence in education.

In parallel to this, this research is of critical importance not only in terms of developing a measurement tool, but also in terms of analyzing pre-service teachers' relationships with technology in depth in a period when contemporary teacher competencies are being redefined. Especially as the role of artificial intelligence in education is becoming more evident day by day, determining the pedagogical readiness levels of teachers towards this technology will enable the planning of effective and sustainable teaching practices. In addition, with the development of this scale, the contents of teacher education programs can be updated, artificial intelligence-focused courses can be designed in pre-service teacher education, and teachers' professional development needs can be determined more systematically. In this respect, the research has the potential to form one of the building blocks of not only individual competencies but also systemic transformation.

This study aims to develop a scale to measure pre-service teachers' level of readiness for artificial intelligence-supported instructional design in a valid and reliable way.

1.1. Problem Statement

"Can a valid and reliable scale be developed to determine the readiness levels of pre-service teachers for artificial intelligence-supported instructional design?"
In line with this main problem, the following problems were formulated:

1. What is the level of construct validity of the scale developed to measure the readiness levels of pre-service teachers for artificial intelligence-supported instructional design?
2. Is the four-factor structure of the developed scale supported by confirmatory factor analysis?
3. What is the level of pre-service teachers' participation in the level of readiness for artificial intelligence-supported instructional design?

2. Method

This section provides methodological aspects of the study. In this sense, the research model, the study population and the sample size, the validity and reliability study of data gathering tools and other tests used for data analysis were presented.

2.1. Research Model

This study aims to develop a valid and reliable scale to measure the readiness levels of pre-service teachers towards artificial intelligence-supported instructional design. In this direction, the study was designed within the scope of the survey model, which is one of the quantitative research methods. The research was conducted in two main stages. In the first stage, exploratory factor analysis (EFA) was conducted for the scale development process. In the second stage, the scale was applied to a different sample group and confirmatory factor analysis (CFA) was performed and the construct validity of the scale was evaluated again.

With this structure, the study has the characteristics of a scale development and validation study. In the scale development process, item writing, expert opinion, pre-application, exploratory factor analysis, confirmatory factor analysis and reliability analysis were conducted systematically. In addition, to reinforce the validity and

reliability levels of the developed scale, it was applied to a different sample group to evaluate the data in a structured multi-stage process.

2.2. Working Group

The study group of the research consists of pre-service teachers studying at Pamukkale University Faculty of Education in the fall semester of the 2024-2025 academic year. A total of 325 pre-server teachers voluntarily participated in the data collection process. These pre-service teachers are studying in the Departments of English Language Teaching, Classroom Teaching, Preschool Teaching, Turkish Language Teaching and Science Teaching within the Faculty of Education, and the study group consists of 2nd, 3rd and 4th grade students studying in these branches.

The demographic characteristics of the pre-service teachers who participated in the study are presented in the table below:

Table 1: Frequency Distribution of the Sample Group According to the Determined Variables (Pilot Application)

Variable	Subcategory	F	%
Gender	Female	245	75.4
	Male	80	24.6
Department	English Language Teaching	55	16.9
	Classroom Teaching	70	21.5
	Preschool Education	65	20.0
	Turkish Language Teaching	60	18.5
	Science Teacher Education	75	23.1
Class Level	Grade 2	110	33.8
	Grade 3	120	36.9
	Grade 4	95	29.2
TOTAL		325	100

When Table 1 is examined, it is seen that most of the pre-service teachers who participated in the study were female and the gender distribution reflects the general situation in faculties of education in Türkiye. In terms of the distribution according to the departments, it is noteworthy that there is a balanced participation from each branch, especially the representation rates of Science and Classroom Teaching departments are higher compared to other fields. The distribution according to grade level is composed of 2nd and 3rd grade students. This situation is important in terms of revealing what kind of readiness profile the scale developed within the scope of the research exhibits at various stages of pre-service teachers' undergraduate education. Kline (2014) argues that considering the item number or factor number in the measurement tool of the sample size, the sample size can be ten times greater than item number during the phase of the scale development.

In the pilot study, data collected from 50 participants served as an initial testing ground to evaluate the psychometric properties of the draft items. According to the literature, the primary aim of a pilot test is not to achieve statistical generalizability but to gain initial insights into item functioning and structure (Johanson & Brooks, 2010). Therefore, although the sample size may appear limited, it is sufficient to conduct item discrimination analysis, item-total correlations, and preliminary reliability estimations. Pilot studies are specifically designed to assess the usability of the instrument and guide item revisions before the main study (Creswell & Creswell, 2018). Furthermore, this sample size has also been deemed acceptable in previous scale development research (e.g., Erkuş, 2016).

2.3. Data Collection Tool

In the construction of the items of the scale, not only theoretical foundations but also the data obtained from the field were utilized. In this direction, an open-ended question was asked by 7 computer and educational

technologies expert teachers with different years of seniority: "What kind of studies do you carry out while designing, planning and implementing the artificial intelligence-supported teaching process? What are the behaviors of your students in these processes?". This qualitative data collection process was conducted to ensure that the scale items were grounded in the field and derived from the real context.

Based on the responses obtained and the literature review, an item pool containing a total of 54 items was created. The items whose content validity was ensured in line with expert opinions were subjected to a preliminary application, and because of the exploration factor analysis, the items that gave low factor loadings and damaged the integrity of meaning were removed from the scale. As a result of this analysis process, the scale had a four-dimensional structure with 32 items.

These dimensions and their contents are as follows:

- **Cognitive Readiness (8 items):** 1, 2, 3, 4, 5, 6, 7, 8
- **Affective Readiness (8 items):** 9, 10, 11, 12, 13, 14, 15, 16
- **Technological Integration Capability (8 items):** 17, 18, 19, 20, 21, 22, 23, 24
- **Perceptual Trust (8 items):** 25, 26, 27, 28, 29, 30, 31, 32

The negatively structured items are as follows: 5, 6, 12, 14, 16, 21, 23, 26, 28, 29, 32. These items were reverse coded in the data analysis process.

Cronbach's alpha coefficients for the reliability level of the scale were calculated separately for both the pilot study and the actual study data. Information on these values is presented in a table below:

Table 2: Cronbach Alpha Reliability Coefficients of the Scale

Sub Dimension	Pilot Application (N=325)	Actual Application* (N=256)
Cognitive Readiness	0.84	0.86
Affective Readiness	0.82	0.85
Technological Integration Capability	0.85	0.87
Perceptual Trust	0.83	0.86
Whole Scale	0.91	0.93

*The scale was applied with a different sample group and it was checked whether the construct validity and internal consistency of the scale were maintained.

When Table 2 is examined, it is seen that all sub-dimensions and the general structure of the scale have extremely high reliability values according to both pilot and actual application results. It was underlined that a reliability value of 0.60 was required for preliminary studies, 0.80 for fundamental studies and between 0.90 and 0.95 for practical studies. On the other hand, the reliability coefficients values concerning the social sciences differ according to the research type, a reliability value of 0.70 for scientific-based studies is required and studies where ability, skills and interest are needed require a reliability coefficient level of 0.85 (Şencan, 2005). When evaluated according to the sub-dimensions, the highest reliability value was obtained in the Technological Integration Ability dimension (0.85) in the real application. This shows that pre-service teachers' competencies to integrate artificial intelligence technologies into teaching processes can be measured consistently. The reliability coefficients of the other dimensions (0.84, 0.82) are also quite high and reveal that the items in the scale show internal consistency in each dimension. Cronbach's alpha values obtained for the whole scale were quite strong both in the pilot study (0.91) and in the actual study (0.93). In this context, the scale was administered to 256 pre-service teachers studying at another faculty of education other than the pre-service teachers studying at Pamukkale University Faculty of Education. The purpose of this application was to determine whether the construct validity and internal consistency of the scale were maintained in different sample groups and to strengthen the generalizability of the scale.

In other words, these results show that the developed scale can be used as a reliable data collection tool not only for the scale development phase but also for statistical analyses in different samples. Cronbach's alpha coefficients above 0.80 in all sub-dimensions reveal that the internal consistency of the scale is at an adequate level and shows consistency between applications. While the stability of the reliability of the developed scale was demonstrated by applying it to a different sample group; a different statistical analysis was not included in this study.

To provide a comprehensive evaluation of the reliability of the scale, item-level analyses were also conducted. Within this scope, item-total correlation coefficients were calculated for each item, and all items were found to have significant correlations ranging between .40 and .72. Moreover, it was determined that the removal of any individual item did not lead to a significant change in the overall Cronbach's Alpha coefficient of the scale. This finding indicates that all items in the scale are structurally homogeneous and collectively contribute to a strong internal consistency.

2.4. Content Validity Process

During the item pool development phase, draft items were prepared for each dimension based on an extensive literature review, and expert feedback was sought to ensure content adequacy. In this context, two experts in educational measurement and two language experts in the field of educational sciences provided qualitative feedback, leading to revisions for content relevance and linguistic clarity. Based on expert evaluations, the Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated following the Lawshe (1975) method. Additionally, to assess inter-rater agreement among experts, Fleiss' Kappa coefficient was employed, which indicated an acceptable level of agreement. To further enhance the content validity of the scale, a pilot implementation was conducted with 18 teacher candidates, and their feedback on item clarity and comprehensibility was collected. As a result of expert input and pilot data, 32 items were finalized under four dimensions out of an initial 54. This systematic and rigorous process provides strong evidence for the scale's content validity.

2.5. Data Analysis

The data obtained within the scope of the research were analyzed through SPSS 25.0 and LISREL 8.80 programs. In the scale development process, each item in the draft form was first transferred to the computer environment according to the pilot application data obtained from 325 pre- service teachers. The responses of the pre-service teachers to each item and their total scores were calculated and exploratory factor analysis (EFA) was applied for the structural validity of the scale. This analysis was conducted to determine the sub-dimensions of the scale in line with the item factor loadings.

Kaiser-Meyer-Olkin (KMO) coefficient was calculated and Bartlett's Test of Sphericity was applied to determine the suitability of the data for factor analysis. In addition, sampling adequacy and suitability of the data for factor analysis were supported by examining the anti-image correlation matrix. To verify the factor structure obtained because of EFA, the scale was applied to a different sample group (n=256) within the scope of the actual application and confirmatory factor analysis (CFA) was performed using LISREL program. Various fit indices such as Chi-square fit index (χ^2/df), RMSEA, SRMR, CFI and GFI were used in the CFA process.

The Kolmogorov-Smirnov test was applied to determine the suitability of the data for normal distribution. The distribution of the variables was examined and the use of parametric or non- parametric tests was determined according to these results. The statistical significance level of the results was accepted as .05. In addition, descriptive statistics of the scale items were reported with arithmetic mean and standard deviation values.

5. Findings

In this section, the data obtained in line with the sub-problems of the study were analyzed and the findings related to the readiness levels of pre-service teachers towards artificial intelligence- supported instructional design were

presented. The findings are structured based on the results of exploratory and confirmatory factor analyses that support the construct validity of the scale and descriptive statistics are given separately for each sub-dimension.

5.1. Construct Validity (EFA) of the Scale for Measuring the Levels of Prospective Teachers

The suitability of the data for analysis and sampling adequacy was determined using Kaiser Meyer Olkin (KMO). The result of our KMO test is .924 and this value shows that the sample size can be characterized as "perfect" for factor analysis and the sample adequacy is extremely high (Kalaycı, 2010 Şencan, 2005; Tavşancıl, 2006).

Table 3. KMO and Bartlett's Test Results Regarding the Suitability of the Data for Factor Analysis

Factor Analysis Suitability Test	Result Value	
Kmo (Kaiser-Meyer-Olkin Measure of Sampling Adequacy)		0.924
Bartlett's Test of Sphericty	Approx. Chi Square	4123.48
	Degrees of freedom(df)	496
	Sig (p)	.001

Before conducting exploration factor analysis (EFA) to evaluate the construct validity of the scale, the suitability of the data for factor analysis was evaluated. In this context, Kaiser-Meyer-Olkin (KMO) coefficient was found to be 0.924 and it was determined that the sample size was "perfectly" suitable for factor analysis. Bartlett's Test of Sphericity result was significant ($\chi^2 = 4123.48$, $df = 496$, $p < .001$). In addition, the anti-image correlation matrix values were examined and it was seen that the relationships between variables were suitable for factor analysis. Exploratory factor analysis was conducted using principal components method and Varimax orthogonal rotation method. As a result of the analysis, four factors with eigenvalues above 1 were obtained. These four factors explain 64.78% of the total variance. Since each item showed a loading value of .40 and above in only one factor, the factor structure is interpretable.

The distribution of the items into factors is consistent with the theoretical structure determined previously. The first factor is named "Cognitive Readiness", the second factor is named "Affective Readiness", the third factor is named "Technological Integration Capability" and the fourth factor is named "Perceptual Confidence". The scale items were distributed evenly across these four factors and no cross-loadings were detected. In line with these findings, it can be said that the scale developed to measure the readiness levels of pre-service teachers for artificial intelligence-supported instructional design has construct validity.

5.2. Factor Analysis Values of the Scale for Readiness Levels

First, factor analysis was conducted using the anti-image correlation matrix. The diagonal of the anti-image correlation matrix should be greater than .50 (Can, 2014). Items with a correlation of less than .50 were removed from the questionnaire. The remaining items were subjected to factor analysis.

Table 4: Anti-Image Correlation Matrix

Article No.	Value	Article No.	Value	Article No.	Value	Article No.	Value
1	0.897	9	0.530	17	0.864	25	0.890
2	0.873	10	0.783	18	0.883	26	0.894
3	0.920	11	0.798	19	0.838	27	0.867
4	0.865	12	0.849	20	0.861	28	0.884
5	0.832	13	0.872	21	0.858	29	0.876
6	0.814	14	0.868	22	0.819	30	0.882

7	0.882	15	0.887	23	0.812	31	0.874
8	0.856	16	0.815	24	0.805	32	0.899

When the anti-image correlation matrix results shown in Table 4 are examined, it is seen that the diagonal values vary between .530 (item 9) and .920 (item 3). This shows that the scale items are suitable to be included in the factor analysis. The fact that the diagonal values in the anti-image matrix are above .50 means that the item shows sufficient correlation with the other items and it is appropriate to keep it in the analysis. Even the 9th item, which has the lowest value, remains above this limit with a value of .530, which reveals that it does not need to be excluded from the analysis. Item 3, which has the highest diagonal value, strongly represents the factor structure. In the light of these data, it can be said that the scale has a robust structure at the item level and forms a data set suitable for factor analysis.

Table 5: Eigenvalues of the Factor Eigenvalues of the Level of Readiness Scale for Artificial Intelligence

	(Initial Eigenvalues)			(Extraction Sums of Squared Loadings)			Descriptive		
Factors	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Sum of Factors	Factor Standard Deviation	Reliability Coefficientα
1 Cognitive Readiness	3,145	18,73	18,73	3,145	18,73	18,73	61,68	7,215	0.84
2 Affective Readiness	2,796	16,45	35,18	2,796	16,45	35,18	58,42	6,982	0.82
3 Technological Integration Capability	2,584	15,20	50,38	2,584	15,20	50,38	63,15	6,713	0.85
4 Perceptual Trust	2,448	14,40	64,78	2,448	14,40	64,78	60,37	6,891	0.83

Table 5 shows the initial eigenvalues and variance percentages explained by each factor of the scale consisting of four factors. While the Cognitive Readiness factor explains 18.73% of the total variance, Affective Readiness explains 16.45%, Technological Integration Ability explains 15.20% and Perceptual Confidence explains 14.40%. In total, the four factors provide an explained variance of 64.78%, supporting the structural validity of the scale. In addition, the mean scores, standard deviations, and Cronbach's Alpha reliability coefficients of each sub-dimension are also included in the table. These values reveal that the scale shows high internal consistency in all sub- dimensions and its usability as a measurement tool is strong.

Items with factor loadings below .40, items in more than one factor and small items with factor loadings below 0.10 were removed from the scale by applying Varimax rotation technique. Yavuz (2005) and Bütüner and Gür (2007) argued that scale items should not be included in more than one factor, the ideal value criterion for the difference between factor loadings should be at least 0.10, and items with factor loadings below 0.10 should be called related items.

Table 6: Factor Loadings of the Level of Readiness Scale for Artificial Intelligence

ITEMS	Factors			
	1	2	3	4
Item 1	.712			
Item 2	.734			
Item 3	.746			
Item 4	.701			
Item 5	.689			
Item 6	.674			
Item 7	.693			
Item 8	.719			
Item 9		.705		
Item 10		.515		
Item 11		.553		
Item 12		.681		
Item 13		.736		
Item 14		744		
Item 15		.688		
Item 16		.707		
Item 17			.599	
Item 18			.728	
Item 19			.566	
Item 20			.688	
Item 21			.695	
Item 22			.601	
Item 23			.501	
Item 24			.664	
Item 25				.741
Item 26				.726
Item 27				.734
Item 28				.711
Item 29				.689
Item 30				.633
Item 31				.561
Item 32				.503

Table 6 shows the factors of each item and the distribution of these items according to the sub-dimensions to which they belong. Factor loadings ranged between .503 and .746 and all items loaded above .40. This shows that the items represent the factors to which they belong in a meaningful and strong way. In addition, the percentages of variance explained and reliability coefficients of each sub-dimension were added to the table. The data obtained reveal that the four- dimensional structure of the scale has a strong and consistent structure and its usability as a measurement tool is high.

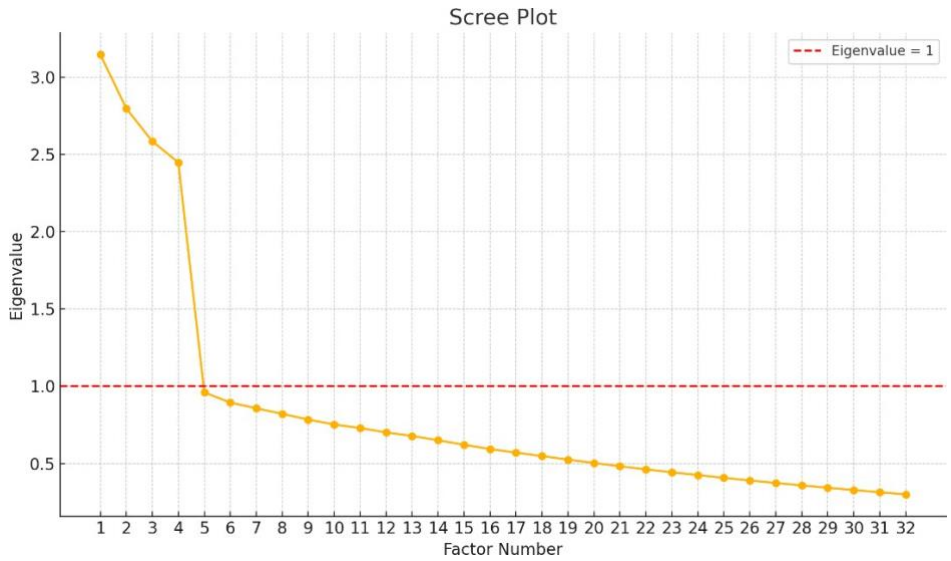

Figure 1: Line Graph for Eigenvalues

The Scree Plot graph presented in Figure 1 provides a visual representation for determining the factors according to the eigenvalues. When the graph is examined, it is seen that the eigenvalues of the first four factors are above 1 and there is a sharp decline starting from the fifth factor. When this situation is evaluated together with the criterion of having an eigenvalue above 1, which is generally used in factor analysis, it supports that the four-factor structure of the scale is appropriate and valid. The red dashed line in the graph was used as the reference point where the eigenvalue was 1 and the four factors above this line were accepted as the main components of the structure.

5.3. Confirmatory Factor Analysis Results (CFA) for the Four-Factor Structure of the Scale

In this section, the results of the confirmatory factor analysis (CFA) conducted to confirm the four- factor structure of the scale obtained from the exploratory factor analysis are presented. CFA was applied to evaluate the conformity of the factor structure of the scale to the predetermined theoretical structure. The analysis was conducted using the LISREL 8.80 program and various fit indices were used to evaluate the fitness of the model.

Table 7: Confirmatory Factor Analysis (CFA) Findings

Fit Indices	**Fit Range**	**Research Model**
		Four-Factors Model
Total Fit Index		
χ^2/df	$0 \leq \chi^2/df \leq 3$	1557.28 / 548= 2.84
Comparative Fit Index		
NFI	.90 ≥ - ≥ .94	.92
NNFI	.90 ≥ - ≥ .94	.93
IFI	.90 ≥ - ≥ .94	.91
CFI	≥ ,95	.96
RMSEA	0.05 ≤ - ≤ 0.08	0.073
Absolute Fit Indices		
GFI	≥ .90	.91
AGFI	≥ .85	.87
Residual Based Indexes of Compliance		
SRMR	.06 ≤ - ≤ .08	.069
RMR		.079

As seen in Table 7 to evaluate the reliability of the two sub-dimensions identified through Confirmatory Factor Analysis, a confirmatory analysis was performed. Results from confirmatory factor analysis indicated that chi-square was (χ^2=1557.28), degree of freedom (df=548, p=0.00) was χ^2/df=2.84; SRMR= .069, RMR=.079; AGFI= .87; GFI=.91; RMSEA= 0.073, CFI=.96, NNFI=.93, NFI=.92, IFI=.91. CFA revealed that χ2 /df ratio is lower than 3. Other goods for fit indices computed by CFA were: IFI= .90 ≥ - ≥ .94, NFI= . 90 ≥ - ≥ .94., NNFI =.90 ≥ - ≥ .94, CFI= ≥ .95, RMSEA= 0.05 ≤ - ≤ 0.08 and GFI= ≥ .90 AGFI =≥ .85 and finally SRMR and RMR = .06 ≤ - ≤ .08. Consequently, the values mentioned above indicate acceptable fit (Şimşek, 2007; Yılmaz & Çelik, 2009).

Table 8: Correlation Values Between Factors and Factors with Total Scale

Factors	1	2	3	4	Total
(1) Cognitive Readiness	*	.641	.590	.565	.828
(2) Affective Readiness		*	.622	.588	.799
(3) Technological Integration Competence			*	.666	.812
(4) Perceived Confidence				*	.785

*All correlations are taken as p< 0.01

Depending on the correlation coefficients of the scale, its reliability is characterized as follows: if it ranges between 0.70 - 1.00, the reliability of the scale is highly dependable; if it ranges between 0.69. - 0.30, the reliability of the scale is moderately dependable; if it ranges between 0.29-0.00, the reliability is low (Büyüköztürk, 2006). When Table 8 is analyzed, it is seen that there are moderate and high-level positive correlations between the sub-dimensions of the scale. Significant correlations were found between Cognitive Readiness and Affective Readiness at r = .64, between Technological Integration Competence and Perceived Confidence at r = .66, between Cognitive Readiness and Technological Integration Competence at r = .59, and between Cognitive Readiness and Perceived Confidence at r = .56. In addition, all the correlation values between the factors were statistically significant (p < .01). It is also noteworthy that the correlation of each factor with the total scale score is also high and significant (p < .01). This finding indicates that the factors make significant contributions to the overall structure of the scale, support construct validity, and the scale has a reliable structure.

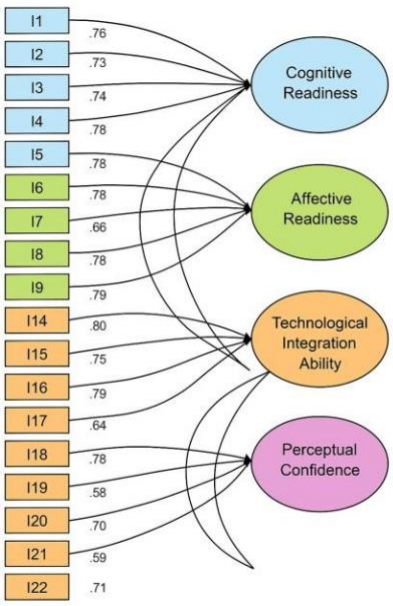

Figure 2: CFA Results for the Four-Factor Model

Figure 2 presents a visual representation of the four-factor model obtained according to the confirmatory factor analysis results of the scale developed to measure the readiness levels of pre-service teachers towards artificial intelligence-supported instructional design. Each factor was structured in relation to the related items and factor loadings were integrated into the model. The figure supports that the scale presents a statistically significant structure consistent with its theoretical foundations. In this structural model, the four main factors (Cognitive Readiness, Affective Readiness, Technological Integration Competence and Perceived Confidence) are presented with the observed variables associated with each of them. Factor loadings were integrated into the model and it was seen that each item was significantly associated only with the factor to which it was related. This model, which also shows the relationships between the factors, provides important evidence supporting the construct validity of the scale.

5.4. Pre-service Teachers' Level of Participation in the Level of Readiness for Artificial Intelligence Supported Instructional Design

In the third sub-problem of the research, "How is the level of participation of pre-service teachers in the level of readiness for artificial intelligence-supported instructional design? Regarding the question, arithmetic mean and standard deviation values for the answers given by the sample group were given and the level of agreement was revealed.

Table 9: Descriptive Statistics of the Items and Levels of Agreement

Item No.	N	Xmean	Ss	Level of Participation	Item No.	N	Xmean	Ss	Level of Participation
3	325	4.78	0.43	Agree Strongly	11	325	4.33	0.74	I agree.
18	325	4.75	0.47	Agree Strongly	32*	325	4.30	0.77	I agree.
30	325	4.72	0.50	Agree Strongly	6*	325	4.28	0.75	I agree.
2	325	4.68	0.51	Agree Strongly	28*	325	4.25	0.79	I agree.
14*	325	4.66	0.49	Agree Strongly	19	325	4.21	0.81	I agree.
26*	325	4.65	0.52	Agree Strongly	8	325	4.20	0.84	I agree.
7	325	4.60	0.58	Agree Strongly	15	325	4.16	0.82	I agree.
12*	325	4.55	0.61	I agree.	10	325	4.13	0.86	I agree.
5*	325	4.53	0.60	I agree.	13	325	4.11	0.88	I agree.
23*	325	4.50	0.65	I agree.	17	325	4.08	0.90	I agree.
9	325	4.46	0.68	I agree.	24	325	4.05	0.92	I agree.
20	325	4.44	0.66	I agree.	21*	325	4.01	0.94	I agree.
1	325	4.41	0.63	I agree.	27	325	3.98	0.95	I agree.
4	325	4.40	0.67	I agree.	22	325	3.92	0.98	I agree.
25	325	4.39	0.69	I agree.	31	325	3.89	1.00	I agree.
16*	325	4.35	0.73	I agree.	29*	325	3.84	1.02	I agree.

*Refers to negative substances.

Table 9 shows the distribution of pre-service teachers' responses to the scale items in detail. The mean scores for all items ranged from 3.84 to 4.78. This result shows that the participants exhibit positive attitudes and have an elevated level of readiness. All the items fall in the "Agree" or "Strongly Agree" range. It is noteworthy that the items numbered 3, 18, 30 and 2-*"I know the ways to integrate artificial intelligence applications into my lesson plan", "I am confident in integrating artificial intelligence into the teaching process", "I believe that artificial intelligence supported activities can increase student participation in the lesson" and "I can benefit from artificial intelligence supported tools while designing instruction*"-have arithmetic means above 4.68, respectively. The elevated levels of agreement with these items indicate that the pre-service teachers felt quite ready for the artificial intelligence-supported instructional design processes.

On the other hand, even items 29 and 31, which have lower means, have positive values of 3.84 and 3.89. These items include the statements *"I find it difficult to integrate AI technologies into classroom management processes"* and *"Planning instruction based on AI is a complex process for me"* respectively. This may suggest

that some pre-service teachers feel certain difficulties in the classroom integration and planning processes of AI technologies. These findings support the fact that there is a significant integrity among the items of the scale and that the participants show a positive tendency in general.

6. Discussion, Conclusion and Recommendations

In this study, the scale developed to measure the readiness levels of pre-service teachers towards artificial intelligence-supported instructional design revealed a four-factor structure: Cognitive Readiness, Affective Readiness, Technological Integration Competence and Perceived Confidence. Exploratory and confirmatory factor analyses revealed that this construction was valid and dependable. This finding reveals that pre-service teachers have a multidimensional competence structure for incorporating artificial intelligence into pedagogical processes.

When the factor structure of the scale was examined, it was seen that the highest internal consistency coefficient belonged to the "Technological Integration Competence" dimension. This shows that pre-service teachers are more confident in recognizing and applying artificial intelligence technologies technically. Gülbahar and Kalelioğlu (2023) also revealed that pre- service teachers have high technological orientation towards artificial intelligence applications.

Similarly, in Beden and Keleş's (2023) study, it was emphasized that pre-service teachers had positive perceptions about their ability to use artificial intelligence-based teaching materials. Another noteworthy finding of the study is that lower averages were observed in some areas of the "Perceived Trust" dimension. This result suggests that pre-service teachers have certain reservations about fully trusting artificial intelligence in the pedagogical context. In the qualitative study conducted by Ulaş and Ayhan (2023), it was observed that pre-service teachers stated that they had technical competencies in integrating artificial intelligence into educational environments, but they had concerns about the process. Especially in processes such as student follow-up, evaluation and guidance, the effect of artificial intelligence on decision-making mechanisms is carefully questioned by pre-service teachers (Kayaduman, 2022).

When the responses to the scale items were analyzed, it was observed that the participants generally gave responses at the "agree" and "strongly agree" levels, that is, their readiness levels were quite high. This finding coincides with the study of Toprakçı and Yücel (2023). In this study, it was revealed that there was a significant relationship between pre-service teachers' artificial intelligence literacy and instructional design competencies. Similarly, the results of our study show that readiness for pedagogical technology integration is integrated not only with technical knowledge but also with pedagogical consciousness.

Other studies in literature also support this situation. For example, Zawacki-Richter et al. (2019) emphasize that increasing teachers' awareness of artificial intelligence applications directly affects the quality of implementation. Lee, Kim, and Park (2021) stated that for pre-service teachers to use artificial intelligence-supported teaching tools effectively, their pedagogical awareness of these technologies should be developed first.

Based on the findings of this study, the following recommendations can be made:

- Artificial intelligence-supported instructional design topics should be included more in teacher education programs, and applied content should be increased to improve the cognitive and affective competencies of candidates.
- Seminars and case studies on the ethical use of artificial intelligence tools, data security and decision-making processes should be offered to pre-service teachers to reduce the reservations that emerged especially in the "Perceived Trust" dimension.
- Elective or compulsory courses on artificial intelligence literacy should be opened in faculties of education, and these courses should be structured in a way that emphasizes practice rather than theoretical knowledge.
- It is recommended to repeat the validity and reliability analyses by applying the scale in different

teacher groups (e.g., science, social sciences) and different universities. Thus, the generalizability of the scale can be established on a more solid basis.

- The developed scale can be used as a needs analysis tool in both pre-service teacher education and in-service professional development programs.
- In future studies, more holistic results can be obtained by establishing a relationship between the scale and pre-service teachers' academic achievement, technology acceptance levels or instructional design performances.

In conclusion, the scale developed in this study provides a comprehensive assessment of pre- service teachers' readiness levels for artificial intelligence-supported instructional design with its cognitive, effective, technological, and self-efficacy-based components. The data obtained show that the scale exhibits a strong psychometric structure and can be used in scientific research and applications in terms of validity and reliability. This may contribute to a more systematic consideration of artificial intelligence-oriented pedagogical competencies in teacher training processes. In addition, using the scale, needs analyses of pre-service teachers can be conducted more objectively, and thus, it can serve as a guiding data source for policy makers in strategic areas such as curriculum development, curriculum update and in-service training. The research offers meaningful contributions not only in terms of individual competencies but also in terms of planning sustainable digital transformation strategies at the system level.

Funding: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics Approval: Not applicable.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 32-36
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.228

Rehearsal Musical Sound and Hearing Health: The Case of Church Instrumentalists

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Abstract
Background: Musicians are at risk for noise-induced heearing loss (NIHL) due to their repeated exposure to loud sound levels without hearing protection. However, limited literature exists regarding the hearing health of student musicians in Ghana. Objective: This study assessed hearing thresholds and sound exposure levels during rehearsals of University of Education, Winneba (UEW) church instumentalists (music students) and compared them with age-matched non-music peers. Methods: A cross-sectional descriptive survey was employed involving twenty participants aged 18 to 25 years, comprising 10 students who did not play music and another 10 music students took part. A structured questionnaire (case history), an AD 27 diagnostic audiometer for pure tone hearing thresholds, a Madsen tympanometer for middle ear status, and a Kamplex KM-2 Mini sound level meter for rehearsal sound assessment were used to gather data. Results: Average rehearsal sound levels among music students ranged from 93–103 dBA with peaks up to 110 dBA. Four music students exhibited notches at 6000 Hz (≥25 dB HL), indicative of early NIHL, while none of the controls did. Tympanometry results were normal for all. Conclusion: Early indicators of NIHL are seen in church instrumentalists who are subjected to high sound levels. There is the need for preventive hearing conservation programmes in Ghanaian music training environments.

Keywords: Noise-Induced Hearing Loss, Music Students, Sound Exposure, Audiometry

1. Introduction

Noise is an inescapable companent of contemporary life, and prolong exposure to high sound levels, including music, can lead to noise-induced hearing loss (NIHL) (Auchter & Le Prell, 2014; Comeau et al., 2018; World Health Organization, 2021, 2022). For the musician, exposure to loud sounds/noise is a constant aspect of their working environment, often occurring for several hours, which places them at particular risk of developing NIHL (Auchter & Le Prell, 2014; Comeau et al., 2018). Accordingly, NIHL is widely recognized as an occupational health hazard for the performing arts.

International research suggests that pre-professional music students are frequently exposed to elevated sound levels during rehearsals, performance practice, and ensemble performance sessions, sometimes exceeding

occupational safety benchmarks (Auchter & Le Prell, 2014; Phillips et al., 2010). Such consistent exposure can have detrimental effects on their hearing health, including hearing loss.

Several studies conducted in Europe and North America report that pre-professional music students often experience sound exposure levels exceeding occupational safety limits, with approximately 33–52% showing audiometric signatures consistent with NIHL - particularly a characteristic notch around 6000 Hz (Auchter & Le Prell, 2014; Barton, 2021; Chesky, 2011; Comeau et al., 2018; Cook-Cunningham et al., 2012; Farmer et al., 2014; Firle & Richter, 2025; Phillips et al., 2010; World Health Organization, 2022). These findings underscore the need to quantify rehearsal exposure and monitor early auditory changes in training contexts.

Despite these international findings, empirical research on the rehearsal sound exposure and hearing health among student musicians in Ghana remains sparse. As music education becomes more increasingly prominent in universities and churches, this lack of evidence poses a risk to the long-term hearing health of young musicians.

In Winneba and similar urban Ghanaian settings, university music students often serve as instrumentalists in both Pentecostal/Charismatic and mainline churches. Typically, rehearsals are held in multipurpose halls or sanctuaries with minimal acoustic treatment, and reflective surfaces like tiles, concrete, or glass. Typical instrumentation includes drum, electric bass, and guitars via amplifiers, digital keyboards, brass/woodwinds, and a public-address system with wedge or in-ear monitoring. Schedules cluster around mid-week and weekend services (roughly 2 - 4 sessions per week, 90 - 180 minutes per session), with close spacing between players and speaker stacks. Regular sound-level monitoring and the usage of hearing protection devices are rare in church settings. Exposure heterogeneity by instrument and on-stage position is shaped by these contextual characteristics, which presumably increase rehearsal sound exposure levels.

This study examines the exposure to rehearsal sounds and hearing status of church instrumentalists who are University of Education, Winneba (UEW) music students compared to their age-matched non-music peers. The study examines potential factors such years of playing, instrument family, rehearsal-room features, proximity to loudspeakers, and use of hearing protection in addition to comparing exposure to recognised occupational benchmarks (time-weighted averages and peak criteria).

2. Methods

The study adopted a descriptive cross-sectional design to investigate the hearing sensitivity and noise exposure levels of student church instrumentalists compared with age-matched non-music peers at the UEW, which included twenty (20) undergraduate students aged 18 and 25 years. Participants comprised of ten (10) Level 200 music students (music group) who serve as instrumentalists in various campus-based churches (percussion, string, and wind instruments) and ten (10) age-matched non-music students from other departments who were not engaged in regular musical activities. To be included in the study, participants for the music group must be student church instrumentalists, should have no self-reported history of chronic ear infection or diagnosed hearing loss and be willing to participate and sign an informed consent with the purpose and procedures explained. The study was conducted at the Centre for Hearing and Speech Service (CHSS), and selected rehearsal rooms used by the music departments at UEW, Winneba. Audiometric and tympanometric assessments were performed on each participant in a soundproof room at the CHSS to establish participants' hearing sensitivity, while sound level measurements were taken in participants' rehearsal environments.

A case history form from CHSS was used to collect data on participants' demographics, musical background, noise exposure history, and self-reported auditory symptoms. Real-time sound pressure levels (SPLs) during 60-minute rehearsal sessions were measured using a Kamplex KM-2 Mini sound level meter. Pure-tone hearing thresholds were obtained with an AD 27 diagnostic audiometer fitted with TDH-39 supra-aural headphones, while a Madsen tympanometer was used to assess middle ear function and rule out pathology prior to audiometric testing.

Prior to data collection, all participants underwent an otoscopic examination to screen for and rule out any external ear canal obstruction or pathology. Following this initial screening, participants completed the case history form

under the supervision of the researcher to ensure accuracy and completeness of responses. This questionnaire gathered information on demographic characteristics, musical background, history of noise exposure, and self-reported auditory symptoms such as tinnitus or temporary threshold shifts. For music participants, sound level measurements were then conducted during their typical rehearsal sessions using a Kamplex KM-2 Mini sound level meter, with continuous recordings taken over a 60-minute period to capture both average equivalent continuous sound levels (Leq) and peak maximum levels (Lmax).

After a rest period of approximately 12 hours following their last rehearsal, pure-tone audiometric assessments were conducted in a sound-treated booth using an AD 27 diagnostic audiometer with TDH-39 supra-aural headphones, employing the modified Hughson-Westlake method (10 dB down, 5 dB up) to establish hearing thresholds at octave and inter-octave frequencies of 250, 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz. Finally, tympanometry was performed using a Madsen tympanometer to evaluate the condition of the middle ear system and confirm normal middle ear function, indicated by Type A tympanograms, before interpreting the audiometric results.

3. Results

The demographic data show that both groups were well-matched in age (mean 20.6 years for music students and 20.2 years for non-music controls) and gender distribution (8 males and 2 females in the music group; 6 males and 4 females in the control group), ensuring comparability between the groups and reducing confounding due to age or sex (Table 1).

Table 1: Participant's demographics

Group	N	Mean Age (years)	Male	Female
Music students	10	20.6	8	2
Non-music controls	10	20.2	6	4

Rehearsal sound level measurements revealed that the music students were exposed to **very high sound pressure levels (SPLs),** with average levels ranging from **93 to 103 dBA** and **peak levels up to 110 dBA.** The calculated mean average SPL was **97.9 dBA (SD ±3.7),** well above the recommended safe exposure limit of 85 dBA for an 8-hour workday (Table 2). The longest daily exposure durations were recorded among percussion (180 minutes) and wind instrument players (up to 150 minutes), indicating prolonged and potentially hazardous noise exposure patterns.

Table 2: Rehearsal time for participants

Participant	Instrument	Avg SPL (dBA)	Peak SPL (dBA)	Duration (mins/day)
M1	Drums (Percussion)	101	108	180
M2	Bass Guitar (Strings)	97	104	150
M3	Electric Guitar (Strings)	95	100	120
M4	Keyboard	93	98	90
M5	Trumpet (Wind)	103	110	120
M6	Saxophone (Wind)	100	107	150
M7	Drums	102	109	180
M8	Acoustic Guitar	94	98	90
M9	Keyboard	93	96	120
M10	Drums (Percussion)	101	106	150

Mean average SPL: 97.9 dBA (SD ±3.7)
Peak SPL range: 96–110 dBA

Audiometric findings showed that music students had **elevated thresholds at higher frequencies,** particularly at **6000 Hz, where the average was 28 dB HL** compared to **14 dB HL in controls (Table 3)**. Notably, **four of the ten music students demonstrated a noise notch (≥25 dB HL) at 6000 Hz,** a classic early marker of noise-induced hearing loss (NIHL), while none of the control group showed such notches. At other frequencies (1000 - 4000 Hz, 8000 Hz), both groups showed thresholds within the clinically normal range (<25 dB HL), though music students tended to have slightly higher values.

Table 3: Average hearing thresholds of participants across tested frequencies

Group	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Music (avg. dB HL)	14	13	13	14	13	17	28	19
Control (avg dB HL)	11	9	9	10	8	10	8	15

Tympanometry confirmed **normal middle ear status (Type A tympanograms)** across all participants, which rules out conductive pathology as a cause of the elevated high-frequency thresholds. Additionally, **8 out of 10 music students reported experiencing tinnitus following rehearsals,** further suggesting temporary auditory stress, while only 2 of the non-music peers reported occasional loud recreational noise exposure.

4. Discussion

This study assessed hearing thresholds and sound exposure levels during rehearsals of University of Education, Winneba (UEW) church instumentalists (music students) and compared them with age-matched non-music peers. The study provides preliminary evidence that student church instrumentalists at UEW are regularly exposed to hazardous sound levels and already exhibit early audiometric signs consistent with noise-induced hearing loss (NIHL). Average rehearsal levels approached ~98 dBA with peaks up to 110 dBA, far exceeding widely accepted occupational guidelines for safe exposure. These exposure profiles dovetail with international literature documenting elevated risks among pre-professional musicians who rehearse and perform in high-level sound environments as a routine condition of study and work (Auchter & Le Prell, 2014; Firle & Richter, 2025; Kornisch et al., 2023; Phillips et al., 2010). Consistent with those reports, 40% of the instrumentalists in our sample showed a high-frequency notch at 6000 Hz (≥25 dB HL) - a classic early marker of NIHL - whereas none of the age-matched non-music peers demonstrated this pattern (Maas, 2019; Phillips et al., 2010).

The frequency-specific elevation at 6000 Hz in the music group, accompanied by normal tympanograms for all participants, supports a predominantly cochlear (sensorineural) origin rather than middle-ear involvement. This aligns with established mechanisms of NIHL in which outer hair cells in the basal turn of the cochlea are particularly vulnerable to sustained and/or impulsive sound exposure (Farmer et al., 2014; Hawkins, 2013). The high prevalence of post-rehearsal tinnitus among instrumentalists (8/10) further suggests temporary auditory stress and is concordant with prior studies that identify tinnitus as an early warning sign of excessive exposure among young musicians (Comeau et al., 2018; Firle & Richter, 2025; Phillips et al., 2010). Notably, the instruments associated with the highest average and peak SPLs in our cohort - percussion and brass/wind - mirror patterns observed elsewhere, where percussionists and brass players often experience the greatest on-stage exposure due to instrument directivity and proximity (Chasin Marshall, 2010; Maas, 2019).

Although mean thresholds for most test frequencies remained within the clinically “normal” range (<25 dB HL), between-group differences at the higher frequencies (particularly 6000 Hz) underline the importance of including inter-octave testing (3000 and 6000 Hz) in screening protocols for music populations. These data also reinforce the point that “normal” audiograms can mask emerging, exposure-related changes in the high frequencies among young adults who are early in their training trajectories. In the Ghanaian context - where formal hearing conservation practices within tertiary music and church settings are not yet routine - the findings fill an important evidence gap and underscore the urgency of structured prevention efforts.

The study's practical implications imply that hearing conservation measures ought to be incorporated into music programmes. Environmental measures like sound treatment in the rehearsal room and ensemble spacing, education on safe listening techniques and the dangers of cumulative noise exposure, regular access to flat-attenuation musician earplugs, and planned audiologic monitoring to identify early changes are a few examples. International research involving student musicians has suggested that normalising protective behaviours can be achieved by incorporating these measures into ensemble policies and curricula (Phillips et al., 2010).

Author Contributions: All authors contributed to this research.

Funding: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics Approval: Not applicable.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 37-49
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.229

Continuing Professional Development and Lifelong Learning among Greek German Language Teachers: Barriers and Experiences

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Abstract
This study explores the factors influencing participation in professional development and the elements contributing to teachers' professional satisfaction. Semi-structured interviews with eleven educators examined barriers such as time constraints, workload, program relevance, and quality of instruction, alongside factors enhancing engagement and professional growth. Findings indicate that limited time and competing responsibilities are major obstacles, while satisfaction depends on the trainer's quality, clarity and applicability of materials, and alignment with teachers' professional needs. The study underscores the importance of accessible, practice-oriented professional development that strengthens instructional competence and professional efficacy, and highlights policy measures to support effective participation.

Keywords: Professional Development, Lifelong Learning, Training Programmes, German Language Teachers

1. Introduction

In recent years, the teaching profession has undergone profound transformations due to the rapid integration of digital technologies, growing classroom diversity, and heightened socio-emotional demands placed on educators. Foreign language (FL) teachers, in particular, operate in increasingly complex environments where they must simultaneously foster linguistic competence, intercultural awareness, and learner autonomy (OECD, 2023; European Commission/Eurydice, 2021). This evolving landscape underscores the urgent need for targeted, flexible, and evidence-based professional development (PD) programs that reflect teachers' real-world challenges and instructional contexts (Richter & Richter, 2024; Huang et al., 2024).

Despite widespread recognition of CPD as a cornerstone for educational quality, teachers' participation is often limited. Engagement depends on a complex interplay of structural, organizational, and psychosocial factors, which may affect both access to professional learning and the effectiveness of training programs (Afshar & Ghasemi, 2020; Zhang et al., 2021; OECD, 2023). Foreign language educators, in particular, face context-specific challenges related to subject-specific pedagogy, alignment with institutional requirements, and technological constraints, making tailored, relevant, and sustainable professional development essential (Nguyen et al., 2022; Scherer & Rolka, 2024; Huang et al., 2024).

Despite the availability of CPD programs, there remains a lack of context-specific research on the needs of FL teachers in Greece, where institutional constraints, curriculum expectations, and limited resources shape access to professional learning opportunities. This study addresses this gap by presenting a qualitative investigation of Greek secondary school teachers of German. The research aims to explore two central questions: which factors influence teachers' participation in professional development programs, and how teachers evaluate program quality in relation to professional satisfaction and growth. Through this lens, the study seeks to inform the design of effective CPD initiatives that are responsive to the practical, professional, and contextual needs of FL educators.

2. The Teaching of German in the Greek Educational System: Structural Features and Pedagogical Challenges

The teaching of German within the Greek school system presents a series of structural, pedagogical, and policy-related challenges that shape both instructional practice and learning outcomes. As a non-compulsory subject, German occupies a secondary role in the foreign language curriculum, offered primarily as a second foreign language from the fifth grade of primary school or, in some cases, from the third grade of lower secondary school. This optional status directly influences students' participation, class size, and continuity of study across educational levels (ECML, 2022). In contrast to English—widely perceived as a prerequisite for academic and professional advancement—German is often selected based on external influences, such as parental preference or peer choice, rather than intrinsic motivation or long-term educational planning (Dosi & Papadopoulou, 2019).

Class composition varies considerably across regions and school types. In urban centers, German language classes typically include between 12 and 20 students, while in rural or island schools the number may drop to as few as six learners. Although smaller class sizes can allow for more personalized teaching, they also restrict the range of communicative and group-based activities, limiting opportunities for authentic language interaction (Gerovasileiou, 2022). Moreover, classes with persistently low enrollment are at risk of cancellation, creating instability in language provision and affecting teachers' employment continuity.

The timetable allocated to German is equally restrictive: two hours per week in primary school—often delivered in a block format—and one to two hours per week in lower and upper secondary education. Such minimal exposure constrains communicative competence development, particularly in oral production and interaction (ECML, 2022). The situation is compounded by the late and often disorganized process of course selection. Since the choice of the second foreign language is typically made after other registration procedures or extracurricular commitments, the planning of German classes is delayed, resulting in uncertainty about staffing, scheduling, and resource allocation. Teachers frequently learn of their placements shortly before the school year begins, leaving little time for pedagogical preparation.

An additional complexity concerns the sociolinguistic diversity of Greek classrooms. Many schools, particularly in regions such as Thessaly and Central Macedonia, host a significant number of students from multilingual or migrant backgrounds. In some cases, 35–40% of students report a first language other than Greek, creating a heterogeneous linguistic environment that both challenges and enriches the learning process (Liakou, 2023). This context underscores the need for plurilingual and intercultural pedagogical approaches that leverage learners' existing linguistic repertoires as a resource rather than a constraint (Dosi & Papadopoulou, 2019; Liakou, 2023). Implementing such approaches requires targeted professional development and institutional support, areas that remain underdeveloped in Greece.

Teachers of German face a demanding teaching landscape that requires them to combine digital literacy, differentiated instruction, and intercultural awareness. Core areas of competence include the management of small and mixed-ability groups, integration of digital media into classroom practice, communicative methodology, alignment with the Common European Framework of Reference for Languages (CEFR), and adaptation to plurilingual contexts (Gerovasileiou, 2022; Katerini, 2023). Despite the recognized need for these skills, systematic professional development opportunities remain limited. Existing programs are often voluntary, fragmented, or insufficiently aligned with classroom realities. In-service training rarely addresses the integration of certification frameworks such as the Goethe-Zertifikat or the effective use of digital pedagogical tools.

Evidence from international contexts indicates that sustained, collaborative professional learning—particularly through mentoring, peer observation, and blended digital modules—can substantially improve teaching quality and adaptability (OECD, 2019b). However, Greece has yet to incorporate such structures into the professional trajectory of foreign language teachers in a consistent manner. This gap affects not only teacher competence but also the long-term viability of the German language in public education.

From a European perspective, the position of German in Greece is comparatively weak. According to Eurostat (2024), German is the third most widely studied foreign language in upper secondary education across the EU, with approximately 21% of students enrolled, following English (96%) and Spanish (27.1%). In Greece, by contrast, fewer than 1% of upper secondary students study two foreign languages, resulting in very limited exposure to German at advanced levels. This discrepancy reflects broader systemic and policy-level challenges rather than a lack of interest in the language itself.

Overall, the teaching of German in the Greek educational system is shaped by a combination of structural and institutional constraints: the optional nature of the subject, small and unstable class sizes, limited instructional time, late student selection, sociolinguistic heterogeneity, insufficient teacher training, and the absence of a coherent national language policy. Yet these challenges also reveal potential pathways for reform. Strengthening the presence of German in Greek schools requires a comprehensive policy framework that integrates curriculum redesign, systematic professional development, plurilingual pedagogical models, and closer collaboration with institutions such as the Goethe-Institut, the Institute of Educational Policy, and national teachers' associations.

A reoriented approach that embeds German language education within the broader goals of multilingual competence, digital pedagogy, and intercultural awareness could significantly enhance its relevance and sustainability. In this sense, the future of German in Greece depends not solely on student choice or individual teacher initiative but on strategic educational planning that recognizes linguistic diversity as a fundamental resource for modern European citizenship.

3. Barriers and Challenges in Teacher Participation in Professional Development Programs

Continuing Professional Development (CPD) is widely recognized as a cornerstone for ensuring quality in education. Systematic professional learning allows teachers to update pedagogical knowledge, adopt innovative instructional methods, adapt to technological and social changes, and enhance student learning outcomes (European Commission/Eurydice, 2021; OECD, 2023). Despite this broad consensus, teachers' actual engagement with CPD remains constrained by a complex interplay of structural, organizational, and psychosocial barriers, which often undermine both participation and impact.

Building on the understanding of structural constraints in German language teaching, this section examines the general challenges that hinder teacher engagement in professional development and then addresses the specific difficulties faced by foreign language educators, highlighting the implications for classroom practice and student learning.

3. 1. General Barriers for Teachers

Despite the recognized importance of Continuous Professional Development (CPD) in enhancing teaching quality and student outcomes, numerous factors continue to impede teachers' active participation and long-term engagement. These barriers are multifaceted—ranging from structural and financial limitations to psychological and institutional challenges—and collectively shape the effectiveness and accessibility of professional learning opportunities.

3.1.1. Time and Workload Constraints

Time scarcity remains the most frequently cited barrier to teacher participation in CPD. Teachers must navigate demanding responsibilities, including lesson planning, instruction, grading, administrative duties, and parental engagement. Additional commitments for CPD can intensify workloads, leading to stress, fatigue, and decreased motivation (Zhang et al., 2021). The Teachers in Europe report indicates that time pressure is a major deterrent, affecting both initial involvement and sustained engagement in professional learning initiatives (European Commission/Eurydice, 2021). In practice, this often results in superficial participation, where teachers attend sessions without being able to meaningfully integrate new skills into classroom instruction.

3.1.2. Financial Constraints

The cost of participation—including tuition fees, travel expenses, and materials—represents a significant barrier, especially in contexts where teachers' salaries are limited (OECD, 2023). The absence of funding or subsidy mechanisms exacerbates inequality, creating disparities between teachers who can afford CPD and those who cannot (Huang et al., 2024). Financial limitations also influence engagement quality, as teachers may choose lower-cost programs that do not adequately address their instructional needs.

3.1.3. Relevance and Quality of CPD Content

Teachers are more likely to engage in CPD programs that are perceived as practically relevant and directly applicable to classroom practice. Programs focused predominantly on theory or general pedagogy, without connection to real teaching contexts, hinder the translation of learning into classroom innovation (Nguyen et al., 2022). OECD (2019 a) emphasizes that the lack of reflective practice, feedback, and post-training support reduces effectiveness, leaving professional learning fragmented and underutilized. Programs with explicit practical focus, follow-up support, and mentoring are more likely to foster substantial pedagogical change.

3.1.4. Institutional and Organizational Barriers

School leadership and institutional culture are critical determinants of CPD success. In schools where administrators do not actively support professional development or allocate resources for participation, teacher engagement is limited (Scherer & Rolka, 2024). Across EU member states, variations in accessibility, quality, and continuity of CPD persist despite formal policy provisions (European Commission/Eurydice, 2021). Furthermore, the lack of structured integration of professional learning into daily practice reduces teachers' capacity to implement new instructional methods.

3.1.5. Technological Barriers

The shift toward digital and blended CPD has highlighted inequities in access to technology. Teachers in rural or under-resourced areas frequently lack sufficient equipment, reliable internet, and technical support, limiting their ability to participate effectively (Huang et al., 2024). Digital competence, including proficiency with online tools and platforms, has emerged as a crucial factor influencing the success of professional learning initiatives.

3.1.6. Psychosocial Factors

Teachers' motivation to participate in CPD is influenced by psychosocial factors such as perceived value, self-efficacy, and professional drive. When teachers perceive CPD as unlikely to result in meaningful change, or

experience burnout, participation decreases (Afshar & Ghasemi, 2020). Broader societal recognition also affects engagement; only 26% of teachers surveyed in TALIS 2018 reported feeling social appreciation for their work (OECD, 2020). Supportive professional communities and recognition of effort are associated with higher motivation and sustained engagement.

3.2. Barriers Specific to Foreign Language Teachers

Foreign language (FL) educators encounter all general barriers while facing additional challenges linked to the nature of their subject. Effective language instruction relies heavily on CPD and institutional support; deficiencies in these areas impede the implementation of communicative, task-based, and innovative approaches.

3.2.1. Lack of Specialized Training

Teaching languages requires particular pedagogical expertise, including facilitating oral communication, differentiating instruction in heterogeneous classrooms, and integrating authentic materials (Nguyen et al., 2022). Standard CPD often emphasizes general pedagogical theory without addressing language-specific challenges. This reduces teachers' confidence and capacity to apply innovative strategies, limits student learning opportunities, and fosters a sense of professional isolation in the absence of peer networks or communities of practice.

3.2.2. Misalignment with Institutional Requirements

National curricula and assessment frameworks frequently prioritize grammar and formal written skills over communicative or integrative approaches (Afshar & Ghasemi, 2020). Teachers face a tension between implementing modern, communicative methods and adhering to formal institutional expectations. Frequent changes in exam requirements, without adequate guidance, amplify uncertainty and discourage engagement in professional learning.

3.2.3. Technology-Specific Challenges in Language Teaching

Effective use of digital tools for language learning, such as Computer-Assisted Language Learning (CALL) software, requires specialized infrastructure and training (Huang et al., 2024). Lack of access to appropriate software, hardware, or technical support reduces instructional quality, limits communicative activity in class, and increases teacher workload and fatigue.

3.2.4. Lack of Continuity and Supportive Structures

Fragmented, short-term CPD programs hinder sustainable integration of new teaching methods (Nguyen et al., 2022). Absence of mentoring, coaching, or structured peer collaboration means teachers often do not receive the feedback necessary to apply new skills effectively. This limitation perpetuates traditional teaching patterns, reduces motivation for future participation, and constrains educational innovation.

3.2.5. Motivation and Professional Recognition

CPD not linked to tangible career or financial benefits is often perceived as an additional burden (Scherer & Rolka, 2024). Limited promotion opportunities and low societal recognition of foreign language teachers contribute to professional undervaluation, reducing motivation to participate and adopt innovative practices. This has direct implications for the quality of language instruction and students' preparedness for intercultural and international communication contexts.

4. Method

This section presents the research methodology.

4.1 Research question

Our research questions were: a) "Which factors influence German language teachers' participation in professional development programs, according to the sample's views?" and b) "What factors shape teachers' satisfaction with professional development programs, according to the sample's views?"

4.2 Research Method -Research Tool

The data collection method was qualitative, because the purpose of the research is to investigate and understand a central theme (Creswell, 2011). The research strategy followed is a case study (Robson, 2010), since it concerns 11 German language teachers during the school year 2024-2025. According to Mason (2003), the data collection technique or better the data production technique was the semi-structured interview, a tool that enables the sequence of questions to be modified (Cohen & Manion, 1994), the choice of emphasis in the most essential aspects of each respondent (Fylan, 2005; Robson, 2010), but requires critical communication skills from the interviewer (Galletta, 2013). Therefore, this tool has been chosen as the most appropriate to highlight the views of the participants.

4.3 Sample

The sample (convenience sampling) consists of 11 German language teachers. Among them, 9 are women and 2 are men. In terms of age group, 4 are between 51 and 60 years old, 4 are between 41 and 50 years old, and 2 are over 60 years old. Regarding teaching experience, it ranges from 10 to 36 years, with most teachers having over 20 years of experience in the field of education. As for their educational background, 6 teachers hold a university degree (Bachelor's), while 5 also possess a Master's degree. Undoubtedly, the participants in this survey do not represent the entire population of German language teachers in Greece, and consequently, the research results are not generalizable.

4.4 Data analysis method

For the analysis of the collected data, content analysis was used. This is a research method that employs a set of procedures, methods, and techniques to draw valid conclusions (Weber, 1990, p. 9). It is a research technique that systematically and objectively leads the researcher to verifiable and valid conclusions derived from written texts and the decoding of interviews (Krippendorf, 1989, p. 7-9). Furthermore, the thematic content analysis allows quantification of the results (Trowler, 1996; Vamvoukas, 2002), which was attempted in this research.

5. Results and Discussion

This section presents the results of the research.

5.1. Factors Affecting Participation in Professional Development

The analysis of the data reveals several key factors that influence teachers' engagement in professional development programs. Responses indicate a multifaceted set of barriers, encompassing issues of time availability, accessibility, program quality, interactivity, and the delivery format of the programs. While some participants reported encountering no significant obstacles, the majority highlighted that professional development participation is often constrained by both structural and personal limitations, reflecting the diverse experiences of educators.

5.1.1. Time Constraints as a Primary Barrier

The most consistently reported factor was the lack of available time. Participants described the demands of their professional and personal lives as leaving minimal room for meaningful engagement in professional development. As one teacher remarked, *"My main difficulty is that I do not have the necessary time to consistently attend a*

professional development program" (E1), while another noted, *"Limited time, especially in the afternoon when other responsibilities exist, makes participation challenging"* (E2). Several participants emphasized the combined impact of time constraints and program scheduling: *"Difficulties in access, the location of the program, and the time required to participate meaningfully hinder my engagement"* (E3), and *"Programs are long and take place during periods of high workload, making participation practically challenging"* (E6). Another participant highlighted the interaction between motivation and time pressure, stating, *"Apart from the lack of time, I often feel a lack of motivation to invest the limited time I have"* (E9). These reflections indicate that daily professional responsibilities and personal commitments leave little room for sustained participation in professional development.

5.2.2. Practical and Logistical Challenges

In addition to time constraints, teachers identified practical barriers related to the organization and accessibility of programs. One participant observed, *"There is difficulty in access due to the location, as well as the significant time required to attend"* (E3), while another emphasized that *"Programs are lengthy and scheduled during periods of intense workload, making them practically inaccessible"* (E6). Such issues underscore the importance of program design and scheduling that align with teachers' realistic capacities.

5.2.3. Program Quality and Interactivity

The quality of professional development programs emerged as a crucial factor. Participants noted that insufficiently engaging presentations and limited trainer expertise can hinder active participation. For instance, *"The trainer's inadequacy and the presentations that were not sufficiently engaging prevented me from participating actively"* (E4), and *"I find it difficult to ask questions or raise doubts, which prevents me from engaging fully"* (E11). Moreover, the mode of program delivery influenced perceptions of engagement. While online programs offered flexibility, participants described them *as "impersonal and limited in terms of interaction with the trainer and colleagues"* (E7), highlighting the need for greater interactivity and collaborative learning opportunities in digital formats.

5.2.4. Variability in Experiences

Interestingly, a subset of participants reported encountering no significant obstacles. As one participant remarked, *"I do not have anything specific to mention, as personally I have not encountered major obstacles"* (E5), while another noted, *"I have not faced any difficulties so far, and my experience has been positive"* (E8). These accounts demonstrate that teachers' experiences of professional development are heterogeneous and are influenced both by individual circumstances and the structural organization of the programs.

In summary, the findings indicate that participation in professional development is shaped by a complex interplay of factors. The lack of available time emerged as the most significant barrier, compounded by logistical constraints, program quality, and the format of delivery. At the same time, the positive experiences reported by some participants suggest that well-organized programs, attentive to teachers' needs and contextual realities, can facilitate meaningful engagement. These results underscore the importance of tailoring professional development programs to the practical realities of teachers' schedules, providing opportunities for interactive and collaborative learning, and ensuring high-quality instruction and support. Such considerations are essential for fostering sustained participation and enhancing the impact of professional development on teaching practice and student outcomes.

5.2. Teacher Persistence and Considerations of Dropping Out from Professional Development Programs

The second part of the results explores teachers' experiences and attitudes regarding the possibility of discontinuing professional development programs. The responses indicate a spectrum of perspectives, ranging from consistent program completion to contemplation of withdrawal, highlighting factors that influence persistence and attrition in professional learning contexts.

5.2.1. Commitment to Completion

The majority of participants emphasized that they have never abandoned a professional development program. For example, several teachers stated, *"I have never dropped out of any professional development program"* (E1), *"No, it has never happened that I abandoned a professional development program"* (E3), and *"No, I have not had the chance to leave any program"* (E7). Similarly, others remarked, *"Despite the difficulties, I have never left a professional development program"* (E6) and *"No, I have never abandoned any program"* (E11). These statements collectively reflect a strong sense of professional responsibility and dedication to continuous learning, suggesting that most teachers perceive completion as a key component of their professional role.

5.2.2. Contemplation of Withdrawal

Although actual dropouts were uncommon, several participants admitted to having considered leaving a program at certain points. For instance, one teacher noted, *"I have never abandoned a program, although there were moments when I seriously considered it"* (E2), while another explained, "*No, I did not abandon, although there was one occasion when I felt strong dissatisfaction because the presentation was unsatisfactory and there was no connection between theory and practice"* (E8). These reflections indicate that contemplation of withdrawal can arise from perceived misalignment between the program content and classroom realities.

In other cases, participants highlighted low content quality as a motivating factor for considering discontinuation. For example, *"I have thought about abandoning a professional development program because I found it particularly boring and uninteresting"* (E9). Additionally, some participants reported that external pressures, such as competing professional and personal responsibilities, contributed to thoughts of withdrawal*: "I have not abandoned any program to date, but there were many moments when I felt excessively pressured by the demands of certain seminars, combined with morning work and family obligations" (*E10). Collectively, these accounts suggest that even without actual dropout, teachers experience tension when programs fail to engage them meaningfully or when participation imposes significant logistical or emotional burdens.

5.2.3. Actual Dropout Experiences

A limited number of participants reported having abandoned a program. One participant explained, *"There was an occasion when I dropped out because the suggestions presented seemed impractical and completely unrealistic"* (E4). In another case, family responsibilities were the primary constraint: *"I decided to leave because the program was held outside working hours, and I could not meet my family obligations, particularly due to my children"* (E5). These testimonies highlight that dropout is associated with either the perceived irrelevance of program content or the practical impossibility of reconciling professional and familial duties, underscoring the importance of program design that considers both relevance and feasibility.

Overall, the data suggest that most teachers strive to complete professional development programs, even under challenging circumstances. Nonetheless, the contemplation of withdrawal frequently arises when programs are perceived as disengaging, overly theoretical, or practically unhelpful, or when participants face high external pressures. The limited incidence of actual dropout points to the critical role of program organization and targeted content: professional development is more likely to be successfully completed when it is relevant, engaging, and sensitive to teachers' professional and personal constraints.

The findings indicate that administrators and program designers should prioritize content quality, applicability, and scheduling flexibility, alongside mechanisms to support teacher motivation and reduce perceived burden. Such strategies can mitigate the risk of attrition, enhance teacher engagement, and ultimately strengthen the impact of professional development on teaching practice and student learning outcomes.

5. 3. Factors Potentially Leading to Dropout from Professional Development Programs

The third part of the results examines participants' perceptions regarding factors that could potentially lead to the discontinuation of professional development programs. Responses reveal multifaceted concerns, primarily related to the instructor's effectiveness, the relevance and clarity of materials, and the overall organization of the programs. This pattern indicates that teachers' sustained engagement is influenced not only by content topics but also by the quality of the learning experience and the degree of active participation.

5.3.1. The Role of the Instructor

The instructor emerged as a decisive factor in shaping participants' likelihood of completing or abandoning a program. Teachers emphasized that the instructor's communication skills, personality, and pedagogical methodology directly affect engagement and interest. For example, one participant noted, *"The personality, methodology, and competence of the instructor could constitute a decisive factor for dropping out"* (E4), while another remarked, *"If the instructor's teaching style lacks clarity and engagement, I would find it difficult to remain in the program"* (E3). These statements highlight that teachers require not only theoretical guidance but also inspiring, active instruction that facilitates understanding and practical application. Inadequate instruction may generate disengagement, diminishing teachers' sense of professional efficacy and personal growth.

5.3.2. Relevance and Clarity of Materials

Another crucial determinant is the appropriateness and clarity of the learning materials. When materials are vague, impractical, or poorly aligned with classroom realities, teachers' interest diminishes. One participant stated, *"The presence of vague and unclear materials, combined with the absence of a meaningful connection between theory and practice, could lead me to abandon the program"* (E2), while another emphasized, *"If the materials do not address my actual needs as a teacher, I would struggle to stay engaged"* (E3). This underscores that relevant and clearly structured materials are essential not only for cognitive understanding but also for maintaining motivation and a positive psychological stance toward professional development. Materials that are perceived as impractical or disconnected from teaching can evoke frustration and reduce engagement.

5.3.3. Program Organization and Structure

Participants also highlighted the influence of program design and organization on potential dropout. One participant commented*, "Poor program organization, combined with overly theoretical content without practical application and information overload, could lead me to abandon the program"* (E9). Similarly, another noted, *"Boring topics, an ineffective instructor, the lack of meaningful theory-practice connection, and inadequate program organization would all be reasons for dropout"* (E10). These insights suggest that coherent structuring and thoughtful pacing are critical for preventing psychological strain, while excessive theoretical density or insufficient practical opportunities can foster anxiety and a sense of futility.

5.3.4. Connection Between Theory and Practice

The integration of theoretical knowledge with practical classroom application was repeatedly emphasized. Participants reported that when theoretical content could not be applied directly, their sense of purpose and professional efficacy decreased. One participant explained, *"The presentation failed to link theory with practice in a way that meaningfully engaged me in the program"* (E8). This observation reinforces the idea that professional development must ensure practical applicability to sustain engagement and support ongoing professional competence.

5.3.5. Teacher Resilience and Satisfaction

Interestingly, a number of participants reported that no additional factors would lead them to abandon a program, reflecting resilience, satisfaction, and professional commitment. Statements included: *"I do not believe there is any other factor that would lead me to drop out of a professional development program"* (E5), *"I cannot think of any other factor that would make me leave a program" (E6)*, and *"I do not identify any other factors that would*

cause me to discontinue participation" (E7, E11). These accounts suggest that well-designed programs with relevant materials, competent instructors, and practical application can create a supportive environment, fostering sustained participation.

Overall, the responses highlight that the likelihood of dropout is influenced by a complex interplay of factors involving the instructor, materials, program organization, and the integration of theory and practice. Achieving a balanced combination of these elements not only enhances interest and engagement but also strengthens teachers' sense of professional efficacy, reducing anxiety and frustration. Therefore, careful program design that accounts for teachers' real needs and incorporates practical applications is crucial for preventing potential dropout and promoting meaningful professional development.

5. 4. Teacher Satisfaction with Professional Development Programs

The evaluation of professional development programs by participants indicates that teacher satisfaction is shaped by a complex interplay of factors, including the quality of the instructor, the relevance and clarity of the materials, the practical applicability of the suggestions, and the overall structure of the program. Teachers appear to assess not only the content but also the program's capacity to meaningfully support their daily teaching practice, which is closely linked to professional self-confidence and a sense of personal efficacy.

5.4.1. Instructor Quality and Communication

The instructor's competence and communicative effectiveness emerged as a critical determinant of satisfaction. When the instructor possesses expertise, experience, and the ability to convey knowledge clearly, programs are perceived as more engaging and constructive. For instance, one participant remarked, *"On a few occasions, satisfaction was reduced due to insufficient knowledge of the instructor and limited interest of the material"* (E2). This observation underscores that a capable and inspiring instructor enhances perceived professional growth, reduces the risk of frustration, and fosters stronger engagement and commitment to the program.

5.4.2. Material Relevance and Appropriateness

The clarity and practical applicability of program materials also constitute a central axis of satisfaction. Teachers reported higher satisfaction when materials were clear, practical, and aligned with classroom realities, allowing for easier integration of new knowledge into teaching practice. As one participant stated, *"Overall, the programs were quite satisfactory and informative, providing significant support in the teaching process"* (E6). Conversely, materials perceived as overly theoretical or impractical led to diminished satisfaction: *"I was not satisfied because they were too theoretical, and many approaches were impossible to apply"* (E4), and *"Most workshops were interesting and useful, but some were excessively theoretical, and their suggestions were difficult to implement in a public school classroom"* (E10). These accounts highlight the importance of practical relevance and applicability for sustaining engagement and promoting active participation.

5.4.3. Balance of Theory and Practice

Another key factor is the integration of theory and practice. Programs that fail to connect theoretical content with practical classroom application are perceived as less satisfying. One participant observed, "My satisfaction was partial, as some programs did not sufficiently link theory to practical classroom applications, while in others, the presentation was fragmented and limited" (E8). This emphasizes that effective professional development requires not only high-quality content but also methods that transform theory into practical skills, enhancing professional competence and the perceived usefulness of the program.

5.4.4. Program Structure and Time Allocation

The program's structure and the time available for implementation also influenced participant experiences. One teacher noted, *"Most of the time the programs were satisfactory, except in cases where the techniques were*

impractical due to limited class time" (E5). This statement illustrates that even well-designed programs may lose effectiveness if the temporal and practical constraints of the school context are not considered.

5.4.5. Neutral or Moderate Satisfaction

Some participants reported neutral or moderate satisfaction, without identifying major problems or remarkable moments. Statements included*: "Quite satisfactory"* (E3, E7) and *"I did not encounter anything that particularly impressed me"* (E11). These responses suggest that, even in the absence of highly positive experiences, participation is still considered valuable as long as there are no major deficiencies in materials, presentation, or practical applicability. This underscores the importance of consistency and reliability in professional development programs.

Overall, participants' responses indicate that teacher satisfaction is contingent upon instructor quality, material relevance and clarity, the balance of theory and practice, practical applicability, and program structure. Programs that integrate clarity, practical relevance, active engagement, and adaptability to classroom needs enhance professional satisfaction and commitment while reducing the likelihood of dissatisfaction or potential dropout. The findings suggest that the true value of professional development lies not only in content delivery but also in the ability of programs to foster effective knowledge transfer, practical competence, and active engagement among teachers.

6. Conclusions and Recommendations

The study focused on two primary research questions. The first addressed the factors that influence teachers' participation in professional development programs, exploring the conditions, barriers, and difficulties that may facilitate or constrain active engagement. The discussion reveals that time constraints emerge as the most prominent barrier, reflecting the heavy workloads teachers face, including lesson planning, grading, administrative duties, and family obligations. This finding aligns with existing research emphasizing the critical role of time scarcity in limiting both initial involvement and sustained engagement in CPD (European Commission/Eurydice, 2021; Zhang et al., 2021). Financial constraints and accessibility issues were also evident, reinforcing prior studies indicating that insufficient funding or travel challenges disproportionately affect participation and quality of engagement (OECD, 2023; Huang et al., 2024). Furthermore, the perceived relevance, quality, and interactivity of programs, as well as the impersonal nature of online learning, were highlighted as significant factors. Teachers' experiences varied, demonstrating that engagement depends not only on personal circumstances but also on program organization, content clarity, and the pedagogical competence of instructors, consistent with research showing that CPD effectiveness relies on practical applicability, instructor expertise, and supportive structures (Nguyen et al., 2022; Scherer & Rolka, 2024). These findings suggest that professional development initiatives should address both structural and psychosocial barriers, ensuring accessibility, relevance, and active engagement to maximize teacher participation.

The second research question focused on teachers' experiences with professional development, including their perceptions of quality, potential reasons for dropout, and overall satisfaction, aiming to understand the factors associated with professional growth and fulfillment. Analysis indicates that most teachers tend to complete programs despite challenges, highlighting professional responsibility and commitment. However, thoughts of withdrawal were linked to poor content quality, lack of connection between theory and practice, and excessive workload, echoing previous studies on the importance of program relevance and instructor competency in sustaining participation (Nguyen et al., 2022; Afshar & Ghasemi, 2020). The quality and transmissibility of the instructor, the clarity and applicability of materials, the organization of the program, and the practical connection between theory and classroom practice were all decisive in shaping engagement, satisfaction, and professional self-efficacy. High-quality, well-structured programs that provide active, interactive learning and practical applicability foster higher motivation and reduce dropout risk, confirming findings on the interplay of structural, content-related, and psychosocial factors in CPD participation (European Commission/Eurydice, 2021; OECD, 2023).

The findings underscore the need for comprehensive policy measures that enhance teacher participation, reduce the risk of dropout, and increase overall satisfaction with professional development programs. Policies should ensure that dedicated time for CPD is formally integrated into the school timetable, relieving teachers from the pressure of balancing professional obligations with additional learning activities. Financial support mechanisms, such as subsidies or funding for tuition and materials, are also essential to guarantee equitable access to high-quality programs. The design of CPD should prioritize practical applicability, relevance to classroom practice, and clarity of content, particularly addressing subject-specific challenges like foreign language instruction. Equally important is the competence and pedagogical skill of program instructors, supported by mentoring and coaching structures that help teachers implement new strategies effectively. Adequate digital infrastructure and systematic ICT training are necessary to facilitate participation, especially in remote or under-resourced contexts. Linking CPD participation to professional recognition, career progression, or certification can further motivate engagement. Finally, fostering collaborative professional ecosystems, including peer networks, communities of practice, and active school leadership, supports sustained learning, mutual support, and a culture of continuous professional growth. When implemented cohesively, such measures can strengthen teacher engagement, professional satisfaction, and instructional effectiveness, thereby improving educational outcomes and promoting the adoption of innovative pedagogical practices.

Author Contributions: All authors contributed to this research.

Funding: Not applicable

Conflicts of Interest: The authors declare no conflict of interest

Informed Consent Statement/Ethics approval: Not applicable

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025:50-58
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.230

E-Learning as a Field for the Development of Soft Skills in Tourism Education and Training Executives: Evaluating Opportunities and Challenges

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Abstract
The present study aims to explore the perspectives of tourism education and training professionals regarding the development of soft skills in e-learning environments. Specifically, it seeks to examine their views on the possession of soft skills, the concept of e-learning, the potential for developing soft skills in e-learning settings, and the usefulness of acquiring these skills in the context of their professional work. The study sample consisted of ten tourism education and training professionals, employed either as instructors or holding senior administrative positions in the tourism sector. Data were collected through semi-structured interviews conducted online via the MSTEAMS e-learning platform during the period from October 2024 to February 2025. The collected data were analyzed using thematic content analysis. The analysis conceptually defined the terms "soft skills" and "e-learning," identified the soft skills that can be developed in e-learning environments, and examined their relevance to teaching and professional practice. The findings indicate that the development of soft skills in e-learning environments requires consideration of factors influencing the educational process, which are deemed critical for the effectiveness of any educational intervention, such as the instructor, instructional material, the use of modern teaching and assessment techniques, and the design and operation of distance learning programs

Keywords: Soft Skills, E-Learning, Tourism Education, Training

1. Introduction

In a world characterized by continuous change, rapid technological and scientific advancements, widespread internet use, the advent of artificial intelligence, and multiculturalism, it becomes necessary to transform education so that individuals are equipped with the essential skills to meet the challenges of the 21st century. In this context, e-learning can serve as a field for skills development, offering the possibility of creating modern learning environments tailored to the needs of today's learners, who are required to engage in continuous learning to adapt to ongoing developments.

However, regarding the term "skills," there is still no unified theoretical framework for understanding them, nor a universally accepted definition. Similarly, the concept of "competencies" is marked by "conceptual confusion" (Telling &Serapioni, 2019: 390). According to Tsolis and Babalis (2023), a skill is defined as the set of knowledge and experiences an individual possesses, which are necessary for completing a task or duty, and skills are distinguished into cognitive and practical. For Karanikola and Panagiotopoulos (2019), skills consist of "a set of achievements, knowledge, and personal characteristics that enable individuals to be employed and succeed in their personal and professional lives."

Particular importance for personal growth and professional development is attributed to soft skills (Borboulis, 2023), although there is no clear and unified definition. Their conceptualization is often made by contrasting "soft" with "hard" skills. James and James (2004) consider soft skills as a way of describing a set of abilities or talents that an individual can bring to the workplace. In the international literature, soft skills are mainly described as personal behaviors, attributes, values, or traits, including ethics, communication, leadership, interpersonal, and teamwork skills. In contrast, "hard" skills are defined as a combination of technical and cognitive abilities (Ling, Ofori, & Low, 2000; Mitchell etal., 2010; Shub&Stonebraker, 2009; Sutton, 2002; Towner, 2002).

Despite their importance, soft skills are not cultivated to the required extent in educational programs and are rarely systematically assessed (New European Skills Agenda). Therefore, it is necessary to transform education and training to meet the needs of citizens, the labor market, and society, aiming for personal development as well as social and economic progress (European Council, 2000).

E-learning can play a crucial role in the educational process, substantially contributing to the cultivation of soft skills through an applicable pedagogical framework. The term "e-learning" is described in various ways, which, however, converge on the general definition of learning conducted electronically (Abbadetal., 2009). In formal and non-formal education, policymakers, researchers, and professionals often use the terms "distance education" and "e-learning" interchangeably, emphasizing the distinction between conventional and distance education (AFT, 2000, 2001; Evans & Nation, 2000; Ryan etal., 2002; Twigg, 2001). In some cases, the term is used to describe the use of ICT in teaching and learning; in others, to indicates a combination of face-to-face and distance education; and in others, it refers exclusively to online learning, which can be asynchronous, synchronous, or hybrid. Gradually, the term "e-learning" is increasingly used, replacing or being equated with the term "distance education," as is the case in the present study, where e-learning is equated with both synchronous and asynchronous distance education.

2. Method

2.1 Purpose and Objectives

a. The purpose of this study is to investigate the contribution of e-learning to the development of soft skills in tourism education and training professionals. Based on the literature review and the research objectives, the following research questions were formulated:
- What are the views of tourism education and training professionals regarding soft skills?
- What are the views of tourism education and training professionals regarding e-learning?

- What are the views of tourism education and training professionals on the development of soft skills through participation in distance learning programs?
- What are the views of tourism education and training professionals regarding the usefulness of acquiring soft skills in the context of their professional duties?

2.2 Type of Research

This study follows a qualitative methodology. The analysis of interview data was conducted using thematic content analysis, which focuses on the diversity of meanings and interactions arising from the interpretation of a phenomenon by different participants (Cohen, Manion & Morrison, 2007). This approach allows for the categorization of data through the use of codes. Coding facilitates the transition from collected data to theoretical relationships and concepts, as well as their interpretation.

2.3 Sample

The study sample consisted of ten tourism education and training professionals. Participants were certified adult educators in the tourism sector and professionals holding senior administrative positions in hospitality and catering organizations.

2.4 Research Instrument

Data collection was conducted through semi-structured interviews, which provide better communication with participants compared to a structured format, and enable a more comprehensive understanding of participants' experiences and perceptions (Bryman, 2017).

Interviews were conducted online during the period October 2024 – February 2025 via the MSTEAMS platform, due to the geographical distribution of participants and for time efficiency. Each interview lasted between thirty (30) and forty (40) minutes.

2.5 Interview Structure

The first part of the interview focused on collecting participants' demographic information, including age, tourism-related education, work experience in the tourism sector, professional position within tourism education structures, and certification in new technologies. The second part included questions based on the research questions. Specifically, the interview topics addressed tourism education and training professionals' knowledge and views regarding soft skills, e-learning, the development of soft skills through participation in distance learning programs, their application in e-learning environments, and the usefulness of acquiring soft skills in the context of their teaching and professional duties.

3. Results

This section presents the results of the research

3.a Participants' Profile

The study sample consisted of ten participants: six women and four men. Their ages ranged from twenty-six to fifty-seven years, with most participants between forty-one and forty-six years old. Most were graduates of higher education tourism programs, while three held degrees from higher tourism schools. Six held a master's degree, one held a doctoral degree, and one was a PhD candidate. Work experience in the tourism sector ranged from seven to thirty-nine years. Nine out of ten participants were instructors at public Vocational Training Institutes in tourism, with two also holding senior positions in hospitality and catering establishments. Regarding digital literacy, almost all participants were certified in ICT.

3.b Participants' Views on the Concept of "Soft Skills"

Analysis revealed that the term "soft skills" was not uniformly understood by all participants and held different semantic meanings. Participants associated soft skills with personal characteristics and experiences acquired outside formal qualifications. For example: *"Yes, I know it, but not with certainty. I think it's about personal traits"* (P1), and *"Generally, anything acquired through experience, and for those who cannot understand it, as I put it, we could say anything that isn't on paper"* (P2).

Regarding the soft skills recognized by participants, communication emerged as the most frequently mentioned skill, often linked to problem-solving, empathy, and teamwork, with a distinction between verbal and non-verbal communication. Empathy was also highlighted as essential in workplace environments, particularly in tourism, affecting both client relationships and colleague collaboration. Time management appeared less frequently. Examples include: *"Communication is the primary soft skill; it supports all others. Even teamwork cannot exist effectively without communication"* (P3); *"It is communication and emotional intelligence—understanding others and putting yourself in their shoes. I consider them very important, sometimes even more than hard skills"* (P4); *"Also, being able to convey information verbally and non-verbally and be understood by others"* (P1).

3.c Participants' Views on the Concept of "E-Learning"

Participants expressed a multidimensional understanding of e-learning, describing it as learning through digital/electronic tools in both distance and face-to-face education. E-learning was equated with synchronous and asynchronous distance learning, emphasizing flexibility in time and space. Participants recognized the importance of digital tools (e.g., learning platforms, Kahoot) as supportive of the learning process. For instance: *"We're talking about distance learning. You meet people from everywhere. You exchange experiences. You can follow the program from home"* (P4); *"Distance and face-to-face learning using electronic tools like videos and slides"* (P5); *"It means learning via computer, either with a teacher or asynchronously without one"* (P6).

Synchronous e-learning was associated with interaction and immediate responses, while asynchronous learning offered flexibility but lacked personal contact between instructor and learner. Example responses: *"Synchronous in the form of an e-classroom and asynchronous learning. Communication via email"* (P5); *"…You save time because you can attend from home, without traveling. There's flexibility in both time and place"* (P1).

The absence of interaction and visual contact was noted as a barrier to active participation and personalized instructor intervention: *"In an e-classroom, you're not sure if they are following. Sometimes, you lack visual contact, which needs to be addressed"* (P6).

Digital tools for formative and summative assessment, such as quizzes and multiple-choice questions, were valued for providing immediate feedback: *"Comprehension tests… exam quizzes"* (P7); *"Critical thinking questions… not rote learning"* (P8).

3.d Participants' Views on Developing Soft Skills in E-Learning Environments

Participants identified communication, collaboration, time management, critical thinking, creativity, empathy, and problem-solving as soft skills developed through e-learning. Adaptability, though less frequently mentioned, was linked to technology use and learners' adjustment to new learning formats. Empathy and creativity could be developed through active participation and interaction with both learning material and peers. Time management emerged as essential in distance learning for meeting deadlines and organizing time. Illustrative quotes: *"It helped me develop teamwork because we worked in groups during synchronous distance learning"* (P1); *"Only time management and critical thinking, as I mentioned"* (P8); *"Yes, it helped me develop empathy. While I was communicative and collaborative, I saw as a learner how it can be achieved"* (P6).

Effective development of these skills depends on conditions such as using modern active teaching methods, clearly distinguishing instructor and learner roles, and incorporating non-verbal communication in distance learning: *"…role-playing, e.g., one person as a client, another as employee, helps develop problem-solving"* (P2); *"…the instructor's clarity and well-structured, interactive material motivated me to participate"* (P5).

Views on ICT's role in soft skills development were mixed. While some expressed concerns about impersonal communication and the lack of non-verbal cues, most acknowledged that skills like communication, creativity, critical thinking, and collaboration could be cultivated under specific conditions: *"I think it's harder. In face-to-face, you get closer to learners. Distance is more impersonal"* (P9); *"It helped people become more social" (EZ); "They start opening up and developing collaboration"* (P2). Preconditions included the instructor, program objectives, teaching techniques, and adapting program goals to learners' needs.

3.e Participants' Views on the Usefulness of Soft Skills in Professional Practice

Soft skills were deemed crucial for building relationships between instructors and learners, understanding learners, using modern teaching and assessment techniques, engaging learners, and managing time. Time management skills helped structure lessons effectively: *"It helps in better time management. You need time limits because discussions can go off-topic. Time management helps plan lessons better"* (P5). *Empathy facilitated learner engagement: "Involving learners in class, not hiding behind desks or cameras"* (P7).

Soft skills also supported the design and implementation of interactive lessons by selecting suitable teaching and assessment techniques and reorganizing methodology: *"Soft skills help choose teaching methods and assessments. If learners do not meet expected outcomes, I adjust methods to engage them"* (P1); *"If the initial approach does not capture learners' interest, I modify teaching methods and use more participatory techniques. I once had a class that was disengaged, so I redesigned it to be collaborative, which worked effectively"* (P6).

In professional practice, soft skills were considered more important than hard skills in the tourism sector. They support effective communication with colleagues and clients, foster collaboration, and facilitate problem-solving. Verbal and non-verbal communication and active listening were essential for interacting with people from diverse cultural and social backgrounds. Empathy was crucial for understanding and meeting the needs of both clients and colleagues. Soft skills were seen as vital not only in tourism but broadly in professional relationships: *"The more soft skills you have, the better you handle interactions with colleagues, supervisors, subordinates, and this extends to personal relationships"* (P10).

Illustrative quotes: *"Tourism is clearly about interacting with people, so soft skills are very important, whether behind a desk or in a hotel"* (P6); *"Soft skills help in tourism, managing client problems, and understanding others' perspectives. Same applies with colleagues"* (P10); *"Especially in front office roles, problem-solving and communication are key skills"* (P5).

Overall, soft skills enable tourism employees to manage problems effectively and ensure smooth operations in hospitality and catering establishments.

4. Conclusions – Recommendations

Many of the research participants approach the term "soft skills" vaguely or are entirely unfamiliar with it. Their understanding was conceptually approached through the distinction between soft and hard skills. This perspective is consistent with the literature, where the conceptual definition of soft skills is often attempted in comparison to hard skills (Whitehurst, 2016). Soft skills were also identified as skills not evidenced by formal qualifications but primarily acquired through experience, a view supported by research indicating that most people distinguish hard skills (education, certified knowledge) from soft skills (interpersonal or intrapersonal skills) (Laker & Powell, 2011). Hard skills can be taught and measured, encompassing academic qualifications and any certified knowledge or practical experience. In contrast, soft skills refer to personal traits, individual

characteristics and communication skills (Hayes, 2002; Perreault, 2004), as also reflected in the findings of this study.

Participants identified communication, empathy and teamwork as key soft skills n the tourism sector (Shabir &Sharma, 2019· Suh, West & Shin, 2012), differentiating between verbal and non-verbal communication. Communication, in particular, emerged as the predominant soft skill, aligning with Levasseur's (2013) assertion that communication is the most important soft skill.

Time management was also recognized as a soft skill, described in terms of meeting deadlines, organizing time, and maintaining consistency in completing tasks. Its importance is confirmed by international literature, where time management appears in many skill models (Tsarpa, 2022; Deloitte, 2018; Sanchez & Ruiz, 2008; Pattnayak, 2020) and is considered essential for adult learners in academic, professional, and personal contexts.

Participants associated e-learning with the use of digital tools in both remote and face-to-face education, as well as with synchronous and asynchronous online learning. This finding aligns with Clark et al. (2020), who state that e-learning encompasses any form of education utilizing the internet, ICT, mobile devices, software, etc. They also equated it with distance learning, confirmed by multiple studies reporting that e-learning and distance education are often used interchangeably and share common characteristics (Evans & Nation, 2000; Ryan, 2002; Twigg, 2001).

Participants perceived that synchronous e-learning supports interaction and immediate responses from the instructor or learning tools, reflecting the high interactivity provided by new technologies, which facilitates both individual and collaborative learning processes (Gros&Salvat, 2004; Shi & Han, 2019; Byrd, 2018). Asynchronous e-learning was described as flexible in terms of time and place, allowing learners to participate from their chosen location and at their own pace, with or without the presence of an instructor (Pandey, 2013; Al-Din &AlRadhi, 2008; Beldhuis, 2012; Almosa, 2001; Papadopoulou& Pavli-Korre, 2025).

The soft skills that participants believed could be developed through e-learning included communication, collaboration, time management, critical thinking, creativity, empathy, and problem-solving skills. Additionally, e-learning was considered a tool for developing learners' adaptability, reflecting the need to adjust to new technologies and educational formats, particularly following the COVID-19 pandemic as well as in rapidly evolving technological environments, in order to maintain employability and foster active participation in processes of continuous improvement and digital innovation (Carvalho &Mourão, 2021).

There was some divergence of opinion regarding the contribution of new technologies to the development of soft skills. However, most participants recognized the potential for cultivating soft skills through distance education, emphasizing the need for specific conditions to be met. These conditions relate to the instructor's role, the use of active teaching techniques such as group work, simulations, role-playing (Karalis&Lintzeris, 2022; Williams, 2023; Salas-Pilcoetal., 2022), the integration of non-verbal communication elements into the learning process (Stone, 2016), and the adaptation of program objectives to learners' needs (Karalis&Lintzeris, 2022).

Participants' main concerns related to the impersonal nature of communication and the absence of non-verbal interaction, a situation explained by the tendency of some learners to disengage or hide behind cameras during synchronous online learning (Elzainy, ElSadik&AlAbdulmonem, 2020).

Participants viewed soft skills in the tourism sector as more important than hard skills, a finding supported by studies showing that technical knowledge is often considered less significant than soft skills (Chung, 2000; Banupriya, 2011; Mitchell, Skinner & White, 2010; Shub&Stonebraker, 2009; Shabir & Sharma, 2019). Soft skills were considered crucial to professional success, facilitating effective communication with colleagues and clients, collaboration, and problem-solving (Sisson & Adams, 2013).

Verbal and non-verbal communication skills, along with active listening, were deemed essential, reflecting the need for tourism employees to interact with people from diverse cultural and social backgrounds (Tesone&

Ricci, 2006; Spowart, 2011; Bowen & Schneider, 1988; Wesley, Jackson & Lee, 2017; Youssef, 2017). Empathy emerged as a fundamental skill, particularly in the tourism sector, highlighting the importance of understanding and addressing the needs of both clients and colleagues (Barlow & Maul, 2000; Tucker, 2016).

The need to acquire soft skills was emphasized not only for the tourism sector but also for all professional relationships, as personality traits are key to providing quality customer service and contributing to individual professional development (Tang, 2020).

Overall, the study shows that most participants believe new technologies, particularly e-learning, can be transformed into a tool for developing soft skills in tourism, bridging the gap between technology and interpersonal skills. Their effectiveness depends on their use, the human factor, and pedagogical design, making e-learning a potentially effective approach for enhancing soft skills when implemented in a targeted and participatory learning environment, taking into account the findings of this study.

Author Contributions: All authors contributed to this research.

Funding: Not applicable

Conflicts of Interest: The authors declare no conflict of interest

Informed Consent Statement/Ethics approval: Not applicable

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 59-69
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.231

Acoustic Characteristics of Speech in Fante Speakers with Hearing Loss

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Abstract
Objective: The study compared the acoustic characteristics of speech in Fante speaking school children with moderately severe to profound sensorineural hearing loss to those with normal hearing. Method: Participants were Ghanaian students aged of 10 to 20, with or without hearing loss. Speech samples of monosyllabic words were recorded in an acoustically treated room. Analysis focused on the duration, voice onset time (VOT), and intensity of plosive sounds. Results: Consonant production of participants varied between individuals with and without hearing loss, especially for specific plosives. Participants with normal hearing had slightly longer voicing patterns compared to those with hearing loss. Participants with hearing loss consistently produced speech with higher maximum intensity values. Notably, /k/, /b/, and /g/ were observed to have the highest intensity values among the sounds. Conclusion: Hearing loss significantly alters the acoustic properties of speech. Individuals with moderately severe to profound sensorineural hearing loss exhibit distinct patterns in speech production that affect VOT, and intensity of consonant articulation.

Keywords: Fante, Hearing Loss, Acoustic Characteristics, Voice Onset Time, Consonants

1. Introduction

Hearing loss influences the developmental journey of children in their acquisition of language and communication skills (Cruzatti et al., 2022: Granlund et al., 2018; Granlund, 2015). Specifically, hearing loss affects children's ability to perceive and reproduce auditory stimuli in their surroundings (Verhoeven et al., 2016). Children with hearing loss experience both acoustic and linguistic barriers to communication (Granlund et al., 2018; Granlund, 2015).

Studies have reported voicing errors by individuals and children with hearing loss (Granlund et al., 2018; Granlund, 2015; Shojaei et al., 2016). For example, Shojaei et al. (2016) observed that prelingually deaf children have obvious problems in the production of consonants and vowels; while Granlund et al. (2018) hold that such children experience both acoustic and linguistic barriers in communication. More specifically, these difficulties are seen in areas such as substitution, neutralization, prolongation, and diphthongization (Shojaei et al., 2016; Sreekumar et al., 2024; Verhoeven et al., 2016); resonance problems, strain, unpleasant quality of voice, high pitch voice, altered breathing pattern, and utterance with excessive vibration (Baudonck et al., 2010; Narasimhan & Nataraja, 2019). These notwithstanding, although these children can accurately produce several isolated

phonemes, they struggle to combine them into continuous speech, leading to reduced speech intelligibility (Sreedevi & Mathew, 2022).

Children's phonological development is influenced by how often each speech sound or phoneme appears in their specific language (Sreedevi & Mathew, 2022). For the school-going child with hearing loss, this can be more challenging in the classroom situation. According to Shojaei et al. (2016), one effect of congenital hearing loss is that normal development of speech is affected, and therefore, children with hearing loss need to be taught speech skills that under normal circumstances will be acquired even unconsciously.

Although hearing loss is prevalent among children in Ghanaian classrooms, literature on the analyzes of the speech of children with hearing loss is virtually unavailable. While studies have explored various aspects of speech production in individuals with hearing loss (Shojaei et al., 2016; Sreedevi & Mathew, 2022; Verhoeven et al., 2016), similar studies on Ghanaian school children are rare. There remains a need to investigate and describe the speech patterns of Ghanaian children with hearing loss, with a focus on the acoustic parameters of plosive consonants. This is necessary in this era of inclusive education as practiced in Ghana to study the peculiar speech disorders of children with hearing loss in the Ghanaian school systems to facilitate management approaches to improve upon their speech.

The oral communication skills of children with hearing loss can be limited, with significant impact on social, educational, and career opportunities. Plosive consonants, including sounds like /p/, /b/, /k/, /g/, /t/, and /d/, play a role in speech articulation and are known to be particularly vulnerable in individuals with hearing impairment (Roohparvar et al., 2024). The ability to accurately produce and perceive these sounds is critical for speech intelligibility.

Fante is a prominent Akan language in Ghana, spoken particularly in the Central and Western regions. As part of the six major dialects of the Akan language, Fante holds a special cultural and historical significance. It serves as the primary language of communication for the Fante people and is also taught in Basic schools within the Central and Western regions (Ghana Statistical Service, 2021). The Fante language boasts a unique linguistic structure, with a rich vocabulary, tonal patterns, and a blend of native Akan elements along with influence from European languages, reflecting Ghana's complex history.

By comparing the speech of children with hearing loss to that of their peers with normal hearing, this study seeks to understand the extent to which hearing loss affects the articulation and acoustic characteristics of plosive consonants. This analysis not only shed light on the unique challenges faced by children with hearing loss but also offered insights into potential differences or similarities between their speech and that of typically developing children.

This study investigated the acoustic characteristics of speech of Fante-speaking school children with moderately severe to profound hearing sensorineural loss and compared them with children with normal hearing. The objective was to provide an analysis of their plosive consonant production and how hearing loss affects the duration, voice onset time (VOT), and intensity of specific speech sounds, particularly plosive consonants.

2. Methods

2.1. Participants

Participants were purposively handpicked based on their hearing history to be included in the study. Participants were recruited from the Center for Hearing and Speech Services (CHSS), University of Education in Winneba, Ghana. The study involved 20 participants aged between 10 and 20 years. This comprised two groups of 10 participants each. Participants in Group 1 had hearing within normal range as determined by pure tone audiometric thresholds (≤25 dB HL) at octaves .25 to 8 kHz. Group 2 involved 10 participants diagnosed with

post-lingual moderately severe to profound bilateral sensorineural hearing loss. Both groups of participants were assessed at the CHSS. Each participant had lived with their hearing loss for 8 years and more.
Participants received audiological assessment at CHSS that included otoscopic examination, pure tone air conduction (at octave frequencies from 0.25 to 8 kHz), and bone conduction threshold testing (at octave frequencies from 0.5 to 4 kHz) in a soundproof booth to determine their hearing sensitivity. Following the audiometric evaluation, participants were seated in a quiet room and instructed by an audiologist about how the speech test/recording would be conducted. Each participant signed a consent form; minors had their parents sign on their behalf for their inclusion in the study.

2.2. Procedure

The recording of the speech material took place at CHSS, in a room with low ambient noise. Participants were asked to read words shown to them on cards (Table 1) and/or name pictures that were shown to them. Participants produced the words in Fante. The words were recorded onto KAYPENTAX software using a unidirectional external microphone connected to a laptop. Each participant was seated in a chair in front of the microphone during the recording. The microphone was 15 cm away from the participant's mouth. Participants were instructed to read the words and say the picture names shown to them as clearly as they could using their natural voice effort. Participants were given several demonstrations and practice of the task before the actual recordings.

Table 1: Wordlist in Fante and their English meaning

S/N	Fante words	Meaning in English
1	Ba	Child
2	Baé	To part/separate
3	Bàm	To embrace, clasp (in welcoming)
4	Bɔ	To strike
5	Boá	To help
6	Bra	Come
7	Brám	To overlay
8	Buá	Respond
9	Bua	To cover
10	Bu	To bend
11	Da	Sleep
12	Dam	To lie in
13	Dɛw	To flare, flame, blaze
14	Dɛw	Joy
15	Duá / Duïa	To sow/plant
16	dɔm	To belong/ crowed
17	Dwa	Cut into pieces/cut up
18	Gyá	To accompany
19	Ká	To bite
20	Kõa	To bend, curve
21	kyɛ́	To keep long, to last or endure
22	kyé,	To divide
23	Kyéa	A bending sideward or a sideward inclination of the head
24	Kyiá	Greeting, salutation
25	Mã	To give
26	Pá	Good
27	Piá	To push onward, press
28	Pră	To sweep with a broom
29	Sá	Dance

30	Soá	To carry on the head
31	Srá	To smear
32	Süá	To learn
33	Taá	To pursue, persecute
34	Twá	Cut
35	Weà	To creep, crawl

Otoscopic examination was performed on the day of testing, and all participants had clear external auditory canal and normal tympanic membranes bilaterally. This was followed by a standard pure-tone audiometric (PTA) air and bone conduction testing to establish the hearing status of participants using the modified Hughson-Westlake (10 dB down, 5 dB up) method. A calibrated Kamplex AD 27 clinical audiometer was used with a set of supraural headphones for the testing in an acoustically treated test room. The audiometer and headphones were checked for proper functioning before conducting each series of tests. All participants in Group 2 had pure tone behavioural thresholds ≥56 dB HL on the day of testing (moderately severe to profound sensorineural hearing loss) (De Sousa et al., 2022). Participants in Group 1 had thresholds ≤ 25 dB HL in both ears on the day of testing.

The categorization of hearing ability was calculated based on pure tone averages of scores obtained at three frequencies (0.5 kHz, 1 kHz, and 2 kHz): Normal hearing (PTA -10 to 25 dB HL), mild hearing loss (PTA 26 to 40 dB HL), moderate hearing loss (PTA 41 to 55 dB HL), moderately severe hearing loss (PTA 56 to 70 dB HL), and severe-to-profound hearing loss (PTA 71 to 91+ dB HL). Normal hearing was determined: Bilateral normal hearing (PTA ≤ 25 dB HL in both ears) and bilateral symmetric sensorineural hearing loss (SNHL) (PTA > 25 dB HL in both ears) (De Sousa et al., 2022).

2.3. Speech recording

All participants had their speeches recorded individually at CHSS in an acoustically treated room with minimal reverberation and ambient noise. The word list included 35 words written on a card with their corresponding picture where necessary. The speech items consisted of monosyllabic words with consonants in the initial positions. The word list was selected based on their familiarity and occurrence in everyday Fante and Ghanaian English. The sound files were recorded in mono (one microphone, one channel) using a high-quality microphone, with sounds digitized at 44.1 kHz and 16 bits as a wav file format, using digital recording equipment. The recording of the speech materials lasted between 30 to 60 minutes.

3. Results

Table 2 shows participants' demographics. For the participants with hearing loss (Group 2), 6 (60%) were males and 4 (40%) were females. The mean age of participants in Group 2 was 14.8 years (SD = 3.4). For the control group – participants with normal hearing - there was an even distribution, 5 (50%) each for both male and female; their mean age was 15.8 years (SD = 3.1).

Table 2: Participants' characteristics

Variables		**Normal hearing (n = 10)**	**Hearing loss (n = 10)**
		n (%)	n (%)
Gender	Male	5 (50)	6 (60)
	Female	5 (50)	4 (40)
Age (years)	Mean (SD)	15.8 (3.1)	14.8 (3.4)

3.1. Hearing thresholds of participants

Table 2 presents the hearing thresholds (dB HL) for participants in the hearing loss group across six frequencies. The details are described in terms of the minimum threshold (Min), maximum threshold (Max), and standard deviation (SD) values.

Table 2: Mean hearing thresholds of participants with hearing loss.

		Hearing threshold					
		250 Hz	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**8000 Hz**
Right ear	Min	60	70	75	70	65	45
	Max	90	95	100	110	100	100
	SD	9.8	8.4	8.3	12.4	10.3	15.5
Left ear	Min	60	75	80	75	75	70
	Max	90	100	105	105	110	95
	SD	9.5	7.8	7.8	9.1	10.7	9.1

For the right ear, the minimum thresholds range from 45 dB HL at 8000 Hz to 60 dB HL at 250 Hz, while the maximum threshold ranges from 90 dB HL to 110 dB at 2000 Hz. The highest standard deviation was 15.5 at 8000 Hz.

For the left ear, the minimum thresholds range from 60 dB HL at 250 Hz to 70 dB HL at 8000 Hz, while the maximum threshold ranges from 90 dB HL at 250 Hz to 110 at 4000 Hz. The SD was highest at 4000 Hz, 10.7.

3.2. Participants consonant duration

Table 3 and Figure 1 compares the duration of various consonant sounds produced by individuals with normal hearing to those with hearing loss. The duration was measured in milliseconds (ms) and included the following consonants: t, p, k, b, d, and g. The results revealed distinct patterns of duration changes across different consonants, suggesting variability in how hearing loss affected speech production.

One key observation was the variability in duration changes between normal hearing and hearing loss conditions. For instance, the consonant /t/ showed a slight decrease in duration from 58 milliseconds (ms) in normal hearing to 52 ms in individuals with hearing loss (Figure 1). In contrast, /p/ exhibited a substantial increase in duration, rising from 63 ms to 80 ms. Meanwhile, the consonant /k/ demonstrated a significant decrease from 141 ms to 62 ms. The voiced consonants /b/ and /g/ also showed reductions in duration from 140 ms to 123 ms and 164 ms to 144 ms, respectively. However, the consonant /d/ remained relatively stable, with a minimal change from 117 ms to 119 ms.

Additionally, there appeared to be a contrast between voiced and voiceless consonants. While voiceless consonants like /p/ and /k/ exhibited opposing trends in duration changes, voiced consonants like /b/ and /g/ tend to have moderately reduced durations. This contrast reflected differences in how individuals with hearing loss perceived and produced voiced versus voiceless sounds.

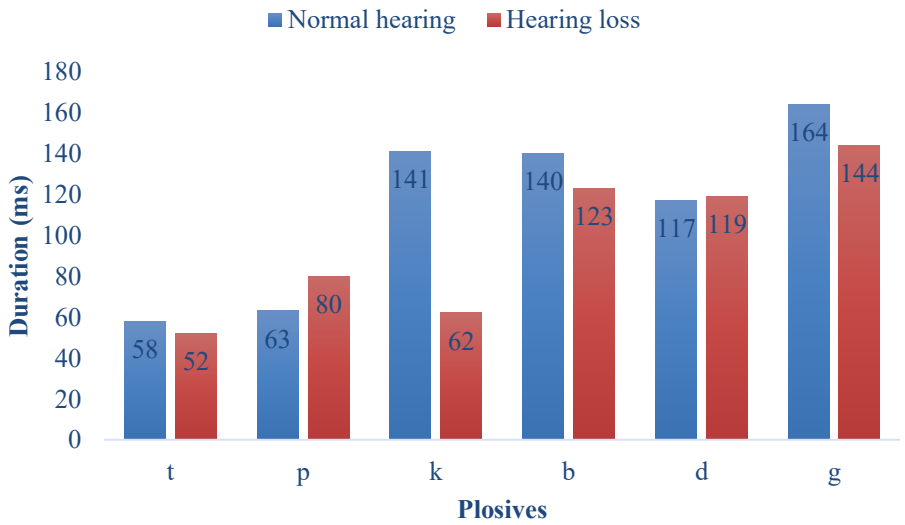

Table 3: Detail of participants consonant durations (ms).

Consonants	Duration normal	Duration hearing loss
t	58	52
p	63	80
k	141	62
b	140	123
d	117	119
g	164	144

The data presented showed VOT values for different speech sounds (consonants) in two groups: individuals with normal hearing and those with hearing loss. VOT is an important acoustic measure that represents the interval between the release of a consonant and the onset of vocal cord vibration, or voicing. Typically, positive VOT values indicated voiceless sounds, while negative values indicated voiced sounds. This data showed how hearing loss may affect speech production, particularly in terms of voiceless and voiced stop consonants.

For voiceless stops (/t/, /p/, /k/), there was a noticeable difference in VOT values between the two groups. The VOT for /t/ was slightly higher in the hearing loss group (12 ms) compared to the normal hearing group (9 ms). In contrast, the VOT for /p/ was lower in the hearing loss group (14 ms) compared to the normal hearing group (19 ms). Similarly, the VOT for /k/ was also reduced in the hearing loss group (23 ms) compared to the normal hearing group (34 ms).

For voiced stops (/b/, /d/, /g/), the data showed that individuals with hearing loss tend to produce these sounds with less negative VOT values compared to those with normal hearing. For instance, the VOT for /b/ in the hearing loss group was -85 ms, while it is -130 ms in the normal hearing group. Similarly, the VOT for /d/ was -102 ms in the hearing loss group, compared to -117 ms in the normal hearing group. The VOT for /g/ showed a slight difference as well, being -158 ms in the hearing loss group versus -163 ms in the normal hearing group.

Table 4: Voice onset time analysis of participants

VOT	Normal hearing	Hearing loss
t	9	12
p	19	14
k	34	23
b	-130	-85
d	-117	-102
g	-163	-158

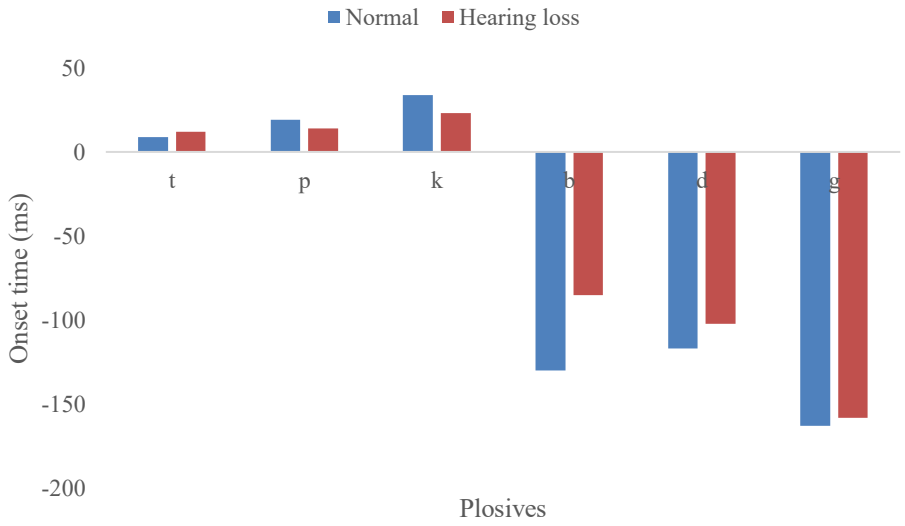

Figure 2: Graphical representation of participants' VOT

The data analysis indicated that the maximum intensity values for the participants with hearing loss are bigger in all the consonants studied than those for the participants with normal hearing. However, the differences between the intensity of /b/ for the hearing loss and the normal hearing participants were very small. For the participants with hearing loss, the plosives /k/, /b/, and / g/ have the highest intensity (68 dB) among the sounds, and this was followed by /t/, and /d/ 67 dB and then /p/ (65 dB) (Figure 3). For participants with normal hearing, however, the sound with the highest intensity was /b/, 67 dB and this was followed by /p/ 60 dB and then /t/ 59 dB then /d/, and /g/ (Table 5). Thus, for both the normal hearing and the hearing loss participants, /b/ was said with very high intensity.

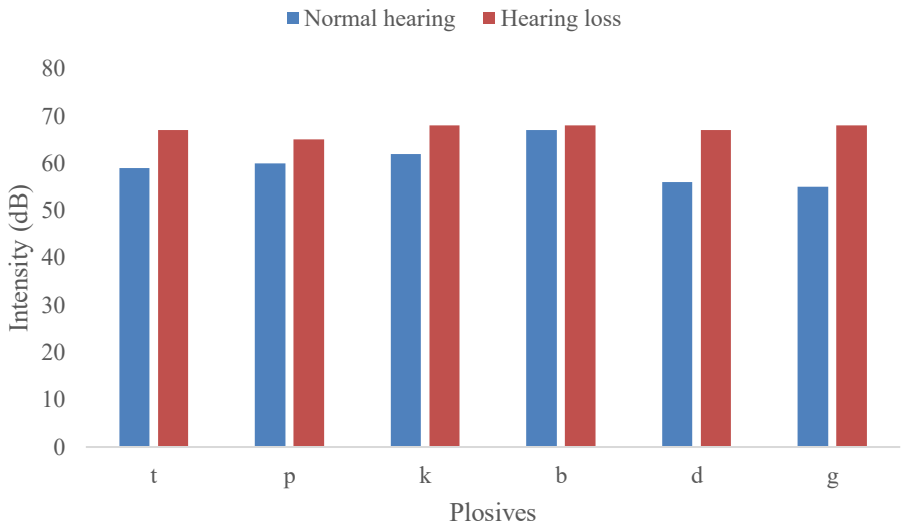

Figure 3: Intensity values of participants' speech

Table 5: Intensity values of participants in the production of plosives

Consonant	Normal hearing	Hearing loss
t	59	67
p	60	65
k	62	68
b	67	68
d	56	67
g	55	68

4. Discussion

The results highlighted the acoustic parameters of speech production among individuals with moderately severe to profound hearing loss compared to those with normal hearing. The discussion focused on the three key acoustic parameters: duration, VOT, and intensity, and how these parameters influenced speech patterns in both groups and the implications for effective communication.

4.1. Duration measurements

The study found variability in duration changes between normal hearing and hearing loss conditions. This variability can be attributed to differences in articulation patterns or compensatory strategies employed by individuals with hearing loss. Some consonants, such as /p/, showed increased duration because of stronger articulatory effort aimed at enhancing audibility. Conversely, reduced durations, as seen with /k/, might indicate challenges in maintaining articulation precision, possibly due to altered auditory feedback or motor adjustments. These findings have practical implications for hearing healthcare and rehabilitation, as they highlighted the importance of addressing articulatory inconsistencies when designing speech therapy programs and management

strategies for individuals with hearing loss. By focusing auditory training programs aimed at enhancing consonant perception and production accuracy.

4.2. Voice Onset Time (VOT) analysis

Findings from the analysis of auditory patterns from both groups revealed subtle differences, with normal hearing participants generally showing slightly longer VOT values, especially for /p/ and /k/. This finding suggested that participants with hearing loss might face challenges in synchronizing voicing with articulation, potentially affecting speech clarity. Additionally, the velar plosive had the longest duration in VOT, followed by the bilabial plosive and then the alveolar plosive for both groups. This pattern suggested a tendency for shortened VOT in voiceless stops among individuals with hearing loss. The reduction in VOT may indicate that these individuals produced voiceless stops with reduced aspiration or a shortened voicing delay. This could be due to altered speech motor control or diminished auditory feedback. This pattern suggested that voiced stops are produced with a shorter pre-voicing duration in individuals with hearing loss, suggesting a weaker or delayed onset of voicing.

For voiced plosives, the differences in VOT values further reflected the impact of hearing loss, with normal hearing participants demonstrating earlier voicing onset, primarily due to their longer duration values for voiced plosives. It is observed that the voicing for the normal hearing participants started earlier than the voicing for participants with hearing loss, as the duration values for the voiced plosives were bigger for the normal hearing participants.

The data indicated that individuals with hearing loss tend to produce voiceless stops with shortened VOT and voiced stops with less negative VOT. This reflected altered motor control or impaired auditory feedback, resulting in changes to both aspiration and voicing characteristics. Verhoeven et al. (2019) observed that the speech characteristics differs in various ways of listeners with hearing loss from those with normal hearing. They (Verhoeven et al., 2019) further noted that a common problem in articulation of consonants involve voicing errors and places articulation errors.

4.3. Intensity Analysis

The analysis of intensity showed the role of hearing loss in modulating the intensity of speech sounds. Participants with hearing loss consistently produced speech with higher maximum intensity values in all consonants studied, with some exceptions, such as /b/, where differences were minimal. Similar findings have been reported, that individuals with hearing loss often have relatively high average pitch or speak in falsetto voice (Narasimhan & Nataraja, 2019). The plosives /k/, /b/, and /g/ stood out in terms of intensity, with the highest intensity values (68 dB) among the sounds. In the normal hearing group, /b/ was produced with the highest intensity, followed by /p/. This observation suggested that /b/ is consistently articulated with high intensity.

Complementarily, the audiometric results suggested elevated thresholds at higher frequencies (e.g., 4000 and 8000 Hz), with maximum thresholds reaching 100 dB and significant variability (SD of up to 15.5). Hearing loss within these frequency regions and at high thresholds can affect individuals' ability to perceive fine acoustic details of consonants, leading to difficulties in accurate production. This will have implications for speech intelligibility.

Additionally, speech production relied heavily on auditory feedback by the individual to monitor and adjust their own articulation (Scheerer & Jones, 2018). Individuals with thresholds at or above 60 dB across all frequencies may struggle to hear their own speech accurately (poor auditory feedback), particularly in the higher frequency consonant sounds. Again, for children with losses above 60 dB at high frequencies, this may result in delays in acquiring high-frequency consonant sounds, which are essential for clear speech development and articulation. Revathi and Sasikaladevi (2019) noted that children with difficulty perceiving high frequency sounds may struggle to hear sounds like "s". "t", and "shi", which are commonly used in everyday speech. Without these sounds, understanding sentences can become challenging. These difficulties may result in distorted articulation

of plosives and stops, since these sounds require exact discrimination and feedback for proper placement and manner of articulation, resulting in articulation errors or substitutions (e.g., replacing /b/ with /p/). Jafari et al., (2016) also found that prelingually deaf children exhibited notable segmental errors in both consonant and vowel production, as well as suprasegmental deviations such as substitution, neutralization, prolongation, and diphthongization.

5. Conclusion

The study examined the effects of hearing loss on speech production among Fante speaking individuals aged 10 to 20 years by analyzing consonant duration, VOT, and intensity. Generally, the findings indicated that hearing loss significantly impacted the acoustic properties of speech in Fante speaking children. Children with hearing loss exhibited distinct patterns in speech production that affects VOT, and intensity of consonant articulation, highlighting the complexity of speech articulation and the challenges faced by individuals with hearing loss. Additionally, the study showed the role of auditory feedback in fine-tuning motor speech control. Clinically, the results highlighted the importance of early and continuous auditory rehabilitation in children with hearing loss to curb its impact on speech development.

6. Future research

Future research should consider longitudinal studies tracking the development of speech in Fante speaking children with hearing loss over time. This could provide useful information into the evolving nature of speech production in these children as they individuals grow and potentially adapt to interventions.

Author Contributions: All authors contributed to this research.

Funding: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics Approval: Not applicable.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 226-232
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.610

The Perception of Filipino as a Medium of Instruction in Physical Education

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Abstract
This research examined the views of first-year Bachelor of Science in Physical Education students of Rizal Technological University on the efficacy of Filipino as the medium of instruction for their Physical Education (PE) courses. Employing a descriptive research design and a researcher-constructed questionnaire that was given to 129 randomly selected students, the research ventured into student preferences, the effectiveness of instructional materials and rubrics in Filipino, and the influence of Filipino as a medium in demonstrations, activities, recitations, and examinations. Results uniformly reveal a high level of preference on the part of the respondents for Filipino as the medium of instruction in all areas considered. Students indicated enhanced understanding, greater involvement, and better performance when Filipino was utilized in class discussions, instructional materials, rubrics, demonstrations, activities, recitations, and exams. These findings support that the utilization of Filipino as the major medium of instruction in Physical Education extensively improves learning and participation, especially in Tagalog-speaking areas. The research emphasizes the significance of language as a facilitator for effective pedagogical practice and encourages broader application of Filipino in teaching PE, complemented by sufficient development of materials and teacher training.

Keywords: Physical Education, Instructional Materials, Language Policy, Student Perception, Filipino

1. Introduction

Language is a crucial component of the learning process, significantly affecting students' understanding, engagement, and overall academic achievement. The dispute in the Philippines over the efficacy of English vs Filipino as the language of education has endured for decades (Bustos-Orosa, 2025). Although English has historically served as the principal medium of teaching, Filipino, as the national language, operates as the lingua franca across the archipelago, profoundly integrated into Filipino culture and everyday conversation. Although English has historically served as a primary language of teaching, Filipino is often regarded as the lingua franca of the island, profoundly integrated into Filipino culture and daily communication.

The topic of Physical Education (PE), which is heavily based on performance, demonstration, and execution, offers a special setting for this language study. Anecdotal evidence and disturbing percentages of low grades in content

courses, particularly performance-based courses, indicate that language could be a decisive influence on student success. This study is intended to assess the effect of Filipino as a medium of instruction on different dimensions of learning PE, such as classroom instruction, student taste, instructional materials, demonstration, and assessment methods. Through the provision of findings on student views, this research hopes to guide Physical Education instructors and educational policymakers on effective pedagogy that harnesses the use of the national language.

Recent studies indicate that employing a student's native language, or the language in which they possess the highest proficiency, might improve learning outcomes. Students may find it challenging to comprehend instructions and concepts presented in a foreign language, which might impede their academic progress (Velasco, 2024).

The historical backdrop of language policy in Philippine education highlights the importance of this matter. In 2024, the Philippine government implemented legislation to abolish the Mother Tongue-Based Multilingual Education (MTB-MLE) policy, requiring that the medium of instruction return to Filipino and, where appropriate, English (Bustos-Orosa, 2025). This policy change has elicited varied responses, with certain instructors voicing apprehensions over its influence on instructional efficacy and student understanding.

This study utilizes Vygotsky's Sociocultural Theory, which asserts that cognitive development primarily arises from social interactions within a cultural framework. Vygotsky highlighted the significance of language in influencing cognition and learning, proposing that education in a student's native language might enhance comprehension and cognitive growth (Sarmiento-Campos, 2022). Cummins' Linguistic Interdependence Hypothesis posits that competency in a student's first language might positively impact the learning of a second language, hence improving overall academic achievement (Clayton, 2024).

Bronfenbrenner's Ecological Systems Theory offers a thorough framework for comprehending the diverse environmental layers that affect a child's development. This theory emphasizes the interrelation of several systems, including home, school, and society, and their cumulative influence on a child's educational experiences (Bronfenbrenner, 2023). Implementing this idea in language training indicates that utilizing Filipino as the medium of instruction fosters a more unified and supportive learning environment, consistent with the child's cultural and linguistic background.

This research investigates the impact of utilizing Filipino as the medium of instruction in physical education on enhancing learning outcomes and optimizing the teaching-learning process for Filipino students.

2. Methodology

This study employed a descriptive research design to assess the perceptions of first-year Bachelor of Science in Physical Education students at Rizal Technological University regarding the use of Filipino language as the medium of instruction in their PE subjects. The descriptive method was chosen to accurately gather and present information about the existing conditions and the degree of detail concerning student preferences and experiences.

2.1. Participants and Sampling

A total of 129 first-year students from the Institute of Physical Education, out of a total population of 192 students across four sections served as the respondents. A random sampling technique was utilized to select participants, ensuring a proportional representation from each section. The demographic profile of the respondents, including age and gender, was also collected.

2.2. Research Instrument

A researcher-made questionnaire was the primary data collection instrument. This questionnaire was developed to assess students opinions on the effectiveness of Filipino as a medium of instruction in PE. It was divided into four main parts:

1. **Demographic Profile:** To gather information on the participants' age and gender.
2. **Student Preference:** To determine if Filipino as a medium of instruction is more effective in terms of general learning preference, classroom performance, and understanding of PE lessons.
3. **Instructional Materials and Rubrics:** To assess the preferred language for preparation and comprehension of instructional materials (visual aids, directions, equipment, books) and rubrics.
4. **Execution of Activities:** To evaluate the preferred language during demonstrations, activities, recitations, and examinations, and its impact on participation, expression, and performance.

The questionnaire was consulted with the thesis adviser and validated by a thesis professor to ensure its relevance and appropriateness.

2.3. Data Gathering Procedures

Permission to conduct the study was first secured from the Dean of the Institute of Physical Education. Upon approval, copies of the questionnaire were distributed to the selected respondents. The researchers ensured that all instruments were retrieved after the participants completed them.

2.4. Data Analysis

Quantitative methods were employed for data analysis, focusing on objective measurements and statistical interpretation. The following statistical tools were used:

2.5. Slovin's Formula

Used to determine the sample size (n) from the total population (N) with a specified margin of error (e) and confidence level (Z-score). n=1+N·e2N Where N = 192, e = 0.05 (5%), Z-score = 1.96.

2.5. Proportional Determination of Respondents per Section

The total sample size was divided by the number of sections to ensure equal distribution. Respondents per section=Number of sections Total samples=4

2.6. Weighted Mean

Used to compute the mean score for each question, allowing for verbal interpretation based on a Likert Scale System. Mean($\bar{x}$)=n∑(xi·si) Where xi is the score for each response option (1-4), si is the frequency of that response, and n is the total number of respondents.
The Likert Scale System used for verbal interpretation was as follows:

- 4: Strongly Agree (3.26 – 4.00)
- 3: Agree (2.51 – 3.25)
- 2: Disagree (1.76 – 2.50)
- 1: Strongly Disagree (1.00 – 1.75)

3. Results

This section presents the analysis and interpretation of the data gathered from the survey, focusing on the demographic profile of the respondents and their perceptions regarding the use of Filipino as the medium of instruction in Physical Education.

3.1. Demographic Profile of Respondents

The study involved 129 first-year PE students. The age distribution revealed that the majority of respondents (57.36%, n=74) were 18 years old, followed by 19-year-olds (31.01%, n=40), and 20-year-olds (11.63%, n=15).

In terms of gender, females constituted a slight majority (51.94%, n=67) compared to males (48.06%, n=62). This demographic composition provides a representative sample of young adult tertiary students in a Physical Education program.

3.2. Student Preference for Filipino as Medium of Instruction

The results consistently indicated a strong preference for Filipino as the medium of instruction among the respondents. For instance, the statement "I like to learn Physical Education using Filipino language" yielded a weighted mean of 3.24, falling within the "Agree" range. Similarly, students "Agree" (weighted mean = 3.21) that they perform better when teachers use Filipino, and "Agree" (weighted mean = 3.14) that they better understand PE lessons in Filipino. A particularly strong agreement was observed for "I talk to my classmates in Filipino during group activities," with a weighted mean of 3.42, categorized as "Strongly Agree." Conversely, while still in the "Agree" range, students showed less preference for English as a medium of instruction (weighted mean = 3.02). These findings align with Castillo and Yap (2001), who noted that students from Tagalog regions often exhibit loyalty towards Tagalog traditions, suggesting that familiarity with the language significantly aids comprehension and comfort in academic settings. Sarmiento-Campos (2022) asserts that instruction in a native language lowers cognitive burden, hence enabling pupils to assimilate new concepts more effectively. Moreover, Velasco (2024) emphasized that learning in a familiar language enhances engagement and involvement, as students have greater confidence in articulating their thoughts and communicating with classmates. The data strongly support the notion that Filipino facilitates a more conducive learning environment for these students.

3.3. Instructional Materials in Filipino

The use of Filipino in instructional materials also garnered positive perceptions. Respondents "Agree" that they understand visual aids better (weighted mean = 3.09), instructions/directions more clearly (weighted mean = 3.18), and remember materials and equipment concepts more effectively (weighted mean = 3.12) when presented in Filipino. Furthermore, a significant number of students "Agree" (weighted mean = 3.05) that they would prefer all written PE materials and books to be published in Filipino. They also "Agree" (weighted mean = 3.11) that they can use equipment appropriately when mechanics are discussed in Filipino. These results underscore the importance of language in the accessibility and effectiveness of learning resources. The current lack of instructional materials in mother tongues, as noted by Nolasco (2012), presents a valid concern, but the student preference highlighted here suggests a clear benefit to addressing this gap. Combong (2025) underscores the beneficial effect of employing Filipino as a medium of teaching on students' academic achievement in Physical Education. The study revealed that students instructed in Filipino exhibited enhanced comprehension and engagement with the subject matter. This corresponds with study's findings, which also shown that instructional materials in Filipino enhance comprehension and retention among students.

3.4. Rubrics in Filipino

Regarding rubrics, the plurality of respondents "Agree" that they understand and comply with rubrics written in Filipino (weighted mean = 3.14), and believe that rubrics can assess activities accordingly when given in Filipino (weighted mean = 2.79). They also "Agree" that they can meet desired learning outcomes (weighted mean = 2.76) and easily apply strategies (weighted mean = 3.07) when rubrics are in Filipino. Interestingly, respondents "Agree" (weighted mean = 2.86) that rubrics written in English would negatively affect their performance. This reinforces Brown's (2012) assertion that rubrics are essential tools for clear communication of expectations, and this study demonstrates that this clarity is enhanced when the language of the rubric is the students' preferred language.

3.5. Filipino in Classroom Execution (Demonstration, Activities, Recitation, Examination)

The study extensively examined the impact of Filipino during various classroom activities:

3.5.1. Demonstration

Students “Agree” (weighted mean = 3.15) that they learn and understand better when teachers demonstrate using Filipino. They also “Agree” (weighted mean = 3.20) that they can understand demonstrations when delivered in Filipino. A strong agreement (weighted mean = 3.26, “Strongly Agree”) was found for getting the instructor’s point more easily in Filipino. This indicates that direct instruction and modeling are significantly more effective in the native language.

3.5.2. Activities

For individual and group activities, students “Agree” (weighted mean = 3.16) that they like participating when instructions are in Filipino. They also “Agree” (weighted mean = 3.16) that teachers can encourage creativity more effectively using Filipino. Furthermore, students “Agree” (weighted mean = 3.17) that they are more participative in group activities and “Agree” (weighted mean = 3.18) that they enjoy activities more when conducted in Filipino. The highest agreement (weighted mean = 3.20, “Agree”) was for actively participating in different activities using Filipino. These findings support Luistro’s (as cited in the thesis) view that mother-tongue based education fosters faster and better learners, leading to increased participation and engagement.

3.5.3. Recitation

In recitations, a larger part of the population “Strongly Agree” that Filipino language paves the way for them to express their thoughts more freely. Specifically, they “Agree” (weighted mean = 3.24) that they can express themselves well in essays, “Agree” (weighted mean = 3.15) that they use Filipino during recitation, and “Strongly Agree” that they can give opinions spontaneously (weighted mean = 3.39), express thoughts (weighted mean = 3.40), and are not afraid to share opinions (weighted mean = 3.36) when using Filipino. This highlights the confidence and fluency students gain when communicating in their preferred language.

3.5.4. Examination

The results show that students “Agree” (weighted mean = 2.98) they get higher scores in quizzes when notes are given in Filipino. While they “Agree” (weighted mean = 2.91) that they prefer exams in English, they “Agree” (weighted mean = 3.17) that they understand questions easily when written in Filipino, “Agree” (weighted mean = 3.19) they can follow instructions very well, and “Agree” (weighted mean = 3.18) they find it easy to answer PE worksheets in Filipino. This suggests that while English might still be perceived as the standard for formal examinations, Filipino significantly aids in comprehension and execution during assessments, potentially leading to better performance.

4. Discussion

The demographic composition reflects a representative group of young adult learners, with age and gender variety enhancing the learning environment. These attributes are crucial to examine when assessing the impact of demographic variables on students’ motivation, engagement, and success in physical education activities and coursework.

The result of students’ preference for Filipino as medium of instruction in teaching Physical Education suggested that students typically experience more comfort and confidence when instruction is conducted in their home language. This choice may stem from the language familiarity and cultural relevance of Filipino, which can improve understanding and participation in classroom discussions.

The result in the use of Filipino instructional material in teaching Physical Education underscored the educational importance of incorporating Filipino into instructional delivery and learning resources. The results support the cognitive and sociolinguistic assertion that understanding and retention are enhanced when instruction is delivered in a language that learners comprehend most effectively. In the realm of physical education, where visual, verbal, and kinesthetic components intersect, employing Filipino can facilitate communication, promote diversity, and enhance skill learning and performance.

The results indicated that employing Filipino in several classroom activities—demonstrations, tasks, recitations, and assessments—significantly improves student understanding, involvement, and achievement. During demonstrations, students indicated a clearer comprehension and increased facility in understanding the instructor's points when Filipino was utilized, highlighting the language's significance in effective modeling and education. In activities, the utilization of Filipino fostered increased involvement, inventiveness, and enjoyment, consistent with Luistro's assertion that mother-tongue education cultivates more engaged and self-assured learners. The consensus during recitations that students articulate ideas, opinions, and thoughts more freely in Filipino underscored its empowering influence on communication and self-expression, alleviating anxiety and linguistic obstacles. Ultimately, although students continue to link English with formal assessments, their increased consensus on comprehending questions, adhering to instructions, and responding more accurately in Filipino suggests that the local language enhances knowledge and improves evaluation outcomes. The persistent preference for Filipino in various educational situations underscores its pedagogical significance in enhancing clarity, inclusion, and substantive learning in Physical Education.

5. Conclusion

Overall, the findings strongly support the hypothesis that Filipino as a medium of instruction is highly effective in teaching Physical Education to first-year tertiary students in a Tagalog-speaking region. Students consistently expressed a preference for Filipino across all aspects of learning, from understanding lectures and instructional materials to actively participating in activities and performing better in assessments. This preference translates into tangible benefits in terms of comprehension, engagement, and academic performance. The study reinforces the importance of leveraging the students' mother tongue or most familiar language to optimize learning outcomes, aligning with established theories on cognitive development and language acquisition. The implications suggest a need for educational institutions to further embrace and support the use of Filipino in PE instruction, coupled with the development of appropriate resources and continuous professional development for teachers.

Funding: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics Approval: Not applicable.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 233-246
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.611

David Hume and Education in the 21st Century: Maintaining A Balance Between Rationality, Emotion, And Morality

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Abstract
Modern educational practices are deeply rooted in the ideas of earlier philosophers. Some 18th-century thinkers have not been fully explored. One such thinker is David Hume. Hume is better known as a philosopher than an educator or educational thinker. Due to the limited research on Hume's thoughts on education, this paper examines his views on education and their relevance to the educational context of the 21st century. This study uses a qualitative, descriptive-philosophical approach using textual analysis and historical interpretation. The primary sources are Hume's original works, such as *A Treatise of Human Nature* (1739–1740), *An Inquiry Concerning Human Understanding* (1748), and *An Inquiry Concerning the Principles of Morals* (1751). The analysis is conducted by interpreting Hume's ideas within the framework of contemporary educational theory, particularly those related to experiential learning, moral education, and the integration of technology into the learning process. The results of the study show that Hume's thoughts are still very current for educational practice in this era. The influence of Hume's thinking on educational practice is evident in how his ideas are applied in various aspects of education, such as a curriculum based on real-life experiences and social morality; teachers acting as facilitators of experience and moral guides; democratic school management based on social reflection; and authentic and reflective learning evaluation. Hume inspired progressive educational figures such as John Dewey, Jean Piaget, and Carl Rogers, who emphasized experiential learning and humanistic education.

Keywords: Empirical Epistemology, Association of Ideas, Habit and Morality, Experiential Curriculum

1. Introduction

In the history of modern philosophy, the name of David Hume (1711–1776) occupies a pivotal position, particularly in the context of empiricism and skepticism. As a Scottish philosopher, historian, and economist, Hume made significant contributions to modern thinking on knowledge, morality, and education (Harris, 2018). His concepts on the origin of ideas, causal relationships, and the formation of morality through habit and experience provide a rich epistemological foundation for education, especially as it faces the challenges of globalization and technological development in the 21st century.

The 21st century is an era of knowledge revolution and digital transformation, learning is no longer limited to conventional classrooms but has shifted towards a learning system based on competency, creativity, and technology. Amid these changes, there is a need to revisit the foundations of educational philosophy to provide new direction and orientation for modern humans. Hume's thinking, with its empirical approach emphasizing experience and observation as the primary sources of knowledge, provides crucial inspiration for understanding how human learning and thinking can be constructed rationally, critically, and contextually.

Hume argued that all knowledge comes from experience, not from pure reason or innate ideas, as rationalists like Descartes believed (Hume, 1748/2007). This principle has profound implications for education: that learning must be based on concrete experience, observation, and reflection on the empirical world. In the context of modern education, this means that the learning process does not simply emphasize memorization or dogma, but rather the development of critical thinking skills, problem-solving skills, and moral and social sensitivity through direct experience.

Furthermore, Hume emphasized the importance of habits and moral emotions in the formation of human character (Hume, 1751/1998). For Hume, morality is not the result of mere rationality, but rather the result of social experience and empathy. This idea has profound relevance in modern character education, which seeks to foster social sensitivity, empathy, and moral responsibility in students. In the era of globalization, rife with digital moral and ethical challenges, Hume's thinking on morality based on social feelings becomes increasingly relevant.

Hume's major ideas are highly relevant to educational practice, yet there are rarely any specific studies linking Hume's ideas to educational practice. Therefore, this study analyzes Hume's main ideas related to education, particularly regarding empiricism, morality, and character formation. By exploring his thoughts, this study aims to reveal how Hume's thinking influences educational practice, including curriculum, the role of teachers, and school management, particularly in the 21st century.

Meanwhile, the significance of this study is: 1) theoretically, it can enrich the philosophical literature on education by demonstrating the relevance of Hume's classical thought in the context of modern education. 2) practically, the results of this study can inspire educators, curriculum designers, and educational policymakers in developing experiential learning models and moral reflection. 3) contextually, this paper is expected to connect the values of Hume's empiricism with educational practices in Indonesia, which are oriented towards active, critical, and character-based learning.

2. Research Method

This study uses a qualitative, descriptive-philosophical approach using textual analysis and historical interpretation. The primary sources are Hume's original works, such as *A Treatise of Human Nature* (1739–1740), *An Inquiry Concerning Human Understanding* (1748), and *An Inquiry Concerning the Principles of Morals* (1751). Secondary sources include modern literature discussing Hume's thinking in the context of education, morality, and epistemology (e.g., Smith, 1941; Macnabb, 1951/1966; Hendel, 1963; Belgion, 1965; MacIntyre and Alasdair, 1965; Merrill and Shahan, 1976; Mossner, 1980; Norton and Taylor, 2008; O'Brien, 2017; and Flage, 2019).

The analysis is conducted by interpreting Hume's ideas within the framework of contemporary educational theory, particularly those related to experiential learning, moral education, and the integration of technology into the learning process. Therefore, the results of this study are interpretive and reflective, rather than normative.

3. Results and Discussion

3.1. Socio-Historical Background of David Hume's Life

David Hume was born on May 7, 1711, in Edinburgh, Scotland, to an educated middle-class family. His father, Joseph Home was a respected lawyer, while his mother, Katherine Falconer, was known as a pious and highly

educated woman (Mossner, 2001). Hume grew up in a conducive social and intellectual environment during a time when Scotland was experiencing the Scottish Enlightenment (Vaccari, 2018). This period was marked by significant advances in philosophy, science, economics, and literature, involving figures such as Adam Smith, Thomas Reid, and Francis Hutcheson (Mossner, 2001).

From childhood, Hume demonstrated a remarkable talent for logical and reflective thinking. At the age of 12, he was accepted into the University of Edinburgh, where he studied Latin, Greek, logic, and philosophy. However, Hume was dissatisfied with the university's highly scholastic and speculative curriculum. He considered formal education to place too much emphasis on the rigid Aristotelian tradition and not enough space for empirical exploration of human experience (Flage, 2019). From this point, his interest in the new scientific methods introduced by Francis Bacon, Isaac Newton, and John Locke grew—all of which would later influence the foundations of his empiricist philosophy.

At a young age, Hume left university without completing a formal degree and chose to live independently as a writer and thinker. In a letter to a friend, Hume confessed that he had "fallen into an irresistible passion for thought," and from that moment on, he resolved to dedicate his life to the pursuit of philosophical truth (Mossner, 2001).

3.2. Intellectual Journey and Major Works

Hume's intellectual journey can be divided into three main phases: the initial period of philosophical system formation (1730–1740), the period of development and clarification (1740–1758), and the period of reflection and public influence (1758–1776) (Mossner, 2001; Slavov, 2016).

Early Period (1730–1740): The Birth of Radical Empiricism

It was during this early period that Hume wrote his most monumental work, *A Treatise of Human Nature* (1739–1740), which he wrote at around the age of 26. The book consists of three main parts: *Of the Understanding*, *Of the Passions*, and *Of Morals*. Through this work, Hume sought to develop a "science of man" in a manner comparable to the scientific method Newton used in physics (Demeter, 2016).

In the Treatise, Hume argued that all knowledge comes from impressions and ideas. Impressions are strong, direct experiences, while ideas are weak copies of those impressions. He rejected the rationalist notion of innate ideas and asserted that the human mind is merely the result of associations of experiences. Hume also introduced the theory of habit as the basis for causality—that our belief in causality is not the result of reason, but of mental habits formed through repeated experience.
The work was initially poorly received by the public, with Hume himself writing that the Treatise "*fell from the press with a barely audible thud*" (Hume, 1739/2007). Nevertheless, the ideas in the book became the foundation of modern empiricism and had a profound influence on the philosophy of education, particularly in the concepts of experiential learning and the association of ideas.

Development Period (1740–1758): Clarification and Publication of Moral Philosophy

After the less successful experience with the Treatise, Hume wrote other works that were more systematic and communicative. These include: 1) *An Enquiry Concerning Human Understanding* (1748), in which he modified and simplified his empiricist theory. In this book, he introduced the concept of the myth of causation, namely, that causal relationships cannot be proven logically but are only believed through custom and experience. 2) *An Enquiry Concerning the Principles of Morals* (1751), which emphasized the importance of feeling and sympathy as the basis of morality. For Hume, morality was not the result of rational deduction, but an expression of human feelings toward the happiness and suffering of others. Both works were more accessible and widely accepted than the Treatise. In an educational context, these works provided a foundation for moral education that was not dogmatic but based on social experience and empathy.

In addition, Hume wrote *Essays, Moral, Political, and Literary* (1741–1777), a collection of essays addressing economic, political, educational, and cultural themes. In it, he examined the role of education in shaping a civilized civil society, emphasizing the importance of social virtue and tolerance, and criticizing educational systems that were overly theoretical and detached from social reality.

Reflection Period (1758–1776): Historian and Public Philosopher

During this period, Hume shifted from theoretical philosophy to history and economics. He wrote *The History of England* (1754–1762), a six-volume masterpiece that examined the political, religious, and social development of England from Julius Caesar's invasion to the Revolution of 1688. This work made him famous throughout England and Europe, even more so than his philosophical works.

Hume also published economic essays such as *Of Money* (1777) which inspired the economic thinking of his close friend Adam Smith. Although these fields may seem distinct from education, Hume consistently demonstrated his belief that the social and moral progress of a nation depends on customs, experience, and social justice—a principle that would later become the foundation of modern social educational theory.
Hume died on August 25, 1776, in Edinburgh, at the age of 65. He inherited a vast and complex legacy of thought that not only changed the course of modern philosophy but also influenced psychology, ethics, social science, and the philosophy of education.

Distinctive Features of Hume's Thought in the Context of Education

Across his entire works and thought, several distinctive features of Hume's thinking are relevant to the field of education:

- *Empirical epistemology*. All forms of knowledge are acquired through sensory experience and reflection on that experience. This forms the basis for the experiential learning approach developed by figures such as John Dewey (1938) and David Kolb (1984).
- *Association of Ideas*. Hume explained that the human mind operates through associations between ideas arising from sensory impressions. In education, this is relevant to the theories of connectionism and associative learning developed in modern psychology such as Pavlov (1928), Watson (1913), and behaviorists (Shanks, 1995).
- *Habit and morality*. For Hume, human moral character is formed through habits and emotional experiences. This forms the basis for practice-based character education, not moral dogma. (Handayani, Ahmad, and Indrawati, 2023).
- *Methodological skepticism*. A critical attitude toward claims of absolute truth teaches the importance of critical and reflective thinking in modern education (Alcock, 1991).
- *Sympathy and empathy*. Hume emphasized social feelings as the basis of morality; this is relevant in 21st-century education, which emphasizes emotional intelligence (Ciarrochi, et al., 2013). and empathy in collaborative learning (Yang , 2023).

Thus, Hume's life and work not only contribute to the history of philosophy but also form a profound philosophical foundation for modern educational theory and practice.

4. David Hume's Main Ideas on Education

4.1. The Nature of Knowledge and Learning According to Hume

David Hume asserted that all human knowledge is rooted in experience. He rejected the rationalist view that the human mind possesses innate ideas present from birth (Hume, 1739/2000). In his work, *A Treatise of Human Nature*, Hume distinguishes between two types of mental perception: *impressions* and *ideas*. Impressions are strong, direct experiences, such as sensations, emotions, or sensory perceptions. Meanwhile, ideas are weak copies of impressions, namely images or memories of those experiences.

This relationship between impressions and ideas is the basis for the processes of thinking and learning. According to Hume, the human brain works by associating ideas based on three main principles:

- *Resemblance* – similar ideas tend to be connected.
- *Contiguity* – ideas experienced close together are related.
- *Cause and effect* – ideas about events are often linked to their consequences.

In the context of education, this view asserts that learning is a process of associating experiences. Knowledge is not simply transferred from teacher to student but rather is formed through concrete experiences that are then associated and processed in the mind. This thinking became the basis for the experiential learning theory later developed by John Dewey (1938) and David Kolb (Kolb, 1984), which emphasizes the cycle of experience, reflection, conceptualization, and application.

Hume also emphasized the importance of habit in the formation of beliefs. Beliefs about the world—including cause and effect—are not the result of pure reason, but rather the result of habits formed through repeated experience (Hume, 1748/2007). Thus, education plays a role in developing habits of thought and action through practice, repetition, and reflection. Teachers, in this case, are not merely transmitters of knowledge, but also guides in developing good intellectual habits.

4.2. Hume and the Formation of Morality: Feelings as the Basis of Ethics

One of Hume's most important contributions to the philosophy of education lies in his theory of morality. In *An Enquiry Concerning the Principles of Morals* (1751), Hume rejected the view that morality is based on reason. He wrote, "Reason is, and ought only to be, the slave of the passions"—reason is merely the servant of feeling (Hume, 1739/2000, p. 415). In other words, human moral decisions are determined more by emotion and sympathy than by rational calculation.

Hume introduced the concept of "*moral sentiment*," or moral feeling, which is the natural human ability to feel the happiness or suffering of others. He argued that humans possess an instinct of sympathy that is the basis of morality and social life. True morality, he argued, is the result of the human ability to empathically feel the suffering and happiness of others (Norton and Taylor, 2008).

In the context of education, Hume's moral theory emphasizes that moral education should be directed at developing empathy and social habits, not simply instilling ethical norms or dogmas. Children need to be encouraged to experience, feel, and reflect on the moral consequences of their actions. This aligns with contemporary character education principles that emphasize social-emotional learning, where students learn through social interaction, collaboration, and emotional reflection (Elias et al., 1997).

4.3. Hume's Empiricism and Its Implications for the Learning Process

Hume's empirical epistemology has important implications for modern learning theory. Some of these implications are as follows.

First, *Learning as an active process.* Because knowledge is formed through experience, thus, learners must be actively involved in activities that allow them to observe, experiment, and reflect. Teachers function as facilitators who create an experientially rich learning environment. **Second**, *Contextual and meaningful learning.* Ideas are only meaningful when rooted in real experiences. Therefore, learning must be linked to the context of learners' lives to avoid abstraction or verbalization. **Third**, *The importance of reflection.* Experience does not automatically produce knowledge; reflection is needed to transform experience into conceptual understanding. Hume called reflection the process of associating higher ideas. **Fourth**, *The role of habit and repetition.* Habit is a mechanism for forming beliefs and character. In education, consistent repetition and practice form stable and deep-rooted thought structures. **Fifth**, *Skepticism as a tool for critical thinking.* Hume introduced a skeptical attitude towards claims of absolute truth. In education, this means fostering critical and reflective thinking skills regarding information, ideology, and authority. Students are encouraged to ask "why" and "how" rather than passively receiving information.

Thus, Hume's empirical epistemology is not only a theory of knowledge, but also a pedagogical framework that emphasizes activity, experience, reflection, and habituation in the educational process.

4.4. Hume's Views on Reason, Emotion, and Human Education

For Hume, humans are not rational beings in the absolute sense, but rather creatures who combine reason and emotion in decision-making. He rejected the rigid dichotomy between reason and feeling, asserting that the two complement each other in moral and intellectual life (Hume, 1739/2000).

In the context of education, this means that the educational system should emphasize not only cognitive or intellectual aspects, but also affective and emotional aspects. The ideal education, according to Hume's interpretation of thought, is one that fosters a balance between logical thinking skills and emotional sensitivity. Teachers not only teach concepts but also help students develop mature moral and emotional personalities.

This concept resonates strongly with the idea of "whole person education" in modern educational philosophy, which seeks to develop the full potential of human beings: intellectual, emotional, social, and spiritual (Noddings, 2013). In other words, education, according to Hume's spirit, is not a mechanistic process, but a humanizing process that fosters experience and moral sensitivity.

4.5. Education as the Formation of Social Habits

The concept of habit in Hume's philosophy relates not only to cognitive beliefs but also to social and moral behavior. He argued that human morality is formed through social habits that are repeated and reinforced by collective experience. In his essay, "Of the Rise and Progress of the Arts and Sciences" (1742), Hume wrote that a civilized society is one that successfully instills habits of rational thought and moral action through education.
In the school context, the formation of these social habits is reflected in 1) the development of a work ethic and social responsibility, 2) the cultivation of empathy and fairness in social interactions, 3) the habit of reflective and critical thinking in assessing experiences.

Teachers play a crucial role in instilling these habits through role modeling and positive reinforcement. Thus, according to Hume, education is not merely the transmission of knowledge, but a process of moral and social habituation that fosters good character.

4.6. Synthesis: Education According to Hume as an Empirical-Moral Project

From Hume's overall thinking, it can be concluded that education is an empirical-moral project that combines: 1) *Empirical knowledge* – learning from real experience through observation and reflection; 2) *Sentimental morality* – cultivating sympathy, empathy, and social virtues; 3) *Intellectual and social habituation* – building belief and behavioral structures through repeated experience; 4) *Critical and reflective* – avoiding dogmatism and prioritizing rational thinking and methodological skepticism.

Hume rejected dogmatic and formalistic education. He desired an education that was lively, open to experience, and fostered moral abilities through social life. Thus, his thinking bridged the gap between empirical philosophy and modern educational theory, which emphasizes learning by doing and moral experience (Otteson, 2021).

5. The Influence of David Hume's Thoughts on Educational Practice

Hume's thought, rooted in empiricism and sentimental ethics, not only had a profound impact on the philosophy of knowledge and morality, but also laid the foundation for several schools of thought in modern education. Hume established the principle that knowledge is the result of experience, and that morality arises from feelings and social habits, not from abstract rationality. These principles became the impetus for the emergence of an educational paradigm that emphasizes experiential learning, moral reflection, and the development of social character (Stroll & Popkin, 2008).

Throughout the history of education, Hume's ideas have inspired the development of various theories and practices, such as 1) the empirical education of John Locke and his successors, 2) the progressive education of John Dewey (1938), 3) experiential learning (Kolb, 1984), 4) and character education based on emotional morality (Noddings, 2013).

Through these channels, Hume's influence extends to all aspects of the educational system: from the curriculum and the role of teachers to school management and the design of learning assessments.

5.1. Influence on the Educational Curriculum

Hume rejected the view that knowledge is acquired through innate ideas; instead, knowledge grows from concrete experience. A direct implication of this is that the educational curriculum should be oriented toward concrete experience and critical reflection on that experience.

Experiential Curriculum

Hume inspired the concept of the "experiential curriculum," a curriculum design that places direct experience at the heart of the learning process. In this paradigm: 1) students not only learn concepts but also conduct, observe, and reflect on those experiences; 2) learning occurs through experiments, discussions, social projects, or field observations; 3) knowledge is actively constructed by students, rather than passively transferred from teachers.
This idea was further developed by John Dewey in *Democracy and Education* (1916) and *Experience and Education* (1938), who viewed education as a social process in which experience forms the basis for intellectual and moral development. Dewey explicitly acknowledged the influence of Hume's empiricism on his theory of experience and reflection (Dewey, 1938).

Contextual and Interdisciplinary Curriculum

Hume's belief that ideas are formed through associations and interconnected experiences encourages an interdisciplinary approach to the curriculum. This means that knowledge should not be taught in silos within academic disciplines, but rather should demonstrate the interconnectedness of concepts, as humans naturally relate to real-life experiences.

This contextual curriculum helps students understand the relationship between science and life, making learning meaningful and applicable (Beane, 1997). Hume emphasized that social and moral experiences are part of the formation of knowledge; therefore, education should also incorporate moral, social, and cultural aspects into curriculum design.

Moral and Social Curriculum

For Hume, morality stems from moral sentiments—feelings of empathy for others. Moral education, therefore, should be directed at fostering sympathy, empathy, and social sensitivity through real-life social experiences, rather than through memorizing norms. The modern curriculum that integrates social-emotional learning (Elias et al., 1997) and character education is a form of implementation of Hume's ideas in contemporary education.

Influence on the Role of Teachers

In Hume's philosophy, teachers are not viewed as absolute authorities holding the truth, but as facilitators of learning experiences. The teacher's role is to help students form associations between experiences and ideas through reflective guidance and empathetic social interactions. Besides that, teachers also play a role as reflective practitioners (Schön, 1983; Brookfield, 2017).

5.2. Teacher as Facilitator of Experience

Hume views learning as the result of direct experience and the association of ideas. Therefore, teachers should create conditions that enable students to: 1) directly experience the phenomena being studied, 2) reflect on these experiences, 3) develop habits of critical and analytical thinking. This model of teacher is evident in the constructivist teaching approach (Piaget, 1977; Vygotsky, 1978), which views students as constructors of their own knowledge. Hume provided a philosophical basis for this view through his theory of empiricism.

5.3. Teacher as Moral and Emotional Guide

Hume places morality within the realm of emotions and sympathy. Therefore, teachers also play a role as guides in developing students' emotional sensitivity. Teachers are required to model empathy, honesty, and fairness, and to foster a classroom climate that fosters mutual respect. This concept predates the idea of humanistic education developed by Carl Rogers (1969), which emphasized the importance of positive emotional relationships between teachers and students.

5.4. Teachers as Models of Habituation

Because, for Hume, morality is formed through habit, teachers play a crucial role in shaping habits of mind and heart. Positive reinforcement (Zeiler, 1976), the practice of acting justly, and moral training in school life are concrete forms of education rooted in Hume's habit theory. In this context, teachers serve as living moral models.

Influence on School Management

Hume's thinking also has implications for educational management. He emphasized the importance of social experience, habit, and justice as the foundation for forming a civilized society. These principles can be applied in modern school management.

First, *Schools as Learning Communities*. Based on Hume's view of society as a place where morality is formed through social habits, schools can be understood as moral and intellectual communities. Schools are not merely formal institutions, but ecosystems where students learn to live together, empathize, and take responsibility. In this regard, school management needs to prioritize participatory, dialogical, and ethical values. The principles of democratic schooling developed by Dewey (1938) represent a practical application of Hume's empirical and moral spirit.

Second, *Moral Leadership in Education*. Hume rejected authoritarianism in morality and emphasized social virtue. In the context of educational leadership, this means that principals or heads of educational institutions should be moral leaders who foster a culture of empathy, reflection, and togetherness (Fullan, 2003; Heifetz, 2009). Leadership oriented toward shared experience and positive moral habits aligns with Hume's social philosophy.

Third, *Experience-Based Evaluation and Decision-Making.* Effective school management must be based on empirical evaluation, not mere assumptions or traditions. Hume's empiricist principles encourage the application of evidence-based management in education, where decisions are made based on data and reflection on experience. This is highly relevant in the modern era, which demands accountability and transparency in the management of educational institutions (Leithwood et al., 2020).

Influence on Evaluation and Assessment Processes

Hume's concept of empiricism has implications for educational evaluation systems. Hume emphasized that knowledge is only valid if it has an empirical basis; therefore, educational assessment must reflect students' actual learning experiences.

Several evaluation principles that align with Hume's ideas include: 1) Authentic assessment – assessing students' abilities in real-life situations, not simply through written exams. 2) Formative assessment – ongoing assessment that provides feedback on learning progress. 3) Reflective evaluation – encouraging students to self-assess their

learning experiences. Thus, evaluation measures not only cognitive learning outcomes but also moral, social, and emotional growth.

Hume's thinking has had a profound influence on modern educational theory and practice. Through his empiricism, he asserted that: 1) education must be rooted in experience and observation, not dogma or tradition; 2) morality and character are formed through social feelings and customs; 3) teachers, curriculum, and school management act as facilitators of moral and intellectual experiences.

In this way, Hume's philosophy became the foundation for the emergence of progressive education, experiential learning, and humanistic character education. He bridged the rational and emotional worlds into a single entity: education as a process of becoming a human being who thinks and feels ethically.

6. The Influence of David Hume's Ideas on Educational Practice in the 21st Century

Entering the 21st century, the world of education faces complex challenges: globalization, digitalization, socio-cultural change, and technological disruption that are transforming the way humans learn and interact. In this context, David Hume's classic ideas appear to have acquired new relevance.

Hume emphasized that knowledge arises from concrete experience, morality grows from social sentiment, and human virtue is formed through the constant cultivation of habits. These principles align with the modern educational paradigm, which emphasizes active, reflective, collaborative, and contextual learning (OECD, 2019). This section will examine how Hume's ideas influence and inspire 21st-century educational practices across several key dimensions: (1) curriculum and learning approaches, (2) the roles of teachers and learners, (3) school management and organizational culture, and (4) the use of digital technology in education.

6.1. Influence on Curriculum and Learning Approaches

Experience-Based and Project-Based Learning

Hume's concept of empiricism—that all knowledge is rooted in sensory experience—has found direct application in the form of Project-Based Learning (PjBL) (Bell, 2010; Kokotsaki, 2016), Experiential Learning (Kolb, 1984), and Inquiry-Based Learning in the 21st century (Chu, et al., 2021). In these models, students do not simply receive information, but actively act, observe, reflect, and draw conclusions. This pattern is identical to Hume's theory of the association of ideas, where empirical experience shapes thought structures and intellectual habits.

The 21st-century curriculum, which emphasizes critical thinking, creativity, collaboration, and communication (the 4Cs) (Trilling and Fadel, 2009), is rooted in Hume's empirical understanding: humans learn to think through association and reflection on experience, not simply memorizing concepts.

Values and Social Intelligence Curriculum

Hume argued that morality arises from moral sentiments, not reason. Therefore, 21st-century education, which emphasizes the importance of social-emotional learning (SEL) (Bailey, et al, 2019) education for empathy, and global citizenship education, is a direct manifestation of Humean ethics. Modern curricula now focus not only on the cognitive domain but also on the affective domain—empathy, self-awareness, and social awareness (CASEL, 2020). All of this aligns with Hume's view that "reason is, and ought only to be, the slave of the passions" (*Treatise of Human Nature*, 1739/2007).

Adaptive and Flexible Curriculum

For Hume, truth is relative to experience and context. In 21st-century education, this translates into the principle of curriculum flexibility—a curriculum that adapts to student needs, social change, and technological dynamics.

Adaptive curricula such as Merdeka Belajar in Indonesia, or the Competency-Based Curriculum in various countries, reflect the spirit of empiricism: learning from concrete reality, not rigid dogma (Kim, 2015).

6.2. Influence on the Role of Teachers and Students

Teachers as Empirical Facilitators

21st-century teachers are expected to act not as centers of knowledge, but as facilitators of learning experiences. This aligns with Hume's view that humans acquire knowledge through observation and practice. Teachers function as facilitators of experiential associations, helping students build connections between theory and reality, and guiding them toward meaningful reflection (Brookfield, 2017).

This role of teacher demands: 1) the ability to design authentic learning experiences, 2) the ability to facilitate critical reflection and discussion, 3) sensitivity to students' emotional and moral dimensions.

Learners as Active Subjects

Hume's philosophy rejects innate ideas, emphasizing that each individual constructs knowledge through personal experience. In the modern context, this means that learners are active subjects in the learning process. This model is evident in student-centered learning, personalized learning, and blended learning approaches, where students are given the freedom to explore and construct meaning from their learning experiences (Anderson, 2016).

Teachers as Shapers of Moral Habits

According to Hume, morality is formed from good social habits. Therefore, 21st-century teachers also function as guides in moral habits, both in the real and digital world. Teachers must instill habits of critical thinking, honesty, and responsibility in a global and technological context (Noddings, 2013).

6.3. Influence on School Management and Organizational Culture

Schools as Moral and Social Communities

Hume views society as a place where morality is formed through social habits and feelings. In the 21st century, the ideal school is not just an academic institution, but a moral community that fosters social and collaborative character (Fullan, 2003). The organizational culture of a school should foster the values of empathy, honesty, and collective responsibility through everyday social practices, not through rigid rules. In the spirit of Hume, morality grows from practice, not from commandments.

Data- and Experience-Based Management

Hume's empiricist principles underlie the concept of evidence-based education management, which involves making decisions based on real data and the results of institutional experience. Modern school management now uses empirical analysis to determine learning strategies, evaluate curriculum, and improve quality (Leithwood et al., 2020). This approach rejects dogma and intuitive decisions, replacing them with a reflective, evidence-based process—in line with Hume's empiricist spirit.

Adaptive and Reflective Leadership

Hume viewed humans as creatures who learn through mistakes and habit. Therefore, 21st-century educational leaders must be adaptive and reflective, open to new experiences, and able to facilitate organizational learning. This type of leadership (Heifetz et al., 2009) aligns with the Humean principle of virtue formation through continually renewed moral and social experiences.

6.4. Utilizing Technology from a Humean Perspective

Although Hume lived long before the digital era, his ideas can be applied in the context of edutech and digital learning in the 21st century.

Technology as a Tool of Experience

For Hume, empirical experience is the foundation of knowledge. In digital education, technology becomes a means to expand sensory and social experiences through simulations, virtual experiments, and online interactions. Platforms such as virtual labs, game-based learning, and augmented reality provide opportunities for students to learn through multisensory experiences, reinforcing the principles of empiricism in modern learning (Johnson et al., 2022).

Technology and the Formation of Learning Habits

Hume emphasizes the role of habits in shaping moral and cognitive behavior. Technology can support the formation of learning habits through adaptive learning systems, gamification, and learning analytics that motivate students to learn consistently. However, Hume also emphasizes the importance of the moral dimension: technology should be used to strengthen social virtue, not simply intellectual efficiency.

Digital Ethics and Sentimental Morality

In the digital world, the sentimental morality proposed by Hume is becoming increasingly relevant. 21st-century education needs to develop digital empathy and ethical awareness, so that technology does not distance humans from human values. Digital ethics education—such as cyber citizenship, digital responsibility, and online empathy training—is a concrete application of Humean ethics in the digital space (Floridi, 2013).

6.5. Global Relevance and Critical Reflection

Hume's thought also has cross-cultural and global relevance: 1) In the context of global citizenship education, Hume's passion for universal empathy and social virtue can form the basis for cross-cultural ethics. 2) In the context of pluralism and democracy, Hume's view of morality as the product of social experience strengthens education for tolerance and intercultural dialogue (Appiah, 2006). 3) In the context of innovation and creativity, Hume's empiricism emphasizes the importance of experimentation, the courage to try, and learning from mistakes—essential characteristics of the 21st-century creative economy (Florida, 2019).

However, critical reflection is also necessary. Hume's empiricism, which emphasizes sensory experience, needs to be combined with a rational and transcendental approach so that education does not lose its profound moral direction (MacIntyre, 1984). Therefore, Hume's philosophy must be seen not as a closed system, but as a framework for dialogue between experience and values.

David Hume's empirical and sentimental moral philosophy offers a highly relevant foundation for 21st-century education. In a fast-paced, data-saturated digital age, Hume reminds us that experience, reflection, and moral habits remain at the heart of true education.
In summary: 1) The curriculum must be based on real experiences, flexible, and values-oriented; 2) Teachers must be facilitators of empathy and guides to moral habits. 3) School management must be based on data and social experience. 4) Technology is used to expand human experience, not replace it.
Hume helps modern education maintain a balance between rationality, emotion, and morality—the three pillars that shape the whole person in a complex global society.

7. Conclusion

The thoughts of David Hume, an 18th-century empiricist and skeptical philosopher, have made extensive contributions to various fields of science, including education. Through works such as *A Treatise of Human Nature*

(1739) and *An Enquiry Concerning Human Understanding* (1748), Hume asserted that all human knowledge stems from experience, that morality arises from feelings (moral sentiments), and that habit is the primary basis for the formation of human beliefs and actions. In the context of education, Hume's ideas have far-reaching implications. 21st-century education faces the challenges of globalization, digitalization, and a moral crisis. In this context, Hume's thoughts are relevant because they emphasize the importance of concrete experience and moral formation through social empathy. The primary objective of this discussion is to understand the relevance of Hume's empiricism and sentimental ethics to contemporary educational practice.

Hume's intellectual journey as a Scottish empiricist thinker sought to bridge Descartes' rationalism and Locke's empiricism. He argued that human reason is nothing more than a tool subject to experience and emotion. His monumental works formed the basis for modern philosophy of science and theory of knowledge. Although not specifically addressing education, Hume viewed education as a process of moral and intellectual conditioning through experience. He rejected dogmatic education that emphasized memorization and abstract logic. Instead, he proposed an education that fostered reflection, empathy, and rational thinking based on empirical evidence.

The influence of Hume's thinking on educational practice is evident in how his ideas are applied in various aspects of education, such as a curriculum based on real-life experiences and social morality; teachers acting as facilitators of experience and moral guides; democratic school management based on social reflection; and authentic and reflective learning evaluation. Hume inspired progressive educational figures such as John Dewey, Jean Piaget, and Carl Rogers, who emphasized experiential learning and humanistic education.

In the 21st century, or the digital age, Hume's philosophy remains relevant. In a world dominated by technology and data, the principles of empiricism emphasize the importance of learning from real experiences, not just simulations. The 21st-century curriculum, which focuses on competencies (4Cs), teachers as facilitators, data-driven management, and digital ethics, is a direct reflection of Hume's empirical and sentimental moral spirit. Furthermore, the use of educational technology—such as virtual labs, adaptive learning, and digital empathy training—can be seen as an application of empirical principles in the modern world.

Overall, Hume reminds us that true education must balance reason, experience, and moral feeling. In the era of globalization and artificial intelligence, this balance is crucial to prevent humans from losing their identity as rational and emotional beings.

Education that emphasizes only cognition without empathy will produce intelligent individuals without hearts; conversely, education that ignores empiricism will lose the foundation of verifiable knowledge. Thus, Hume's legacy serves as a reminder that education is the art of developing critical thinking habits while fostering a just moral sense.

7. Implications and Recommendations

1. For Curriculum Developers: Hume's principles of empiricism can be used to strengthen contextual, project-based, and experiential approaches to students.
2. For Teachers: Strengthening reflective and empathetic capacities is necessary so that teachers can become facilitators of experience and moral guides.
3. For School Management: A data-driven, participatory management system rooted in a culture of collective reflection is necessary.
4. For Digital Education: The development of educational technology needs to be grounded in Hume's sentimental moral ethics to remain humanistic and empathetic.
5. For Educational Researchers: Hume's thinking can serve as a foundation for empirical studies of educational philosophy, particularly regarding the relationship between emotions, habits, and learning.

Author Contributions: All authors contributed to this research.

Funding: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics Approval: Not applicable.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 247-253
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.612

Empowering Adapted and Inclusive Physical Education Through Artificial Intelligence: A Systematic Review

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Abstract
Artificial intelligence (AI) is rapidly transforming the education sector. It can offer inclusivity for students with special educational needs in Physical Education (PE). This review synthesized current researches and reviews that focused on the application and future directions of AI in Adapted Physical Education (APE) and Inclusive Physical Education (IPE). It is grounded in established theoretical frameworks, including the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Universal Design for Learning (UDL). The AI-driven methods help overcome the drawbacks of traditional methods, such as large class sizes and insufficient individualized support. With the help of AI, personalized learning, real-time feedback, and data-driven instructional modifications become feasible. The application of AI to APE/IPE includes motion analysis, adaptive learning platforms, intelligent tutoring systems, and virtual and augmented reality for skills development, injury prevention, and health monitoring. However, concerns and difficulties persist around data privacy issues, ethical considerations, inadequate teacher training, infrastructure limitations, and ensuring equal access to AI technology. The review emphasizes the necessity for professional development of educators, clear policy frameworks for data protection, and inclusive design with stakeholders to ensure that AI tools align with the pedagogical goals and learner needs. Future research should focus on the longitudinal impacts, cultural adaptability, and the balance of AI support with human interaction to sustain the social and motivational aspects of physical education. Ultimately responsible, clear, and well-supported AI integration in APE/IPE holds promise for transforming teaching and learning practices towards a more engaging, personalized, and effective physical education for all students.

Keywords: AI, Personalized Learning, Physical Education

1. Introduction

Artificial intelligence (AI) is rapidly transforming many sectors, including education, with Physical Education (PE) being no exception (Karimi & Khawaja, 2023; Wang et al., 2024; Wang & Wang, 2024; Wu et al., 2025). In response to the diverse needs of students and evolving learning styles, AI offers new possibilities as a tool for developing more flexible, efficient, and accessible learning environments (Singh et al., 2024; Wu et al., 2025). These innovations are especially promising for Adapted Physical Education (APE) and Inclusive Physical

Education (IPE), where the goal is to ensure that all students, including those with special educational needs, are involved. In this ever-changing world, integrating AI into physical education (PE) has become a crucial field of educational innovation (Wu et al., 2025).

Enhancing the inclusion of students with special educational needs in physical education classes is the aim of adapted physical activity (APA) and inclusive physical education (IPE) (Ben Rakaa et al., 2025). According to Rakaa et al. (2025) and Li (2025), the strategy is essential for physical development, engagement, equitable and active involvement of all students. However, common problems with traditional PE approaches, such as large class sizes, a lack of resources, and the inability to provide sufficient individualized support, may make it difficult to effectively incorporate students with diverse abilities (Li, 2025).

The incorporation of AI in adaptive physical education is based on various recognized theoretical frameworks. According to Wu et al. (2025), the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) provide insight into user acceptability factors that are essential for educators and students to adopt AI successfully. AI technologies apply the Universal Design for Learning (UDL) principles advocated by inclusive education frameworks by offering a variety of interaction, representation, and expression options suited for different learning needs (Rakaa et.al., 2025).

The purpose of this review paper is to explore how AI can support APE and IPE. It will methodically examine the advantages and difficulties of incorporating AI into physical education. This paper aims to give an understanding of AI's role in developing more engaging, adaptive, and supportive learning environments for students with special educational needs.

2. Methods

This review synthesized findings from several systematic and scoping reviews, as well as empirical studies. The methodological approach of this review is described below.

2.1. Search Strategy

Studies were identified by searching keywords from various electronic databases: Google Scholar, PubMed, ProQuest, Research Gate, and Scientific Research. A time search parameter was also established, which covers the years 2021 to 2025. Keywords used included: AI-related terms: “artificial intelligence” and “AI”, for PE-related terms: "physical education," "PE," "adapted physical activity," "APA," "inclusive physical education". Boolean operators like “AND” were also used to narrow search scopes within categories.

2.2. Inclusion

The research had to be published within the years 2021-2025 and should be English-based. It should evaluate the effects of modified teaching methods in physical education or investigate the use of Artificial Intelligence in Adapted or Inclusive Physical Education, or Physical Education. It is focused on students, educators, or professionals in physical education or adapted physical education/ inclusive education. Discusses the results of using AI, like how well students learn, how engaged they are, how they develop their skills, or how difficult it is to incorporate AI into teaching methods.

2.3. Exclusion

Unrelated studies, not directly related to the review, or those with incomplete keywords. Research that is not specifically about physical education, adapted physical education, or inclusive physical education. Even theoretical or conceptual papers that lack empirical support.

3. Results

The PRISMA 2020 flow diagram (Figure 1) illustrates the study procedure. Initially, 334 studies were identified through various sources such as Google Scholar, PubMed, ProQuest, ResearchGate, and Scientific Research. Due to being unrelated to the study, duplicates or having incomplete keywords, 289 studies were excluded from the list during the screening process. Furthermore, during the assessment, 23 were removed for reasons such as being non-English (3), unpublished (6), in books (2), and not available in full text (12). Ultimately, 22 studies met the eligibility criteria and were included in the final review.

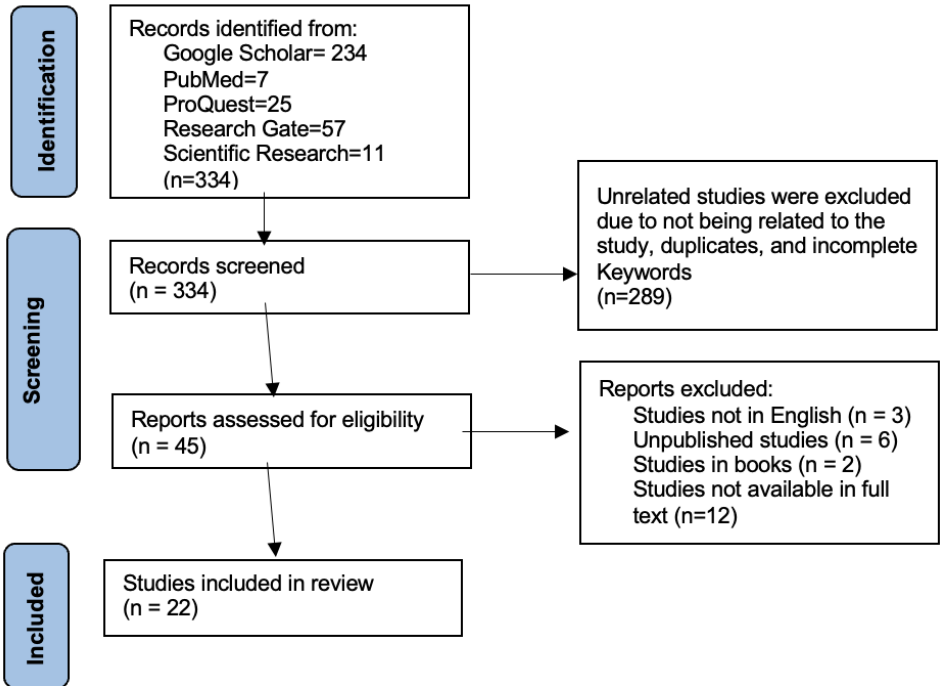

Figure 1 PRISMA 2020 flow diagram

Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

The effective application of AI in improved physical education practices is being documented by more recent studies. Ji et al. (2025) demonstrated how AI-powered motion analysis made it possible to conduct accurate, customized skill evaluations, which sped up students' development in modified curricula. According to Li (2025 and Singh et al. (2024), immersive virtual and augmented reality settings created for students with impairments resulted in increased engagement and improvement of motor skills. According to Cui et al. (2025), wearable AI technologies offer real-time health monitoring to minimize training loads and avoid injury, which greatly enhances student welfare. The significance of user experience design was highlighted by Wu et al. (2025), who further employed extended UTAUT models to identify characteristics promoting positive behavioral intention toward the consumption of AI-generated materials among PE students.

4. Discussion

This review highlights AI's transformative potential for Adapted and Inclusive Physical Education by exploring its advantages, challenges, and how AI can be improved to be utilized in the field.

4.1. Advantages of AI for Adapted Physical Education

AI's core advantage is its capacity to tailor educational activities to meet the individual needs, learning preferences, and physical circumstances of students (Li, 2025; Singh et al., 2024; Sun, 2025). Such personalization is critical in APE and IPE, where diverse abilities require customized methods beyond one-size-fits-all approaches (Kabudi et al., 2021; Sun, 2025). Moreover, AI helps remove barriers faced by learners from different language backgrounds, those with disabilities, or those living in remote areas (Khan, 2024; Li, 2025; Singh et al., 2024).

Traditional training often lacks timely and precise feedback, but AI-powered tools offer quick, accurate, and objective feedback on performance and movement patterns (Ji et al., 2025; Kabudi et al., 2021; Wu et al., 2025; Zhong et al., 2025). Technologies like human skeletal analysis and 3D reconstruction enable teachers to pinpoint specific areas for improvement, facilitate quick adaptations, and enhance the effectiveness and fairness of PE evaluations. (Guo, 2023; Ji et al., 2025; Kabudi et al., 2021; Singh et al., 2024; Wang et al., 2024).

Immersive technologies, including virtual reality and augmented reality, when paired with gamification, create interactive learning environments that greatly increases student engagement and motivation. These are particularly helpful for students with learning difficulties, by improving their motor skills and participation in fitness activities (Li, 2025; Singh et al., 2024; Wu et al., 2025). Real-time health monitoring by smart wearable AI devices further advances injury prevention and supports personalized training by continuously tracking physiological and exercise load data, allowing early risk detection and optimized instructional decisions (Cui et al., 2025; Singh et al., 2024; Sun, 2025; Wang & Li, 2024; Zhong et al., 2025).

AI also assists educators by automating administrative tasks such as lesson planning, equipment management, and attendance tracking, which maximizes teaching efficiency and resource use (Cui et al., 2025; Singh et al., 2024; Sun, 2025). It also helps teachers adjust to new curricular standards and maximizes the use of resources (Kaya, 2025).

4.2. Difficulties and Challenges

AI integration of AI to PE is complex and raises significant concerns. Data privacy, security, and algorithmic bias are major concerns due to the extensive collection and analysis of student data (McNamara et al., 2025; Miao, 2023; UNESCO, 2021; Wang & Li, 2024). According to UNESCO (2021), strong policy frameworks are necessary to ensure ethical use and safeguard learners' rights because generative AI has the potential to provide biased or misleading information.

The literature on the subjective experiences of physical education instructors and their readiness to successfully incorporate AI is noticeably lacking (UNESCO, 2021). The insufficient preparation and inexperience of PE teachers are one of the most prominent barriers to broader acceptance (Rakaa et al., 2025; Kaya, 2025; Martín-Rodríguez & Madrigal-Cerezo, 2025; Singh et al., 2024). To successfully integrate AI tools while retaining their pedagogical understanding, teachers require professional development that covers both technological skills and pedagogical issues. Inadequate infrastructure, technical limitations, and unequal access to AI-supported resources further contribute to educational inequities and must be addressed to ensure fair access (Rakaa et al., 2025; Li, 2025; McNamara et al., 2025). To avoid educational inequalities, it is essential to ensure fair access to AI-supported physical education resources and to use interfaces that are both affordable and easy to use.

Since physical education is dynamic, careless AI implementation can lead to student over-reliance, passive learning, or fragmented knowledge, potentially reducing the effectiveness of dynamic physical education (Zhong et al., 2025). Therefore, the human and social elements of teaching and learning must remain certain in AI integration.

4.3. Data Privacy, Security, and Ethical Use

The integration of AI in adapted and inclusive physical education brings considerable benefits but also raises important questions about data privacy and security. AI systems typically require the collection of a vast amount of sensitive information, including students' academic performance, behavioral patterns, and even biometric data such as facial recognition and/ or physiological measurements. This extensive data collection creates challenges around consent, data ownership, and protection. Without strong safeguards, sensitive data could be vulnerable to breaches, misuse, or unauthorized access, undermining students' privacy rights and trust (McNamara et al., 2025; UNESCO, 2021).

To address these concerns, educational institutions must adopt rigorous data governance frameworks and comply with strict data privacy regulations like the General Data Protection Regulation (GDPR). Modern guidelines, including UNESCO's guidelines on ethical AI use (2021), place a strong emphasis on accountable, transparent AI systems that protect learner privacy and avoid algorithmic bias. Informed consent, data minimization, and secured storage of sensitive biometric and performance data gathered by AI devices are all required by compliance with data protection laws of GDPR counterparts. Furthermore, transparent policies and informed consent processes build confidence among students, educators, and stakeholders in AI use. Ethical AI implementation involves not only technical safeguards but also accountability mechanisms to ensure fairness, transparency, and respect for learner rights (UNESCO, 2021).

4.4. Future Research Directions

Despite the promising advances, substantial gaps remain requiring further investigation.

To determine long-term advantages and potential side effects, longitudinal research monitoring the physical, cognitive, and psychosocial effects of AI-enhanced physical education is required. It is also vital to investigate how cultural contexts influence AI adoption, acceptance, and equity to develop solutions that are sensitive and adaptable across different educational settings.

Continued innovation is also required to create accessible, user-friendly AI gadgets that are specifically suited for a range of disabilities and learning needs. Future research should aim to identify the optimal balance between AI-driven automation and human interaction, preserving the social, motivational, and embodied aspects intrinsic to physical education. Addressing these priorities will help ensure that AI serves as a supportive tool that enhances, rather than replaces educators' role in fostering inclusive and effective physical education.

5. Conclusion

AI is poised to fundamentally reshape adapted and inclusive physical education by offering personalized, engaging, and effective learning experiences. AI provides significant advantages, including customized workout regimens, real-time evaluation and feedback, enhanced student engagement via immersive technologies, and simplified administrative duties for teachers. For students with diverse needs, these AI-driven developments greatly improve overall learning results and improve accessibility and educational outcomes, promoting equity and inclusion in physical education settings.

However, there are several significant obstacles to overcome before utilizing AI in this area. AI introduces crucial challenges such as data privacy, ethical concerns, infrastructure deficits, unequal access to technology, and the need for thorough teacher preparation. To ensure AI enhances rather than replaces the vital role of educators and the embodied aspects of physical learning, it is necessary to integrate AI in PE in a comprehensive way that takes into account both technological capabilities and human consideration. There should be professional development, clear policy formation, and inclusive stakeholder collaboration. Moreover, ongoing researches should examine the long-term cognitive, physical, and social impacts of AI adoption, explore culturally responsive implementations, and elucidate optimal balances between AI use and human interaction in learning.

Moving forward, a collaborative approach among policymakers, educators, researchers, and developers is essential to create clear guidelines, inclusive policies, and transparent, accessible AI solutions. Continuous research must investigate the long-term impacts of AI on physical, cognitive, and social aspects of learning, while preserving the vital human elements of motivation and interaction inherent to quality physical education. Through these efforts, AI can become a powerful tool to empower all learners to reach their highest potential in diverse and inclusive educational environments.

6. Future Recommendations

The following actions are advised to promote ethical, responsible, and inclusive incorporation of AI in Adapted and Inclusive Physical Education:

1. *Policy, Ethics, and Data Protection for Policymakers:* Policymakers should create and implement legal frameworks that protect data privacy, support moral AI design protecting learner privacy and avoiding algorithmic bias, and allocate funds fairly for AI infrastructure in educational institutions.
2. *For Professional Development and Pedagogical Integration among Educators:* To effectively integrate AI tools while maintaining learner-centered, inclusive practices, educators should participate in continual professional development centered on AI technologies and pedagogy. Training must cover AI tool operation, ethical data handling, and curriculum adaptation while maintaining learner-centered, inclusive practices.
3. *For Developers Inclusive Co-design and Stakeholder Engagement:* Collaborate with educators, students, and disability advocates to create AI systems that are transparent, accessible, and in line with inclusive education objectives. Institutions should encourage stakeholders' collaboration, including students, parents, administrators, and tech companies, in co-design procedures. This approach helps match AI applications with local requirements and values, encouraging support and cooperative problem-solving. AI systems should be programmed to be transparent, accessible, and in line with inclusive education objectives.
4. *For Institutional Readiness and Infrastructure Investment:* Conduct readiness assessment, invest in strong infrastructure as well as strong network connectivity, then guarantee the availability of technical support and maintenance. Institutions should conduct readiness assessments and create explicit trial initiatives and feedback loops.
5. *For Future Research of Researchers*: Researchers should encourage empirical investigation of AI applications' impact on long-term educational outcomes. Longitudinal research is suggested to determine the long-term advantages and potential side effects on the physical, cognitive, and psychosocial effects of the AI-enhanced physical education. Research should define the best ratios between AI assistance and direct human interaction to preserve the social and motivational learning components intrinsic to physical education. Researchers should also explore culturally responsive implementation to ensure AI technologies are sensitive and flexible enough to accommodate a range of demographics.

Funding: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics Approval: Not applicable.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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The Asian Institute of Research
Education Quarterly Reviews
Vol.8, No.4, 2025: 254-265
ISSN 2621-5799

DOI: 10.31014/aior.1993.08.04.613

Improving Scientific Thinking Skills Through a Value-Based Mobile Seamless Learning Model: A Quasi-Experimental Study in Physics Education

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Abstract
This study investigated the effectiveness of the iSCan learning model combined with Mobile Seamless Learning (MSL) in improving students' scientific thinking skills on static and dynamic fluid topics. A quantitative approach using a quasi-experimental pretest–posttest control group design was applied. The study involved 102 eleventh-grade students at SMA Muhammadiyah 10 GKB, Gresik, who were randomly assigned to an experimental group (n = 51) and a control group (n = 51). The experimental group received instruction through the iSCan–MSL model across four seamless learning phases: informal, formal 1, formal 2, and combined formal–informal. The control group followed conventional instruction. Data were collected using a validated two-tier scientific thinking test, which had a content validity score of 90% and a reliability coefficient of Cronbach's α = 0.869. The results showed a statistically significant improvement in scientific thinking skills for students in the iSCan–MSL group compared to the control group. These findings suggest that the continuous integration of value-based learning and mobile technology can effectively strengthen scientific reasoning and enhance student engagement in 21st-century physics learning.

Keywords: iSCan Model, Mobile Seamless Learning, Scientific Thinking Skills, Physics Education, Fluid Mechanics

1. Introduction

1.1 Introduce the Problem

The rapid changes in society and technology in the 21st century have gradually pushed education to rethink its traditional role. Schools can no longer stay focused only on delivering information, because students today need a

broader set of abilities—especially critical thinking, creativity, collaboration, and communication—to deal with increasingly complex global issues (Utami et al., 2024; Zharylgapova et al., 2025). In reality, however, many physics classes, including those covering topics such as fluid mechanics, still rely heavily on teacher explanations and routine exercises. Learning tends to emphasize remembering formulas instead of helping students understand how scientific ideas actually work. Because of this, a number of students find it difficult to interpret abstract concepts, follow the mathematical reasoning behind them, or use these concepts to solve problems they encounter in daily life. Their scientific literacy and problem-solving skills naturally become limited. This condition shows that there is still a wide gap between what modern science education expects and what happens in many classrooms. Unless more innovative and flexible learning models are introduced, physics education will continue producing students who know the surface of the material but struggle to analyze or apply it in meaningful ways.

The situation described above does not simply call for recognizing the mismatch in current practice; it also requires researchers to offer practical ways to improve it. In recent years, learning models that blend values, technology, and student-driven inquiry have become more relevant, especially for classrooms that expect both academic progress and character formation. One possible direction is to connect value-based approaches with learning environments that allow students to move more freely across activities and contexts. Building on this idea, the present study integrates an Islamic value–oriented model (iSCan) with Mobile Seamless Learning (MSL) as a combined strategy to address the learning challenges identified earlier. Through this integration, the study seeks not only to strengthen students' conceptual understanding but also to encourage scientific habits of mind, ethical sensitivity, and sustained engagement in studying science. Such an approach is particularly suitable for educational settings where moral development and cognitive competence are viewed as complementary goals rather than separate concerns.

For these reasons, the present study focuses on examining how effective the iSCan–MSL model is in improving students' scientific thinking abilities within physics learning. At the heart of this inquiry is a simple but important question: can an integrative design like this address the weaknesses of conventional physics instruction, especially in fostering deeper conceptual understanding and more mature scientific reasoning? Should the model demonstrate clear benefits, it may serve as a realistic alternative for science classrooms that need to respond to both the cognitive demands and the learning contexts of 21st-century students. Such efforts are in line with broader international expectations that call for teaching approaches capable of nurturing scientifically literate learners who can think critically and make informed judgments.

1.2 Explore Importance of the Problem

The need to strengthen students' scientific thinking becomes even more apparent when we look closely at how fluid mechanics is taught in secondary physics courses. Topics such as pressure, buoyancy, and fluid flow deal with phenomena that cannot be observed directly, so students must rely on mental models, visualizations, and the ability to connect several abstract ideas at once. These processes are not easy to carry out without sufficient scaffolding or meaningful interaction during learning. When instruction does not provide room for inquiry, hands-on exploration, or contextual explanations, many students fall back on memorizing equations rather than understanding why those equations work. As a result, their grasp of the material tends to be shallow and easily breaks down when they are asked to solve problems or apply the concepts in unfamiliar situations.

The need for students to develop scientific thinking skills is even more visible when we examine current global issues. Many problems today, such as environmental degradation, technological change, and public debates related to science, require people who can understand evidence and make careful judgments. Students, therefore, must learn how to read information critically, check the reliability of data, and think about the wider impact of their decisions. These abilities are not only important for school learning but also for daily life. For this reason, developing scientific thinking has become a responsibility for the whole education system, not only for science teachers. Society now depends on individuals who are able to participate in solving problems and contribute to sustainable and healthy communities.

Based on this situation, the combination of a value-based learning approach, represented by the iSCan model, with the flexible structure of mobile seamless learning becomes very relevant. This combination offers two important advantages. It can make learning more meaningful because moral or religious values are included in ways that fit students' daily experiences. At the same time, it can improve learning effectiveness by using mobile technology to support continuous study inside and outside the classroom. Therefore, this research is not only useful for strengthening educational theory but also has practical value for science education, especially in settings where attention to values and the use of technology are both considered important.

1.3 Describe Relevant Scholarship

Several studies have shown that inquiry-based learning (IBL), especially when supported by technology or mobile devices, can help improve students' higher-order thinking skills and their scientific literacy. One meta-analysis, for example, reported that mobile-based inquiry learning produced a strong positive impact on students' creative thinking, with a high effect size and a very significant p-value ($p < 0.001$). This result suggests that using mobile technology within IBL can be an effective approach for developing students' cognitive abilities (Suyatmo et al., 2023). In the field of physics education, research that combines inquiry learning with virtual simulations, such as PhET, also shows better outcomes in higher-order thinking and conceptual understanding when compared to traditional classroom methods (Nasar et al., 2025).

Recent studies in physics education also show that guided inquiry, whether carried out through virtual activities, hybrid formats, or with the help of mobile media, can enhance students' science process skills, their understanding of concepts, and their critical thinking abilities (Fitriyana et al., 2025; S. Ida Kholida et al., 2025). The findings indicate that when learners take part actively by exploring phenomena, performing experiments—either real or simulated—and discussing the outcomes, their reasoning and problem-solving abilities tend to grow stronger. Their scientific literacy also increases. Overall, this body of research offers solid support for the idea that inquiry-based methods, when combined with technology and flexible learning conditions, can be effective strategies for improving science learning.

Even with the progress found in previous studies, there is still limited research that connects value-based frameworks, such as religious or moral orientations, with inquiry-based mobile learning in physics classes. Many investigations mainly discuss cognitive results, including thinking skills and understanding of concepts, while paying less attention to how value orientation may shape students' motivation, their ethical judgment in science, or the depth of their engagement in learning—especially in contexts that are influenced by certain cultural or religious backgrounds. This situation highlights the novelty of the present study. It seeks to examine whether the iSCan–MSL model can help students develop scientific thinking while also encouraging value-aware scientific inquiry in a way that fits the educational environment.

1.4 State Hypotheses and Their Correspondence to Research Design

Based on the theoretical rationale and empirical evidence presented, this study formulates the following hypotheses:
H1: Students who receive instruction through the iSCan–MSL model will demonstrate significantly higher scientific thinking skills compared to students who receive conventional physics instruction.
H2: Improvements in scientific thinking skills among students in the iSCan–MSL group will be mediated by enhanced continuity of learning across formal and informal contexts, increased active engagement, value-integrated inquiry, and the affordances of mobile learning that support flexible, contextual, and collaborative learning.

To test these hypotheses, this study employs a quasi-experimental pretest–posttest control group design, which enables rigorous comparisons between the experimental and control groups. This design provides a strong basis for inferring whether observed differences in scientific thinking can be attributed to the instructional model. If the hypotheses are supported, the findings will offer theoretical contributions by demonstrating how value-based, technology-enhanced inquiry learning can strengthen students' scientific reasoning. In addition, the results are

expected to provide practical implications for physics education, particularly in settings where value orientations and modern pedagogical approaches intersect.

2. Method

2.1 Identify Subsections

This study employed a quantitative approach using a quasi-experimental method to investigate the effect of the iSCan–Mobile Seamless Learning (iSCan–MSL) model on students' scientific thinking skills in physics learning. A detailed description of the participants, instruments, research design, intervention procedures, and data analysis is provided to ensure methodological transparency and allow for replicability.

2.2 Participant (Subject) Characteristics

The study was conducted at SMA Muhammadiyah 10 GKB, Gresik, Indonesia, involving eleventh-grade students with an average age of 17 years. All participants were formally enrolled in physics courses during the academic year in which the study was implemented. No exclusion criteria were applied, and the students were assumed to possess relatively comparable prior knowledge of the physics topic. Participant involvement was supported by the school and carried out in regular classroom settings, with no incentives provided.

2.3 Sampling Procedures

A simple random sampling technique was used by mixing students from the two classes and then assigning them evenly to the experimental and control groups to reduce possible bias. In total, 102 students took part in the study, with 51 students in each group. The data were collected in the school setting under normal classroom supervision. Ethical approval was obtained from the school administration, and students participated voluntarily.

2.3.1 Sample Size, Power, and Precision

All 102 students in the population were taken as the sample so that the results would be more precise and fairly represent the group being studied. The experimental and control groups were kept equal in number (n = 51 for each group) to support a balanced comparison during analysis. Even so, the conclusions of this study should be understood as applying mainly to settings that share similar demographic and academic characteristics.

2.3.2 Measures and Covariates

The data in this study were collected through a questionnaire and a two-tier test designed to assess students' scientific thinking skills. These skills were evaluated using eight indicators. First, asking scientific questions or formulating problems, which refers to the ability to state questions that are clear, measurable, and testable (Darman et al., 2024). Second, formulating hypotheses and predictions, meaning the skill of proposing reasonable assumptions and anticipating possible outcomes of an experiment (Kalinowski & Pelakh, 2024). Third, designing experiments and controlling variables, which includes planning procedures to test a hypothesis and identifying independent, dependent, and control variables (Lawson, 1978). Fourth, measuring and collecting data, which covers choosing suitable tools, recording information systematically, and maintaining reliability and validity (Darman et al., 2024).

The fifth indicator is analyzing and interpreting data, referring to the use of quantitative or qualitative techniques to answer research questions and draw conclusions (Darman et al., 2024). Sixth, scientific reasoning, which involves probabilistic, proportional, and correlational reasoning such as comparing ratios, estimating probabilities, and distinguishing correlation from causation (Bao et al., 2018). Seventh, evaluating evidence and constructing arguments, meaning the ability to judge the strength of evidence, consider alternative explanations, and build arguments based on the claim–evidence–reasoning structure (Seeratan et al., 2020). (Darman et al., 2024). Student responses were scored using a four-point Likert scale, where 4 = very good, 3 = good, 2 = fair, and 1 = poor.

Table 1: Scientific Thinking Skills Indicator Matrix

No.	Indicators	Operational sub-indicators	Activity
1	Formulating scientific problems and questions	Identifying researchable phenomena, formulating measurable and testable questions	Students write a scientific question based on a phenomenon.
2	Forming hypotheses and predictions	Relating two variables and predicting experimental outcomes	Create a hypothesis based on the phenomenon and predict the outcome.
3	Planning experiments and controlling variables	Identifying independent, dependent, and control variables and determining experimental steps	Design a simple experimental step.
4	Conducting measurements and collecting data	Determining measuring instruments, units, recording methods, and data reliability	Fill in a data table of experimental results using the correct format.
5	Analyzing and interpreting data	Processing data into graphs/tables and drawing logical conclusions	Create a graph of the relationship between variables and a brief conclusion.
6	Evaluating scientific evidence and arguments	Determining the validity of evidence and writing data-based arguments (claim-evidence-reasoning)	Analyze a claim and provide reasons based on the data.
7	Representing and communicating scientific results	Preparing reports or presentations of experimental results	Write a scientific report or poster.
8	Reflecting and developing scientific attitudes	Identifying experimental limitations and suggesting improvements	Write a reflection after the experiment.

Table 2: Practical Assignment Assessment Rubric (Scientific Thinking Rubric)

No.	Indicators	Score			
		4	3	2	1
1	Formulating scientific problems and questions	Clear, specific, and scientifically testable questions	The question is quite clear, but still general.	Vague and difficult-to-test questions	Not writing a question / irrelevant
2	Forming hypotheses and predictions	Logical, theory-based hypotheses with measurable predictions	The hypothesis is logical, but the predictions are not measurable.	Hypotheses not based on data/facts	Not writing a hypothesis
3	Planning experiments and controlling variables	All variables are identified, and the design is realistic and controlled	Some variables are identified.	Illogical design/unclear variables	Not writing an experimental design
4	Conducting measurements and collecting data	Data is complete, organized, and uses correct units	The data is quite complete but not organized.	Incomplete data/many errors	Not taking measurements
5	Analyzing and interpreting data	Uses graphs/tables, and interpretations are based on the data	There is a simple analysis, but it is not in-depth.	Inaccurate analysis	Not doing analysis
6	Evaluating scientific evidence and arguments	Strong arguments with concrete evidence	The argument is logical, but the evidence is not strong enough.	Weak arguments/lack of evidence	Not providing arguments
7	Representing and communicating scientific results	Complete report (objectives, methods, results, and discussion)	The report is quite complete, but the analysis is lacking.	Minimal and unsystematic reporting	Not submitting a report
8	Reflecting and developing scientific attitudes	Demonstrates self-awareness and suggests	Only mentions general shortcomings.	Irrelevant reflections	No reflection

	improvements to the experiment

Table 3: Distribution of Static and Dynamic Fluid Two Tier Test Instruments

No.	Main Aspects	Tested
1 – 4	Formulating questions/phenomena and hypotheses	Questioning, prediction
5 – 9	Experimental design and variable control	Experimental design
10 – 13	Data measurement and collection	Experimental practice
14 – 17	Data analysis and interpretation	Graphs, variable relationships
18 – 19	Evaluating evidence and arguments	Claim-evidence reasoning
20	Scientific reflection	Metacognition/scientific attitude

The scientific thinking questionnaire was first reviewed by an expert to assess its content validity. The evaluation produced a Product Score Validity (PSV) of 90%, indicating that the instrument was highly appropriate for use. The scientific thinking test, consisting of 20 two-tier questions, was then examined for construct validity. Table 4 summarizes the item-validity results based on Pearson's correlation, while Table 5 reports the reliability findings using Cronbach's Alpha. Using a sample of 30 students, the critical r-value at the 0.05 significance level (two-tailed) was 0.312. Items with correlation values above 0.361 were considered valid. The analysis showed that all 20 items exceeded this threshold, and the reliability coefficient of $\alpha = 0.869$ indicated strong internal consistency. On this basis, the entire set of items was judged to be both valid and reliable.

Table 4: Validity of Test Items

Item	Value	Validation
1	0.380	Valid
2	0.487	Valid
3	0.602	Valid
4	0.688	Valid
5	0.687	Valid
6	0.395	Valid
7	0.665	Valid
8	0.436	Valid
9	0.553	Valid
10	0.610	Valid
11	0.438	Valid
12	0.487	Valid
13	0.391	Valid
14	0.599	Valid
15	0.639	Valid
16	0.378	Valid
17	0.665	Valid
18	0.436	Valid
19	0.389	Valid
20	0.696	Valid

Table 5: Reliability of Test Items

Reliability Statistics	
Cronbach's Alpha	N of Items
.869	20

The data in this study were analyzed using an independent samples t-test. This procedure was applied to examine whether the average scores of the two groups differed significantly—the group taught with the iSCan–MSL model and the group that received conventional instruction. Prior to running the t-test, two assumptions were checked:

(1) the distribution of the data had to meet normality requirements, and (2) the variances of the groups needed to be homogeneous. After both conditions were confirmed, the independent samples t-test was carried out to compare the performance of the two groups.

2.3.3 Research Design

This study used a quantitative approach with a quasi-experimental design to examine the influence of the iSCan learning model on students' scientific thinking skills. A pretest–posttest control group design was applied. The overall design is summarized in Table 1, which shows the division between the experimental and control groups. Students in the experimental group learned through the iSCan–MSL model, while those in the control group followed conventional instruction that did not include the iSCan–MSL components. Learning in the experimental group was carried out across four seamless learning stages: an informal stage, followed by formal stage 1, formal stage 2, and a final stage that combined formal and informal activities. The intervention was implemented through physics practicum sessions centered on the topics of static and dynamic fluids.

Table 6: Research Design

Group	Pretest	Treatment	Postest
A_1	O_1	X	O_2
A_2	O_3	--	O_4

Description:
A1: Experimental group that participated in learning activities using the iSCan–MSL model
A2: Control group that participated in learning activities without the iSCan–MSL model
O1: Pretest administered to the experimental group before the learning activities
O2: Posttest administered to the experimental group after the learning activities
O3: Pretest administered to the control group before the learning activities
O4: Posttest administered to the control group after the learning activities
X: Treatment administered to the experimental group using the iSCan–MSL model
— : No treatment administered to the control group (conventional learning only)

2.3.4 Experimental Manipulations or Interventions

The iSCan–MSL model was applied to the experimental group over four weekly meetings, with each session lasting 90 minutes. The instruction followed four seamless learning phases:
(a) an informal learning stage,
(b) formal phase 1,
(c) formal phase 2, and
(d) a final stage that combined formal and informal activities.
Across these phases, students engaged in experiments, problem-solving tasks, and group discussions, all supported by mobile devices. In contrast, the control group learned through conventional direct instruction, which relied on teacher explanations, PowerPoint slides, and individual practice tasks, without any seamless learning components.

The intervention was designed to strengthen scientific thinking processes, while both groups covered the same physics content and received equal instructional time.

3. Results

This section reports the analysis of students' scientific thinking skills based on the pretest and posttest results from both the experimental group (iSCan–MSL) and the control group. All statistical procedures were carried out after confirming that the data met the normality and homogeneity requirements, ensuring that the findings could be interpreted appropriately.

3.1 Recruitment

The recruitment and data collection took place over four consecutive weeks, in line with the implementation of the intervention. All 102 eleventh-grade students who were eligible took part in the study and completed both the pretest and posttest assessments.

3.2 Statistics and Data Analysis

After all research activities were finished and the data had been collected, the dataset was checked first for normality and homogeneity before running the t-test. Both the practicum and written pretest–posttest scores were included in these checks to make sure the data met the required assumptions. The pretest scores were used to identify the initial scientific thinking abilities of students in each group and to verify that both groups started from comparable baseline levels. The posttest scores, on the other hand, were used to assess students' scientific thinking skills after the learning activities were completed.

Table 7: Results of the Normality Test of the Scientific Thinking Pretest

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Test	iSCan-MSL	.111	51	.158	.955	51	.052
	Non-iSCan-MSL	.108	51	.196	.966	51	.148
Practical	iSCan-MSL	.083	51	.200*	.979	51	.503
	Non-iSCan-MSL	.107	51	.200*	.969	51	.210

Table 8: Results of the Homogeneity Test of the Scientific Thinking Pretest

	Levene Statistic	df1	df2	Sig.
Test	.060	1	100	.807
Practical	1.614	1	100	.207

Table 9: Independent Sample t-test Scientific Thinking Pretest

	Group	N	Mean	SD	t	df	p
Test	iSCan-MSL	51	29.41	9.625	-.306	100	.760
	Non-iSCan-MSL	51	30.00	9.798			
Practical	iSCan-MSL	51	32.7451	6.60028	-.347	100	.729
	Non-iSCan-MSL	51	33.2353	7.62060			

Based on the pretest results for students' scientific thinking skills, the normality test in Table 7 showed Sig. = .158 > .050 for the iSCan–MSL group and Sig. = .196 > .050 for the Non-iSCan–MSL group. The homogeneity test also produced a Sig. value of .807 > .050. These results indicate that the pretest data were both normally distributed and homogeneous. A similar pattern was found in the practicum pretest results. The normality tests for both the iSCan–MSL and Non-iSCan–MSL groups were Sig. = .200 > .050, and the homogeneity test showed Sig. = .207 > .050. Thus, the practicum pretest data also satisfied the normality and homogeneity assumptions.

After confirming that the data met the required assumptions, an independent samples t-test was carried out. The written post-test results showed that students who learned through the iSCan–MSL model reached an average score of 83.92, while those in the conventional group scored 79.92. The p-value of .048 < .050 indicates that the difference between the two groups was statistically significant. For the practicum post-test, the iSCan–MSL group obtained a mean of 82.74, compared with 73.43 in the group that did not use the model. The p-value of .000 < .050 also shows a significant effect of the iSCan–MSL model on students' scientific thinking skills..

Table 10: Results of the Normality Test for the Scientific Thinking Post-Test

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.

Test	iSCan-MSL	.114	51	.093	.958	51	.072
	Non-iSCan-MSL	.109	51	.183	.963	51	.111
Practical	iSCan-MSL	.103	51	.200*	.978	51	.457
	Non-iSCan-MSL	.103	51	.200*	.970	51	.219

Table 11: Results of the Homogeneity Test of the Scientific Thinking Post-Test

	Levene Statistic	df1	df2	Sig.
Test	.000	1	100	.990
Practical	1.846	1	100	.177

Table 12: Independent Sample t-test Posttest Scientific Thinking

	Group	N	Mean	SD	t	df	p
Test	iSCan-MSL	51	83.92	10.311	2.000	100	.048
	Non-iSCan-MSL	51	79.80	10.486	2.000	99.972	.048
Practical	iSCan-MSL	51	82.7451	6.78703	6.474	100	.000
	Non-iSCan-MSL	51	73.4314	7.71299			

The post-test normality results in Table 10 show that the written test scores from the group that learned using the iSCan–MSL model had a Sig. value of .093, which is higher than the .050 threshold. The group taught without iSCan–MSL also met the normality requirement, with a Sig. value of .183. The homogeneity test for the written assessment produced a Sig. value of .990, indicating that the variances between the two groups were similar. For the practicum scores, both the iSCan–MSL and Non-iSCan–MSL groups obtained a Sig. value of .200 in the normality test, again exceeding the .050 cutoff. The homogeneity test resulted in a Sig. value of .177. Taken together, these findings confirm that the practicum post-test data were normally distributed and had homogeneous variances, so they met the assumptions required for further statistical analysis.

After verifying that all assumptions were met, an independent samples t-test was conducted. The written post-test scores showed that students who learned through the iSCan–MSL model achieved an average of 83.92, compared with 79.92 in the group taught conventionally. With a p-value of .048, which is below the .050 threshold, this difference was statistically significant. For the practicum post-test, students in the iSCan–MSL group obtained a mean score of 82.74, while the group that did not use the model scored 73.43. The p-value of .000 further confirms that the iSCan–MSL model had a significant positive effect on students' scientific thinking skills.

3.3 Ancillary Analyses

No additional subgroup or exploratory analyses were conducted beyond the primary statistical procedures.

3.4 Participant Flow

A total of 102 students participated in the study and were randomly assigned to two groups, with 51 students in the experimental group and 51 in the control group. Throughout the intervention, no students dropped out or moved between groups. As a result, all participants' data were included in the main analyses.

3.5 Intervention or Manipulation Fidelity

For studies involving interventions or experimental manipulations, it is important to show that the procedures were carried out as planned. In basic experimental research, this could include results from manipulation checks. In applied research, it might involve keeping records and observations of intervention sessions, as well as tracking attendance to ensure that all planned activities were delivered to the participants as intended.

3.6 Baseline Data

At the baseline, students in both groups had similar demographic and academic characteristics. All participants were eleventh-grade students from the same school (SMA Muhammadiyah 10 GKB, Gresik, Indonesia), with an average age of 17 years, and were enrolled in the same physics curriculum during the study period. These similarities helped ensure that both groups experienced comparable school environments, instructional conditions, and curriculum exposure before the intervention. Before the treatment, both groups showed limited scientific thinking skills. As discussed in the introduction, traditional teacher-centered instruction in physics—particularly in abstract topics like fluid mechanics—often leads to difficulties in understanding concepts, applying scientific reasoning, and solving real-world problems. This situation was reflected in the pre-intervention data, showing that students initially tended to rely more on memorization than on inquiry-based reasoning.

The pretest results further confirmed that the two groups were equivalent. Statistical tests showed no significant difference in the initial scientific thinking skills between the experimental group ($M = 29.41$) and the control group ($M = 30.00$) for the written assessment ($p = .760 > .050$). Similarly, practicum pretest scores were comparable, with the experimental group scoring $M = 32.74$ and the control group $M = 33.23$ ($p = .729 > .050$). Both sets of data met the assumptions of normality and homogeneity, suggesting that any improvements observed after the intervention could be attributed to the instructional model rather than pre-existing differences in skill. Overall, these baseline characteristics support a valid comparison between the experimental and control groups. The data also show that before the iSCan–MSL intervention, both groups had similarly low levels of scientific reasoning and had not yet experienced inquiry-based, value-integrated, or technology-supported learning strategies, highlighting the need and relevance of the intervention applied in this study.

3.6.1 Statistics and Data Analysis

Pretest scores were used to check whether the scientific thinking skills of the two groups were comparable at the start. The normality test (Table 7) showed Sig. = .158 > .050 for the iSCan–MSL group and Sig. = .196 > .050 for the control group. The homogeneity test gave a Sig. value of .807 > .050. Practicum scores also showed normal and homogeneous distributions, with Sig. = .200 > .050 for both groups and homogeneity Sig. = .207 > .050. An independent samples t-test (Table 9) showed no significant differences between the experimental and control groups for both the written test scores ($M = 29.41$ vs. 30.00; $p = .760 > .050$) and the practicum scores ($M = 32.74$ vs. 33.23; $p = .729 > .050$). These results confirm that the two groups had similar scientific thinking skills before the intervention.

3.6.2 Adverse Events

No adverse events or disruptions were reported during the intervention or data collection process.

4. Discussion

In this study, students who learned through the iSCan Mobile Seamless Learning (iSCan–MSL) model achieved a higher average post-test score ($M = 83.92$) on the written scientific thinking assessment than those in the conventional group ($M = 79.92$), and the difference was statistically significant ($p = .048 < .05$). This finding is consistent with earlier studies showing that technology-supported seamless learning environments can improve physics learning outcomes. For example, Abdullah (2024) reported that implementing a seamless learning strategy positively affected achievement in basic physics courses. Similarly Asmiliyah et al. (2021) found that mobile learning combined with a STEM approach effectively enhanced students' critical thinking skills in physics. These results suggest that the "Search" and "Active" stages in the iSCan–MSL model—which encourage exploration, inquiry, and continuous engagement—may play a key role in improving students' performance on written scientific thinking assessments.

The practicum results showed that students in the iSCan–MSL group scored an average of 82.74, compared with 73.43 in the control group, with a highly significant p-value of .000 (< .05). This suggests that the iSCan–MSL model improves not only written assessment performance but also students' scientific practice skills. This finding aligns with previous studies indicating that mobile media combined with active learning approaches can enhance

higher-order thinking skills (HOTS) and scientific reasoning in physics. For instance, Priatna et al. (2025) reported significant gains in students' HOTS through Android-based physics learning media. The "Creative" and "Network" elements of the iSCan–MSL model may support these improvements by promoting collaborative knowledge construction and creative exploration, which directly strengthen students' abilities in laboratory and experimental tasks.

In addition, the religious aspect within the "Islamic" component of the iSCan–MSL model seems to provide meaningful context and enhance students' internal motivation. Although studies combining religious values specifically with physics learning are limited, Muzaidin et al. (2025) found that integrating technology in Islamic education improved students' cognition and critical thinking. Similarly, Husain et al. (2024) reported that e-learning media incorporating religious contexts can enhance both cognitive processing and learning motivation from a neuroscience perspective. Therefore, the Islamic element in the iSCan–MSL model likely supports greater student engagement and deeper conceptual understanding, which in turn helps develop scientific thinking skills.

Moreover, the findings suggest that the iSCan–MSL model has a greater impact on practical skills than on written assessments, with a difference of about 9.31 points compared to roughly 4 points. This implies that mobile, seamless, active, and collaborative learning is particularly effective for supporting practical or experimental activities, rather than relying only on written instruction. Supporting this, Anggraini et al. (2024) reported that student worksheets assisted by augmented reality significantly improved students' critical thinking skills in high school physics. Therefore, the iSCan–MSL model, with its strong emphasis on the "Active" and "Search" stages, appears well-suited for developing scientific thinking skills through hands-on practice and interactive learning.

Finally, the results of this study show that the iSCan–MSL model is a promising approach for teaching physics, as it can enhance scientific thinking across both conceptual understanding (written assessments) and practical skills (laboratory performance). These findings also highlight the importance of learning designs that are contextually meaningful, active, collaborative, and seamless. This is consistent with the seamless learning framework, which emphasizes that flexibility and continuity in learning support students' cognitive development (Roshonah et al., 2022). However, this study has some limitations, including the sample size, the duration of the intervention, and variations in student characteristics. Future research should address these factors to improve the generalizability of the findings and to build on the current results.

Author Contributions: Conceptualization, Author 1 and Author 2; Methodology, Author 1; Software, Author 3; Validation, Author 1, Author 2, and Author 3; Formal Analysis, Author 1; Investigation, Author 1; Resources, Author 2; Data Curation, Author 1 and Author 3; Writing Original Draft Preparation, Author 1; Writing Review & Editing, Author 2 and Author 3; Visualization, Author 3; Supervision, Author 2; Project Administration, Author 1.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics approval: Not applicable.

Data Availability Statement: In this section, please provide details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. You might choose to exclude this statement if the study did not report any data. This section is optional.

Acknowledgments: In this section you can acknowledge any support given which is not covered by the author contribution or funding sections. This may include administrative and technical support, or donations in kind (e.g., materials used for experiments). This section is optional.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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