

INTEGRATING SOCIOCULTURAL CONTEXTS IN SCIENCE EDUCATION: COMPARATIVE ANALYSIS AND STRATEGIC ADAPTATIONS

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Article Info

Received: Oct 18, 2024

Revised: Dec 13, 2024

Accepted: Feb 02, 2025

OnlineVersion: Feb 16, 2025

Abstract

The relevance of this study lies in its exploration of effective learning strategies across diverse sociocultural contexts, thereby underscoring the necessity to adapt educational practices in order to meet the requirements of culturally and socially varied student populations. The aim of this study was to investigate the impact of sociocultural factors on education in Kosovo and Kyrgyzstan, with a view to identifying effective adaptations of educational strategies within these unique cultural and historical settings. The applied research methods included a comparative analysis of the educational systems in Kosovo and Kyrgyzstan, and an interdisciplinary approach to examine the manner in which historical, cultural, and social factors are integrated into teaching methodologies. The results indicated that sociocultural contexts exert a significant influence on educational outcomes, thereby underscoring the necessity for tailored teaching strategies that take into account students' cultural backgrounds, social status, and ethical values. The study concluded that the successful adaptation of educational strategies requires comprehensive training for teachers, the incorporation of ethical considerations, and the development of culturally competent teaching materials. The present study offers profound insights into contemporary challenges, including technological integration and the need for diverse approaches. This study does a comparative examination of the sociocultural effects on education in Kosovo and Kyrgyzstan, providing insights into the influence of historical legacies and cultural variety on contemporary educational issues in both multicultural contexts. The findings provide recommendations for establishing inclusive educational environments, enhancing cultural competency among instructors, and utilising technology to meet the varied needs of students.

Keywords: Educational Adaptation, Educational Assessment, Learning Strategies, Personality Development, Teacher Training.



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INTRODUCTION

Sociocultural elements significantly influence educational methods and student development in modern educational settings. Nonetheless, these environments encounter several obstacles that impede

their adaptation to the changing requirements of a globalised and multicultural society. Technological progress, cultural variety, and societal change consistently reshape the framework and substance of education, requiring ongoing innovation and modernisation within educational institutions. Many institutions, however, have difficulties in aligning their methodologies and objectives with the diverse cultures, beliefs, and preparation levels of their students. Such difficulties can lead to disparities in the quality of education, restricted access to educational resources, and inadequate preparation of students for intercultural engagement and global competition. Unaddressed, these challenges risk deepening sociocultural inequalities, thereby limiting social mobility and societal development.

This research is urgent due to the need to address deficiencies in existing educational procedures, especially in the proper integration of sociocultural variables into the learning process. Existing studies underscore the importance of a sociocultural framework in science education, illustrating the influence of cultural traditions, social norms, and language environments on student performance (Rodriguez et al., 2020; Zhou, 2020; Azis, & Clefoto, 2024; Naimah, Villamor, & Al Wosabi, 2024). Sociocultural theory establishes a basis for seeing science education as both a conduit for information dissemination and a vehicle for socialisation, wherein pupils assimilate values, norms, and cultural identity (Chan, 2020; Wang et al., 2020; Mardiaty, Alorgbey & Zarogi, 2024; Setiyani, Panomram, & Wangdi, 2024). Nonetheless, there are still study deficiencies in examining the interaction between sociocultural and sociomaterial factors, including access to technology and educational resources, that profoundly influence the learning environment (Chan, 2020; Wang et al., 2020). Moreover, previous research has recognised the capacity of modern pedagogical technologies to improve communicative competence and social integration (Kulieva et al., 2019; Yevseiev et al., 2020; Pulatova, 2023; Endra & Villaflor, 2024; Syahputra, G., & Edwards, 2024), although empirical evidence regarding their adaptation to varied sociocultural contexts remains scarce. Furthermore, the significance of multilingualism as an educational resource has been recognised (Santoso, 2020; Luo, 2020; Fernande, Sridharan, & Kuandee, 2024). However, practical methodologies for incorporating multilingual tactics into conventional learning settings remain insufficiently investigated.

Research by Liu and Liu (2023), Li and Liu (2023), and Nguyen et al. (2023) highlighted key aspects of student learning and adaptation in diverse sociocultural environments. Liu and Liu examined second-language learning in a transnational context, detailing challenges and opportunities for students abroad. Li and Liu emphasized the importance of sociocultural context in developing effective teaching methods, while Nguyen et al. explored international students' engagement in sociocultural tasks, reinforcing the need for inclusive educational environments. Ongaro et al. (2024) provided recommendations for combating misinformation and fostering critical thinking, while Kebaetse et al. (2024) identified sociocultural factors affecting student adaptation to Project-Based Learning. Both studies underscored the importance of sociocultural considerations in educational program design. Larsen (2023) analyzed future teachers' perceptions of cultural diversity, and Méndez López (2022) examined emotional and sociocultural influences on foreign language teachers' identities. Leskinen (2023) explored distributed leadership and innovation in elementary schools. These studies confirmed the significance of integrating sociocultural aspects into teacher training to develop competence in diverse educational settings. Kumpulainen et al. (2020) highlighted family influence on children's digital skills, while Kaliisa et al. (2022) systematically reviewed sociocultural factors in digital learning. Sentance et al. (2019) examined programming education through a sociocultural lens, showing that integrating cultural and social aspects enhances learning outcomes.

Schnepfleitner and Ferreira (2021) explored transformational learning, emphasizing sociocultural influences on student development. Ardoin and Heimlich (2021) examined environmental impacts on learning, stressing the role of context in education. Ando (2021) studied sociocultural influences on university learning and teaching, while Hwa (2023) analyzed teacher responsibility in international research. Li (2020) investigated language teachers' cognitive processes from a sociocultural perspective, and Pham et al. (2024) explored primary school teachers' professional development in Vietnam's education reforms. Wang et al. (2019) demonstrated how sociocultural factors shape children's learning. Barratt-Pugh (2001) highlighted sociocultural influences on literacy learning, and Duarte (2019) examined multilingual education's impact on learning effectiveness. All these studies have enriched the understanding of how sociocultural factors influence learning and education and help to develop appropriate pedagogical techniques and strategies, contributing to the creation of a more inclusive and adaptive educational environment.

This study aims to identify the principal sociocultural elements affecting educational practices in multicultural settings and formulate practical strategies to mitigate these problems. This research examines how science education might overcome sociocultural divisions and foster inclusion, drawing ideas from the complex sociocultural dynamics and historical legacies of Kosovo and Kyrgyzstan. The objectives encompass devising ways that improve the efficacy of educational programs, especially in multilingual and multicultural settings, and promoting equal access to excellent science education. The results are anticipated to enhance the formulation of culturally responsive educational methodologies that cater to the requirements of varied student demographics while fostering intercultural comprehension and global preparedness. This research provides a paradigm for enhancing the flexibility and inclusiveness of educational institutions by including sociocultural and sociomaterial factors in a continuously evolving environment.

RESEARCH METHOD

This study employs a qualitative theoretical framework, concentrating on the interplay between multidisciplinary methodologies and the sociocultural adaptation of science education within multicultural contexts, particularly in Kosovo and Kyrgyzstan. The study encompasses a comparative historical analysis and an assessment of educational practices and their effects on student development across various sociocultural situations. The sample entailed the deliberate selection of scholarly papers, government reports, and historical documents that offer pertinent insights into the development of educational institutions in both nations. Sources were selected based on their emphasis on cultural diversity, educational advancement, and personal development results. A total of 52 papers were examined, comprising 15 peer-reviewed academic publications, 12 government reports, and 25 case studies from educational institutions. The inclusion criteria emphasised scholarly publications, government reports, and institutional case studies that examine sociocultural effects, instructional practices, and personal development in multicultural educational settings in Kosovo and Kyrgyzstan. Exclusion criteria removed sources that lacked direct connection to science education, sociocultural settings, or empirical evidence, in addition to non-peer-reviewed or opinion-based materials. The current study provides an overview of the historical aspects of educational systems in both countries and a comparative analysis of their development. As a result of the comparison, the main trends and characteristics of science education in each country were identified, including factors affecting the sociocultural adaptation of science education. The data-collecting approach utilised document analysis, entailing a systematic assessment and classification of information from chosen sources. Table 1 delineates the grid for the data-gathering instrument.

Table 1. Data collection instrument grid for analysing educational practices

Data source type	Instrument description	Data collected
Peer-reviewed articles	Thematic analysis of key findings	Educational trends, sociocultural challenges
Government reports	Content analysis of policy and curriculum changes	Historical and policy-related insights
Institutional case studies	Comparative evaluation of implementation practices	Examples of adaptation strategies

The data were examined employing both thematic and comparative methodologies. The thematic analysis entailed recognising persistent themes within the data, including the influence of cultural variety on learning outcomes, teacher leadership in multicultural settings, and the significance of ethics in educational adaptation. Comparative research was conducted to juxtapose educational processes in Kosovo and Kyrgyzstan, revealing shared trends and distinctive features. Quantitative insights were obtained by quantifying the frequency of particular themes within the data. The coding was conducted with qualitative data analysis software (NVivo), guaranteeing a systematic and repeatable methodology. Descriptive statistics were utilised to encapsulate data trends and elucidate the primary aspects affecting educational adaptation.

The study, primarily qualitative, employed basic statistical tools to evaluate the coded data and ensure its reliability. Microsoft Excel was utilised for descriptive statistical computations to encapsulate data trends and elucidate the primary aspects affecting educational adaptation. Descriptive metrics

encompassed frequency counts, percentage distributions, cross-tabulations, and trend analysis. A sample of 52 documents was assessed for saturation, and theme density confirmed the adequacy of the sample for comprehensive coverage of the study objectives. The computation of statistical power was superfluous, given this study does not employ primary data or partake in quantitative hypothesis testing. However, the diversity of sources ensures a thorough and representative understanding of the subject.

Further, the study examined the impact of the educational process on the personal development of students through the prism of several key aspects, including cognitive development, which included broadening horizons, mastering new knowledge and skills, and the development of critical thinking and analytical abilities. Another important stage of the study was the consideration of social development, including interaction with others, the development of communication skills, and cooperation. Emotional development, emotion management, and self-regulation abilities were also examined. The next stage of the study was aimed at developing recommendations and strategies for the development of science education, considering sociocultural changes and challenges inherent in countries such as Kyrgyzstan and Kosovo. Strategies for adapting educational programs were also described in detail, which included ways of implementation and the expected result from the proposed actions.

In the course of the study, the key principles of sociocultural adaptation of science education and the methods used to implement these principles were investigated. In particular, the method of the interdisciplinary approach in science education and its effectiveness in adapting educational programs to a variety of sociocultural contexts in the framework of training future teachers were investigated. In the process of adapting educational strategies to sociocultural contexts, attention was paid to ethical aspects: it was determined which cultural and social factors can influence the learning process and the perception of educational material by various categories of students, which helped to identify key aspects of culture that should be considered when developing and adapting educational programs.

In the process of adaptation planning, it was decided to include in the educational material a variety of cultural elements reflecting a variety of cultural traditions and values. Special attention was paid to a balanced approach to presenting various cultural aspects so that the educational material was accessible and understandable to all students, regardless of their cultural background. The issue of ensuring cultural sensitivity in the learning process was considered, which included aspects of teaching teachers and educational specialists how to work with diverse cultural groups and creating an educational environment that promotes respect for differences and supports cultural diversity.

The role of pedagogical leadership in the sociocultural adaptation of science education was also considered, which revealed the key characteristics of a teacher-leader who can successfully lead the process of adapting science education to diverse sociocultural contexts. The last stage of the study was devoted to the investigation of the problem of evaluating the effectiveness of adapted educational programs. To do this, criteria and methods for evaluating effectiveness were considered, including the compliance of educational goals and objectives with cultural and social needs, academic success of students, and the level of involvement and participation of children.

RESULTS AND DISCUSSION

Learning and personal development in multicultural educational environments: The cases of Kosovo and Kyrgyzstan

Science education plays a key role in personality development, and this influence is closely related to the sociocultural contexts in which learning takes place. In the process of learning, a person obtains knowledge, skills, values and beliefs that determine their worldview and behaviour (Kurniawan et al., 2024; Sofyan & Tlali, 2024; Syahril et al., 2024). Sociocultural factors such as cultural traditions, social status, ethnicity, language, and religious beliefs have a significant impact on the educational process and personality development.

Education in a sociocultural context is not only a means of knowledge transfer but also an instrument of socialisation and education. Different cultures and societies have different ideas about the goals and objectives of science education, which determines its content and methods. For example, some cultures focus on the development of individual abilities and creative thinking, while others emphasise the importance of observing traditions and social norms (Huretska, 2023; Kurniawati, Jaya & Swansyah, 2024; Rachmatika & Salighehdar, 2024). The sociocultural impact on education is also manifested in the knowledge and values that are transmitted through curricula and educational materials (Ponomarenko, 2022). Education in a sociocultural context can serve as a tool for social mobility and integration. Access to education and its quality significantly affect a person's social status and

opportunities in society. Therefore, it is important to strive to ensure equal educational opportunities for all sociocultural groups and consider their needs and characteristics when developing educational strategies.

The educational space in Kyrgyzstan reflects the rich cultural heritage of this country, which is home to diverse ethnic groups and cultural traditions (Adylbek Kyzy et al., 2024; Yulianti & Awingan, 2024). Historically, Kyrgyzstan has been at the crossroads of various cultural streams, including the influence of Turkic, Mongolian, Islamic, and Russian cultures. This diverse cultural context has had a strong impact on educational practices and personality development processes: the modern national educational system strives to preserve and promote cultural diversity, including languages of various ethnic groups, cultural traditions, and historical features (Law of the Kyrgyz..., 2023). However, modern educational organisations also face challenges related to children's limited access to education as a result of various cultural and social factors, the integration of new technologies, and modern educational approaches while maintaining a craving for cultural values and traditions of the country (UNICEF, 2024).

In Kosovo, the educational space is also closely linked to its unique sociocultural environment, reflecting the rich historical heritage of the region. For many centuries, Kosovo has been a place of mixing of different cultures, languages, and religions, which has formed a unique sociocultural dynamic that influences educational practices and personality development processes. Historical events such as the Serbian Orthodox tradition, Turkish influence during Ottoman rule, and later political and cultural changes have left a deep mark on Kosovo's educational system. Nowadays, educational institutions in Kosovo face the challenges of integrating different cultural and linguistic groups, creating an inclusive environment, and creating curricula that reflect the diversity of the region, which underlines the importance of considering sociocultural aspects in the development of educational strategies and methods (White & Saqipi, 2021; Ayuni, Maghdalena & Basa, 2024; Suprihatiningrum et al., 2024; Salsabila et al. 2025).

Having considered the sociocultural aspects of education in Kosovo and Kyrgyzstan, the parallels based on the rich cultural heritage and historical events became evident. This study addresses the research issues by demonstrating how sociocultural influences influence educational methods and individual development. The amalgamation of cultures and languages in Kosovo underscores the potential for promoting intercultural comprehension. However, it also poses difficulties in developing inclusive educational curriculum. In Kyrgyzstan, historical influences from Turkic, Mongolian, Islamic, and Russian cultures have generated varied educational practices, prioritising cultural preservation while addressing current technology integration. The results indicate that in both nations, sociocultural variables significantly influence pedagogical approaches and educational results, especially in relation to language variety and resource inequities. In Kosovo, after the breakup of Yugoslavia and the declaration of independence from Serbia in 2008, the educational system went through a period of changes and adaptations to new political and sociocultural realities. Kyrgyzstan, in turn, faced transformations and the transition to a new education system after the collapse of the Union of Soviet Socialist Republics in 1991. Both countries have deep historical roots, a complex ethnic structure, and face challenges in integrating diverse cultural groups into the educational process.

Since the educational process has a significant impact on the personal development of students, this process includes several key aspects, the first of which is cognitive development. Learning can broaden the horizons of students, help them master new knowledge and skills, and develop critical thinking and analytical abilities (Lewinski, 2015; Qiu, Ikeda, & Yamashita, 2025). Through educational materials and educational activities, they learn to analyse information, draw conclusions, solve problems, and make informed decisions. Another aspect is social development. Education provides students with the opportunity to interact with others and develop communication, collaboration, and empathy skills. As part of the learning process, they learn to work in a group, speak publicly, listen, and respect other people's opinions. Through the fostering of an aspect such as emotional development, education can help students broaden their emotional intelligence, recognise and manage their feelings, and develop self-regulation and stress resilience. Successful adaptation to various educational situations helps students develop self-confidence and their abilities (Baizhumanova et al., 2024). Ultimately, an important aspect is personal self-determination and self-realisation. Education provides students with the opportunity to explore their interests and hobbies, define their goals and values, and develop their potential. Through educational projects, research activities, and other forms of active learning, students can unlock their creative potential and achieve personal growth.

Given the diversity of sociocultural contexts, educational institutions in countries such as Kyrgyzstan and Kosovo face a number of serious problems that affect various aspects of their activities. One of these problems is the heterogeneity of students. Children with different levels of education, different cultural and social backgrounds, language characteristics, and specific needs can study in educational institutions, which creates difficulties for teachers in organising lessons and selecting teaching methods that would suit all students. Another problem is the language barrier. In educational institutions, there are often students for whom the language of instruction is not their native language, which can lead to misunderstandings, difficulties in learning the material, and social isolation of such children (Duanaeva et al., 2023). Cultural differences can also be highlighted among the problems: different cultural norms and values can create conflicts and misunderstandings both between children and between students and teachers; a lack of understanding of cultural characteristics can lead to conflicts and difficulties in communication. Given the diversity of sociocultural contexts, educational institutions often face limited resources; they may not be sufficient to provide quality education to all students, especially those who need additional support. Also, an important problem was the adaptation of curricula: in a rapidly changing world, educational programs must be constantly updated and adapted to changing sociocultural realities. Insufficient updating of programs can lead to obsolescence of knowledge and incompetence of students (Altynbekova et al., 2024).

The effectiveness of educational programs in heterogeneous sociocultural environments depends on many factors that interact and influence learning outcomes. One of the key factors is the cultural competence of teachers. Teachers who understand and respect cultural differences can better adapt their teaching methods to the needs of diverse students (Tazhitova et al., 2024). They can create an inclusive educational environment where every student feels accepted and respected. In addition, educational institutions should provide access to modern educational technologies and resources that can help students with different levels of training and learning needs. Another important factor is the flexibility and differentiation of educational programs: they must be able to adapt to different levels of training of students, their individual needs, and learning styles. Flexible educational strategies allow teachers to work effectively with diverse groups of children (Mokliak & Tarelko, 2023).

Such a factor as active interaction between students and teachers includes collective learning, exchange of experience and knowledge, and cooperation between students and teachers, which contribute to more effective learning and achievement of educational goals (Citrawan et al., 2024). In addition, the effectiveness of educational programmes in heterogeneous sociocultural environments depends on the support and involvement of the administration of educational institutions. The administration should create conditions for the successful education of students from different cultural and social groups, provide resources and support for teachers and children. The following recommendations and strategies can be proposed for the development of education, considering sociocultural changes and challenges inherent in countries such as Kyrgyzstan and Kosovo: 1). Promotion of cultural diversity: the introduction of educational programmes and events, for example, the organisation of cultural festivals, thematic months, lectures and discussions about cultural traditions; 2). Intercultural communication training: development and integration of special courses and trainings on intercultural communication and interaction aimed at helping students and teachers develop skills in a multinational and multicultural environment; 3). Integration of technology and online learning: use of modern technologies such as online platforms, virtual classrooms and multimedia resources to provide a convenient and accessible educational experience for students from different sociocultural environments; 4). Involvement of experts and consultants: collaboration with experts from the fields of culture and history to develop and implement educational programmes that consider the cultural characteristics and needs of different groups of students; 5). Support and development of intercultural exchange: creation of exchange programmes for students and teachers to get acquainted with different cultures, languages and customs; 6). The development of intercultural education in the curriculum: the introduction of educational courses and programmes that encourage the study of different cultures and traditions, and the analysis of their impact on society and human history; 7). Creation of an open and inclusive educational environment: creating an atmosphere of mutual respect, tolerance and support in which each student feels accepted and an important participant in the educational community.

These recommendations and strategies can help educational institutions adapt to sociocultural changes and challenges, and create an educational environment that promotes the development of all students, regardless of their cultural and social background. Various methods and strategies are widely used to adapt educational programmes to a variety of cultural and social contexts, which allow

considering the needs and characteristics of each group of students. The efficacy of educational programs in many sociocultural contexts relies on several aspects, including the cultural competency of educators, availability of educational technologies, adaptable instructional methodologies, and support from educational administrations. Recommendations encompass the promotion of cultural diversity, training in intercultural communication, the integration of technology, the involvement of experts, the support of intercultural interaction, the development of intercultural education curriculum, and the establishment of inclusive educational settings (Table 2).

Table 2. Programme for adaptation of educational strategies

Strategies for adapting educational programmes	Steps to adapt educational strategies	Expected result
Research and analysis of cultural and social characteristics of students	<ol style="list-style-type: none"> 1. Conducting a review of the cultural and social characteristics of students. 2. Analysis of data and statistics on sociocultural groups of students. 3. Definition of the basic needs and expectations of different groups. 	Understanding the main cultural and social contexts of students, which will effectively adapt educational programmes to their needs and expectations
Development of multi-level educational materials	<ol style="list-style-type: none"> 1. Creation of learning resources that consider the diversity of student preferences and abilities. 2. Introduction of various formats of materials: texts, images, audio and video. 3. Adaptation of training tasks to cultural and social contexts. 	Creation of educational resources that contribute to a deeper understanding of the material and active participation of students in the learning process
Use of differentiated educational strategies	<ol style="list-style-type: none"> 1. Conducting individualised classes and assignments for each student. 2. Organisation of group work considering the diversity of cultural and social groups. 3. Provision of additional support and feedback to students with special needs. 	Increasing the level of education and participation of children from various sociocultural groups, which contributes to more effective achievement of educational goals
Conducting intercultural exchange and interaction	<ol style="list-style-type: none"> 1. Organisation of events and projects aimed at exploring cultural differences and similarities. 2. Conducting training through intercultural exchange and cooperation between students. 3. Creation of conditions for mutual understanding and cooperation between representatives of different cultures. 	Improvement of intercultural understanding and interaction between students, development of interpersonal skills and cooperation
Introduction of a culturally competent approach	<ol style="list-style-type: none"> 1. Consideration of cultural characteristics and traditions of students in the development of educational materials and conducting classes. 2. Inclusion of materials and examples from different cultures in the educational process. 3. Encouraging the participation of students from different cultural backgrounds in the educational process. 	Creation of an inclusive and supportive educational environment that respects and appreciates the diversity of cultures and social contexts, which contributes to more effective learning and development of students

Science education profoundly impacts personality development, with sociocultural settings being pivotal in moulding this process. The investigation indicated that cultural traditions, social position, ethnicity, language, and religious views significantly influence educational outcomes and personal development. In Kyrgyzstan, the educational system embodies the nation's rich cultural legacy

by incorporating many ethnic groups and cultural customs (Adylbek Kyzy et al., 2024). In Kosovo, the educational landscape is shaped by a combination of Serbian Orthodox traditions, Turkish influences, and political transformations, which affect educational practices and individual development (White & Saqipi, 2021). Educational institutions in Kyrgyzstan and Kosovo have several challenges arising from diverse social origins. Factors include student diversity, language barriers, cultural differences, resource constraints, and the need for ongoing curriculum updates (Duanaeva et al., 2023; Altynbekova et al., 2024). Addressing these challenges requires cultural competence among educators, access to modern educational technologies, flexible educational programs, and active interaction between students and teachers (Tazhitova et al., 2024; Mokliak & Tarelko, 2023). The study's findings have substantial implications for educational policy and practice. Educators and governments must prioritise cultural competency training, flexible teaching methodologies, and technological integration to create inclusive and effective learning environments. These adjustments are crucial for addressing the diverse needs of children in multicultural settings.

The present study corroborates other studies emphasising the substantial influence of sociocultural circumstances on educational experiences (Allman, 2020; Fives & Barnes, 2022). The results from Kyrgyzstan and Kosovo highlight the significance of cultural competence among educators and the necessity for inclusive educational settings. The research underscores the incorporation of contemporary technologies and interdisciplinary methods, which were less significant in prior studies (Mispani & Widayati, 2021).

Interrelation of interdisciplinary approaches and sociocultural adaptation of science education

The use of interdisciplinary approaches in adapting educational programmes to a variety of sociocultural contexts is a key aspect in modern educational practice. An interdisciplinary approach involves collaboration and integration of knowledge from various fields of science, which allows for the creation of deeper and more comprehensive educational strategies.

In the context of the adaptation of educational programmes, interdisciplinary methods allow considering a wide range of factors affecting the learning and development of students. For example, when creating educational materials and techniques, the inclusion of knowledge from sociology, cultural studies, psychology and anthropology allows for a deeper understanding of the sociocultural context in which students function and adapt educational approaches to their needs. Interdisciplinary methods also contribute to a broader and more comprehensive understanding of the problems faced by educational institutions in a variety of sociocultural contexts. They allow going beyond highly specialised approaches and considering the problems of science education in their broad sociocultural context, which contributes to a more effective search for solutions and the development of adapted strategies. Moreover, the use of interdisciplinary methods can contribute to the development of critical thinking and a creative approach to solving educational problems. Teaching students of pedagogical specialities using various disciplines and methods will allow them to see the problem from different points, and develop skills in analysing, synthesising and applying knowledge in various contexts.

Project-based environments and the use of technology are new developments in multidisciplinary science education that promote sociocultural adaptability by fostering cross-disciplinary collaboration. The usefulness of project-based learning in developing student involvement and critical thinking abilities in multidisciplinary contexts has been demonstrated by recent research, including Bolick et al. (2023). Furthermore, Markula & Aksela (2021) stress the use of projects in K–12 scientific instruction, showing how these methods may improve students' comprehension of difficult problems by tying together different areas of knowledge. Teachers may provide inclusive learning experiences that connect with students from a variety of sociocultural backgrounds and foster a greater awareness of the world by using these trends.

One example of the application of interdisciplinary approaches in science education is the creation of interdisciplinary courses and programmes. Such courses combine knowledge from several fields of science, which allows students to consider the problem from different perspectives and better understand its complexity. An example of the application of interdisciplinary approaches is the use of project work in the educational process: project work allows students to apply knowledge and skills from various fields to solve real problems or tasks. For example, students can work on a project to create an educational application that requires knowledge from the fields of programming, design, pedagogy, and marketing. Interdisciplinary approaches can also be used to develop students' critical

thinking. The study of various disciplines and methods of analysis allows students to develop the ability to analyse information, draw conclusions and make informed decisions.

Educators may face several challenges while applying multidisciplinary approaches in their classrooms. Primary problems encompass curricular constraints that hinder the integration of varied courses, with inadequate training and professional development chances that render educators ill-equipped for interdisciplinary instruction. Language difficulties can exacerbate the learning environment, especially in culturally diverse classrooms where students may lack a shared language. Moreover, resource limitations frequently obstruct the provision of sufficient assistance and materials for successful multidisciplinary learning experiences. Schools should prioritise professional development that prepares educators with vital transdisciplinary skills and techniques to tackle these difficulties. Implementing adaptable curricular frameworks enables instructors to integrate many subjects while addressing unique student requirements. Encouraging cooperation among educators across diverse topics helps cultivate a supportive network for resource sharing and the exchange of best practices. Ultimately, utilising technology can improve access to educational resources and promote communication among students from diverse backgrounds, therefore addressing disparities arising from language and cultural barriers.

Interdisciplinary approaches are crucial for customising educational programs to diverse sociocultural contexts. These techniques integrate ideas from other disciplines, such as sociology, cultural studies, psychology, and anthropology, to develop comprehensive educational solutions (Bolick et al., 2023; Markula & Aksela, 2021). Project-based learning and the application of technology foster multidisciplinary collaboration and augment critical thinking abilities. The research revealed that science education within sociocultural contexts fulfils several functions beyond mere information transmission, encompassing socialisation and social mobility. Diverse cultures emphasise distinct educational objectives, including individual capabilities and innovative thought as opposed to conformity to customs and societal norms (Huretska, 2023). The content and methodologies of science education are significantly shaped by the sociocultural context, as demonstrated by the curriculum and educational resources in Kyrgyzstan and Kosovo (Ponomarenko, 2022).

Ethical aspects of adapting educational strategies to sociocultural contexts

The adaptation of educational programmes and methods to different cultural and social contexts raises a number of ethical issues that require careful consideration and consideration in the planning and implementation of educational initiatives. One of the key ethical issues is the cultural adaptation of educational content, which is what aspects of culture should be represented in educational materials, what values and norms should be taken into consideration when organising the educational process, and how to balance respect for cultural traditions with the need to provide all students with equal educational opportunities.

The issue of cultural sensitivity in science education includes aspects such as respect for differences in cultural and social practices, awareness and recognition of the diversity of life styles and values, and the desire to create an educational environment that is inclusive and supportive for all students, regardless of their cultural or social background. Another important ethical issue is related to the inclusion of local communities and representatives of cultural and social groups in the process of developing and implementing educational programmes and initiatives. This is important not only from the standpoint of ensuring the authenticity and relevance of science education, but also from the standpoint of respect for the rights and interests of local communities and their right to participate in decision-making that relate to the science education of new generations.

One of the main ethical principles that should guide the adaptation of educational programmes to diverse cultural and social contexts is the principle of justice and equality. This means that all students should have equal opportunities to receive a quality science education, regardless of their cultural or social status, and that educational programmes should be designed in such a way as to consider and support the diversity of needs and abilities of each student. In the process of adapting education to different cultural and social contexts, various ethical dilemmas may arise that require careful analysis and the search for balanced solutions. Modifying educational programs to align with sociocultural contexts presents ethical dilemmas, including the cultural adaptation of material, cultural sensitivity, and the engagement of local populations. Fundamental principles of justice, equality, and engagement with local experts are crucial for establishing inclusive and supportive educational settings (Table 3).

Table 3. Principles of sociocultural adaptation of science education

Principle	Implementation
Respect for cultural differences and dialogue	It is important to be aware of and respect differences in cultural and social practices, and to maintain an open and respectful dialogue between representatives of different cultural and social groups. This will help to avoid conflicts and misunderstandings and contribute to the creation of an educational environment that considers the needs and values of all participants.
Inclusivity and equality	It is important to strive to create an inclusive educational environment that supports the participation of all children, regardless of their cultural or social status. To do this, efforts should be directed towards developing educational programmes and teaching methods based on the diversity of needs and abilities of each student, and ensuring equal access to educational resources and opportunities.
Collaboration with local communities and experts	It is important to include representatives of local communities and cultural groups in the process of developing and implementing educational programmes and initiatives. This helps to ensure the authenticity and relevance of education, and to take into account local characteristics and needs.
Teaching ethical thinking and decision making	It is important to include training in ethical thinking and decision-making in educational programmes to help students of pedagogical specialities develop skills in analysing ethical dilemmas, identifying alternative solutions and making informed decisions based on values and principles of justice and respect.
Constant updating and adaptation	Educational programmes and methods must be constantly updated and adapted to changing sociocultural contexts and challenges. This helps to ensure the relevance of education and to consider changes in cultural and social requirements and expectations.

Role of pedagogical leadership in the sociocultural adaptation of education

Pedagogical leadership denotes the function of educational leaders in directing and shaping curriculum creation, assisting educators, and improving student participation within the framework of sociocultural adaptation. This leadership emphasises the establishment of inclusive educational settings that acknowledge and honour varied cultural origins, guaranteeing fair access to learning opportunities for all students. Effective pedagogical leaders aggressively advocate for culturally responsive teaching techniques, enabling the incorporation of sociocultural elements into educational initiatives (Volkova, 2022). They prioritise continuous professional development to remain knowledgeable about best practices in sociocultural adaptation, allowing them to guide their institutions in meeting the distinct requirements of their student populations and promoting an atmosphere that embraces diversity and inclusion.

Heads of educational institutions play a key role in organising the adaptation of educational programmes to sociocultural differences. They should have an understanding of the importance of the cultural and social context for science education and be aware of the need to adapt educational programmes to the diversity of cultural and social needs of students. Managers should also encourage and support the development and implementation of adaptation strategies, including providing the necessary resources and support for educators, which includes conducting training events, organising the exchange of experiences, and building networks and partnerships with local communities and organisations.

It is especially important that the heads of educational organisations act as leaders in the development of an inclusive educational culture that considers and values the diversity of cultural and social perspectives (Ridwan et al., 2024). They must create an educational environment in which every student feels accepted and supported, and ensure equal access to educational opportunities for all. Moreover, the heads of educational organisations should be flexible and open to change, adapting educational programmes and methods to changing sociocultural requirements and challenges. They should encourage innovation and experimentation in education that contribute to the creation of more adapted and relevant educational strategies. Heads of educational institutions should act as catalysts for changes in education, striving to create an educational environment that reflects and respects the diversity of cultural and social contexts and provides equal opportunities for all students.

The teacher-leader, who contributes to the successful adaptation of science education to diverse sociocultural contexts, has a number of characteristics that help them effectively manage the process of change and create an educational environment that considers the needs and characteristics of each student. Such a leader has a broad understanding of cultural and social differences, and is also aware of their impact on the educational process. It has in-depth knowledge and understanding of the cultural and social characteristics of various groups of students and can consider them when developing and implementing educational programmes. In addition, the teacher is a leader who contributes to the adaptation of education to diverse sociocultural contexts, has the skills of intercultural interaction and communication. Such a teacher should be able to effectively interact with representatives of various cultural groups, build relationships based on mutual respect and trust, and contribute to the creation of an inclusive educational environment.

The teacher-leader's ability to empathise and understand the individual needs and abilities of each student is characterised by the ability to listen to and take into consideration the opinions and requests of students, create conditions for the development of their individual talents and abilities, and support them in the learning process. In addition, the teacher is a leader who contributes to the successful adaptation of education to diverse sociocultural contexts, has strategic thinking skills and the ability to make informed decisions in difficult situations. The teacher can analyse current trends and challenges in education, identify the needs of students, and take measures to adapt educational strategies to changing sociocultural contexts.

Effective pedagogical leadership is essential for tailoring educational programs to sociocultural disparities. Leaders must comprehend cultural and social circumstances, endorse adaptation tactics, cultivate inclusive educational environments, and remain receptive to change. Teacher-leaders must demonstrate multicultural communication skills, empathy, and strategic thinking to successfully manage the educational process.

Evaluation of the effectiveness of adapted educational programmes

Evaluation of the effectiveness of educational programmes in the context of sociocultural adaptation is a complex and multilevel process that includes a number of criteria and methods. One of the key criteria for the effectiveness of such programmes is the degree to which educational goals and objectives correspond to the cultural and social needs and expectations of students. The assessment should be based on an analysis of the relevance of the content and teaching methods to the cultural and social contexts of students, their interests and needs. Another important criterion of effectiveness is the academic success of students from various sociocultural groups, which includes an assessment of the level of educational achievements, the diversity and quality of knowledge, skills and abilities acquired. The criterion of effectiveness is also the level of involvement and participation of children from various sociocultural groups in the educational process. To do this, it is necessary to assess the level of activity, motivation and interest of students, and their participation in additional educational activities and projects (Putriningsih et al., 2023). It is also necessary to regularly collect and analyse feedback from students, teachers, and other participants in the educational process. This will help identify the strengths and weaknesses of the programme, and offer recommendations for its improvement. Another important method is the direct observation of the learning process and the interaction of students in the educational environment. Observations can be carried out both by qualified observers and by the participants of the educational process themselves, which allows getting a more complete picture of its effectiveness.

To assess the efficacy of educational programs for sociocultural adaptation, standardised exams and questionnaires may be utilised. Culturally responsive standardised tests, such as dynamic assessment, may evaluate both academic success and pupils' growth potential, taking into account their cultural and language backgrounds. Furthermore, surveys may be tailored to incorporate enquiries on students' perceptions of the curriculum's effectiveness in addressing their cultural requirements, employing Likert scales to quantify the responses. These evaluations may be customised for various sociocultural groups by engaging community stakeholders in their formulation, ensuring that the terminology, examples, and circumstances employed are pertinent to all pupils. Assessments may involve oral presentations for cultures that prioritise verbal communication over written forms or collaborative projects that embody community values. The justification for these selections is rooted in the necessity to provide a fair assessment framework that recognises cultural diversity and fosters tolerance. In addition to standard tests and exams, teacher can include projects, essays, portfolios,

practical assignments, and even cultural artefacts. All this will allow considering the differences in preferences and abilities of students from different sociocultural groups. Another effective assessment method is the use of authentic assignments and situations. For example, instead of abstract learning tasks, students can be asked to solve real problems that they may encounter in their lives or professional activities in order to better understand the material and apply it in practical situations.

To systematically gather and evaluate feedback from students, educators, and stakeholders, numerous techniques and platforms may be utilised, including online surveys, focus groups, and digital feedback systems. Surveys conducted on platforms like Google Forms or SurveyMonkey may collect quantitative data regarding student happiness and engagement, whereas focus groups enable comprehensive talks to provide qualitative insights into the educational experience. Digital feedback instruments such as Padlet or Mentimeter provide real-time contributions during sessions, thereby improving quick responsiveness to participant requirements. It is essential to customise these tools for various sociocultural groups. For instance, surveys must employ culturally pertinent language and situations, while focus group discussions should be moderated to guarantee that all perspectives are acknowledged. The justification for these selections is to cultivate an inclusive educational atmosphere that appreciates multiple viewpoints and adeptly tackles the distinct issues encountered by pupils from different origins. By integrating quantitative and qualitative methodologies, educators may attain a holistic comprehension of program efficacy and make informed decisions for ongoing enhancement.

An important aspect of effective assessment in various sociocultural environments is the consideration of context and cultural characteristics. For example, in some cultures it may be customary to use oral expression of thoughts, while in others written forms are preferred. With this in mind, assessment methods can be adapted to be more in line with cultural expectations and standards. It is also extremely important to conduct an assessment taking into account the principles of justice and equality. This means that assessment methods should be objective and not discriminate against students based on their cultural or social background. It is important to ensure equal opportunities for all students and to take into account their individual needs and abilities when conducting assessments (Zhumasheva et al., 2022).

A recurring topic in both recent and earlier research is the understanding that sociocultural settings have a big influence on learning experiences. Allman (2020) asserts that education is an essential instrument for socialisation within certain cultural contexts in addition to being a means for the transfer of knowledge. Present research supports this notion by highlighting the profound impact of cultural traditions, social norms, and historical legacies on educational settings. The results from Kyrgyzstan and Kosovo, for example, demonstrate how different sociocultural dynamics resulting from their complex historical legacies influence educational methods and personality development. Furthermore, the significance of cultural competency among educators is emphasised by the current study. It supports previous research, such as that conducted by Fives and Barnes (2022), which suggests that in order to establish inclusive learning environments, educators need have an awareness of the varied backgrounds of their students. A common understanding of the need of cultural awareness training for effective teaching is shown in the emphasis on this topic in both the new and older literature.

Current study offers a more sophisticated view of the modern issues encountered by educational institutions, even though fundamental patterns remain. Mispani and Widayati (2021) explicitly discuss how the Industrial Revolution 4.0 calls for a reassessment of educational approaches in order to integrate technology innovations while honouring cultural values. This emphasis on incorporating contemporary technology into sociocultural education is less noticeable in previous research, which mostly focused on conventional teaching methods without taking into account the effects of online learning settings. Additionally, the current study emphasises how diverse student populations provide a big obstacle for teachers working in multicultural environments. The findings indicate that students often come from varied educational backgrounds and possess different language proficiencies, which complicates lesson planning and instructional methods. Although this complexity is recognised, it has not been fully examined in previous publications such as Brown (2020), which concentrated more on subjectivity within certain fields than on the wider ramifications of student diversity across educational environments.

Recognising the importance of sociocultural circumstances in influencing educational experiences is a major issue in both recent and earlier research. Walsh et al. (2019), for example, stressed the value of participatory learning theories in play-based education, contending that these

methods provide a more welcoming and stimulating learning environment. The results from Kyrgyzstan and Kosovo, where social norms and cultural traditions have a significant impact on educational methods, are consistent with this idea. Additionally, Tian (2021) addressed the ways in which social, political, and economic factors impact China's educational curriculum. The findings from Kyrgyzstan and Kosovo, where historical occurrences and various cultural influences have an equal impact on educational methods and content, are supported by this viewpoint. The necessity of culturally responsive teaching methods is shown by the emphasis on comprehending local settings in order to create pertinent curriculum. present research offers a more sophisticated view of the present issues in sociocultural education, even if fundamental themes remain. To address learners' misunderstandings, de la Hera et al. (2019) concentrated on how social interactions promote conceptual transformation. Walsh et al. (2019) emphasised several ways that sociocultural elements might improve learning outcomes, although this emphasis on interaction stands in contrast to their focus on participatory learning as a pedagogical technique.

The current study provides deeper insights into modern difficulties such as technology integration and the necessity for multidisciplinary methods, even though there are recurring themes about the impact of sociocultural influences on education. A growing understanding of the complexity of variety in learning situations is reflected in the development of ideas concerning sociocultural education. Fostering cultural competency among educators and putting flexible, inclusive techniques into practice will be essential for ensuring equitable learning opportunities across a range of sociocultural contexts as educational systems continue to adapt to these realities. The successful adaptation of educational programmes to diverse sociocultural contexts plays a key role in improving the effectiveness of the educational process and achieving positive learning outcomes. During the review of the papers by other authors, it was also noted that researchers agree on the importance of a deep understanding of the cultural and social characteristics of various groups of students, and the need for constant updating of educational practices in accordance with changing sociocultural trends.

Assessing the efficacy of educational programs in sociocultural adaptation necessitates an evaluation of the alignment of educational objectives with cultural requirements, academic achievement, student engagement, and participant feedback. Standardised examinations, surveys, authentic tasks, and direct observations are vital approaches for thorough evaluation. The study had limitations, notably its concentration on particular countries and dependence on qualitative data. Future study has to broaden its focus to encompass a wider array of sociocultural situations and utilise mixed-methods methodologies for a more thorough understanding.

CONCLUSION

The research examined the sociocultural factors affecting the science educational system in Kosovo and Kyrgyzstan, highlighting problems and possibilities influenced by historical and cultural contexts. Both nations must modify educational systems to accommodate the needs of various cultural and socioeconomic groups, tackling issues such as resource constraints, inadequate teacher training, and ineffective curriculum. The research advocated an integrated strategy to adapt educational practices, emphasising varied learning approaches, intercultural interchange, and the cultivation of cultural competency among educators. The research culminated in the creation of a program designed to adapt educational practices, focusing on the assessment of student requirements, the provision of varied educational resources, and the encouragement of interdisciplinary methods in teacher training. This method empowers instructors to function proficiently in multicultural settings and provides students with analytical ability to tackle intricate global issues. The research underscored the ethical aspects of educational adaptation, stressing the necessity for justice, equality, and inclusion within educational settings to provide equitable chances for all students. A disadvantage of the study was the lack of publicly accessible data about the academic achievement of pupils from various ethnic groups in Kyrgyzstan and Kosovo. Subsequent study ought to concentrate on examining this data to yield profound insights into the influence of sociocultural variables on academic performance and to pinpoint certain domains for additional intervention.

ACKNOWLEDGMENTS

The authors declare that there are no acknowledgments to be made, as no external funding, institutional support, or contributions beyond the listed authors were involved in the preparation of this research.

AUTHOR CONTRIBUTIONS

Conceptualization, Shukrije Baruti and Salamat Moldaliev; Methodology, Salamat Moldaliev; Software, Miranda Baruti-Sylejmani; Validation, Nazira Koichubaeva; Formal Analysis, Nazira Koichubaeva; Investigation, Miranda Baruti-Sylejmani; Resources, Nazira Koichubaeva; Writing – Original Draft Preparation, Shukrije Baruti, Salamat Moldaliev, Miranda Baruti-Sylejmani and Nazira Koichubaeva; Writing – Review & Editing, Shukrije Baruti and Nazira Koichubaeva; Visualization, Nazira Koichubaeva; Supervision, Shukrije Baruti; Project Administration, Shukrije Baruti; Funding Acquisition, Miranda Baruti-Sylejmani”.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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