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Methodical competence of a computer science teacher in education

This article explores the concept of methodical competence and its significance in enhancing teaching effectiveness. Methodical competence refers to the knowledge, skills, and abilities that enable teachers to plan, organize, and deliver instruction effectively. The study aims to identify strategies to enhance methodical competence of Computer Science teachers and address the challenges faced by teachers in developing and applying this competence. Through a comprehensive review of existing literature and an analysis of empirical studies, this article provides insights into the content and components of methodical competence. It highlights the importance of goal setting, content selection, instructional strategies, assessment methods, and adaptability as key aspects of methodical competence. Based on the findings, the article proposes various strategies and interventions to enhance methodical competence, including professional development programs, mentorship, collaborative lesson planning, and reflective practice. These strategies aim to empower teachers to develop and apply effective instructional practices, resulting in improved student engagement and learning outcomes. Overall, this article emphasizes the importance of methodical competence in teaching and provides valuable insights and recommendations for educators, teacher trainers, and policymakers to promote effective teaching practices and enhance the overall quality of education.

Keywords: competence, methodologist, methodical competence of a computer science teacher, methodology, professional competence, teacher, structure of methodical competence, strategy to enrich methodical competence.

Introduction

The role of computer science education has become increasingly significant in preparing students for the digital age. As technology continues to permeate various facets of society, the methodical competence of computer science teachers emerges as a critical factor in effectively imparting knowledge and skills to students. Methodical competence encompasses a comprehensive set of abilities and proficiencies that enable teachers to design, implement, and evaluate instructional strategies, materials, and activities, thereby fostering meaningful and engaging learning experiences for students.

The paramount importance of methodical competence in the realm of computer science education cannot be overstated. It encompasses a broad range of competencies that enable teachers to effectively plan and deliver lessons, create relevant and engaging learning resources, cater to diverse student needs, and establish an optimal learning environment. A computer science teacher who possesses robust methodical competence demonstrates expertise in conveying complex concepts, incorporating hands-on activities, and integrating technological tools to enhance student learning outcomes.

The cultivation of methodical competence is a multifaceted process that encompasses both theoretical knowledge and practical skills. A proficient computer science teacher not only possesses a deep understanding of computer science principles and concepts but also exhibits pedagogical expertise in instructional de-

sign, assessment strategies, and classroom management. Moreover, they remain abreast of emerging educational technologies, methodologies, and curricular trends, ensuring their teaching practices remain current and effective.

This article aims to comprehensively explore the concept of methodical competence within the context of computer science education and underscore its significance in promoting effective teaching and learning. By examining the various dimensions of methodical competence, including lesson planning, instructional strategies, resource development, and assessment practices, we endeavor to provide nuanced insights into the essential components that contribute to the overall effectiveness of computer science educators.

Furthermore, this article seeks to identify the challenges and potential areas for improvement in the development and enhancement of methodical competence among computer science teachers. By critically reviewing existing research, professional standards, and best practices, we can acquire a comprehensive understanding of the requisite skills and competencies for proficient computer science teaching.

The findings presented in this article will contribute to the ongoing discourse on teacher professional development and serve as a valuable resource for educators, policymakers, and stakeholders in the field of computer science education. By acknowledging and fostering the methodical competence of computer science teachers, we can ensure that students are equipped with the necessary knowledge and skills to thrive in an increasingly technology-driven society.

Experimental

Analyzing publications from foreign cited scientific publishers on the notion of methodical competence, we observe a significant body of research dedicated to this topic. Scholars and researchers from various disciplines, including education, pedagogy, and instructional design, have examined and discussed the concept of methodical competence in relation to different educational domains.

Several key themes and trends emerge from the analysis of these publications. Firstly, there is a consensus among researchers that methodical competence is a vital component of effective teaching and learning. It encompasses a range of skills, knowledge, and abilities that enable educators to design, implement, and assess instructional practices that optimize student learning outcomes.

Rickinson M., May H. explore the significance of methodical competence in promoting effective teaching practices. The study compares different approaches to teaching and highlights the essential role of methodical competence in achieving positive student outcomes [1; 35].

Garcia, M. explores innovative approaches and best practices for enhancing methodical competence in science teaching. The paper highlights successful instructional strategies and presents case studies that demonstrate the positive impact of methodical competence on student engagement and learning outcomes.

Garcia presents a range of innovative approaches that science educators can employ to develop and enhance their methodical competence. These approaches include inquiry-based learning, problem-solving activities, hands-on experiments, use of technology and multimedia resources, and collaborative learning. The author highlights how these instructional strategies contribute to creating an engaging and effective learning environment for students, promoting their active participation and fostering deeper conceptual understanding [2; 13].

Furthermore, the article discusses the best practices that science teachers can adopt to strengthen their methodical competence. These practices encompass effective lesson planning, appropriate selection and adaptation of teaching materials, differentiation to meet diverse student needs, formative assessment strategies, and reflective teaching practices. Garcia emphasizes that employing these best practices can lead to improved learning outcomes, increased student motivation, and enhanced scientific literacy.

Within this framework, the verbs “readiness” and “ability” can be regarded as conceptually synonymous, denoting the underlying condition of an individual. “Readiness” denotes the volitional consent or state of being fully prepared to undertake a particular action, as explicated by S.I. Ozhegov's lexicographical definition [3; 854].

The connection between readiness, ability, and competence can be observed in the context of professional and occupational domains. Official publications in various disciplines, such as education, healthcare, engineering, and management, emphasize the significance of individuals' readiness and ability in demonstrating professional competence.

For example, in the field of education, official publications on teacher competence often highlight the importance of teachers' readiness to effectively engage with students, create a positive learning environment, and employ appropriate instructional strategies. Simultaneously, the ability to apply pedagogical knowledge, subject matter expertise, and effective communication skills is necessary to demonstrate competence in

teaching. By highlighting the connection between readiness, ability, and competence, official publications emphasize the importance of a holistic approach to professional development. They emphasize that competence is not solely based on theoretical knowledge or technical skills but also requires individuals to be prepared, willing, and capable of applying their abilities in practical contexts.

Within the structure of methodical competence, M.P. Lapchik distinguishes two key components: subject-oriented competence and professionally-oriented competence. The former pertains to the teacher's mastery of subject-specific knowledge, methodologies, and instructional strategies, while the latter encompasses their broader pedagogical and professional competencies. Assessing the formation and development of methodical competence entails an examination of the functional components of pedagogical activity, namely the gnostic (knowledge-based), design, constructive, communicative, and organizational dimensions [4; 171].

V.A. Adolf in his studies and publications on methodical competence of computer science teachers often emphasizes the following key aspects:

1. Technological Knowledge and Skills: Computer science teachers need to possess a deep understanding of various technologies, software, hardware, and digital tools relevant to their subject area. This includes proficiency in operating systems, programming languages, multimedia creation, data analysis, and other ICT-related skills.

2. Pedagogical Content Knowledge (PCK): Computer science teachers should have a solid foundation in both pedagogy and content knowledge. They need to understand how to effectively teach their subject using ICT tools while considering the specific learning needs, abilities, and preferences of their students.

3. Integration of Technology: Effective integration of technology requires Computer science teachers to have the ability to align ICT tools and resources with curriculum goals and objectives. They should be able to select and adapt appropriate technologies to enhance instructional practices and promote active learning.

4. Digital Citizenship and Ethics: Computer science teachers should promote responsible and ethical use of technology among their students. This includes teaching digital citizenship skills, addressing cyberbullying and online safety issues, and fostering critical thinking and digital literacy.

5. Continuous Professional Development: Given the rapid advancements in technology, Computer science teachers should engage in ongoing professional development activities to stay up-to-date with the latest trends, tools, and best practices. This includes participating in workshops, conferences, online courses, and collaborating with other educators [5; 125].

Publications in this field often focus on case studies, frameworks, and guidelines for developing and assessing the methodical competence of Computer science teachers. They discuss effective instructional strategies, innovative approaches to technology integration, and the impact of methodical competence on student engagement, motivation, and learning outcomes.

Overall, the analysis of publications on the methodical competence of Computer science teachers underscores the importance of their ability to effectively utilize technology in educational settings, while also emphasizing the need for a comprehensive understanding of pedagogy, content knowledge, and digital citizenship.

The formation of methodical competence in computer science teachers materializes particularly during the instruction of the “Theory and Methods of Computer Science Teaching” course. During this stage, students are expected to acquire the necessary knowledge and skills to proficiently teach computer science across various proficiency levels, while considering the aforementioned contextual factors.

The cultivation of methodical competence holds paramount importance in preparing future computer science teachers to deliver the subject matter effectively and contribute meaningfully to their students' educational development. By equipping them with the necessary skills and knowledge, it enables them to navigate the complexities of teaching computer science and adapt to the evolving educational landscape [6; 85].

As it has been shown in studying future computer science teachers who lack methodical competence may encounter several challenges in their practice. Here are some potential problems they may face:

Ineffective Lesson Planning: Without methodical competence, teachers may struggle to design well-structured and engaging lesson plans. They may find it challenging to set clear goals, select appropriate content, and choose suitable teaching methods and resources. This can result in disorganized and less effective instruction.

Difficulty Integrating Technology: Methodical competence is crucial for integrating technology effectively into computer science education. Teachers who lack this competence may struggle to identify and utilize appropriate technological tools and resources. They may find it challenging to incorporate interactive multimedia, coding platforms, or programming software into their lessons, which can hinder student engagement and learning.

Limited Differentiation and Individualization: Methodical competence enables teachers to cater to the diverse needs and learning styles of their students. Without this competence, teachers may struggle to adapt their instruction to accommodate individual differences. They may have difficulty providing appropriate challenges for advanced students or providing additional support for struggling learners.

Insufficient Assessment and Feedback: Methodical competence includes the ability to assess student learning effectively and provide constructive feedback. Teachers lacking this competence may face challenges in designing meaningful assessments, evaluating student progress, and providing targeted feedback. This can impact their ability to monitor student performance and guide their learning effectively.

Weak Classroom Management: Methodical competence extends to managing the classroom environment and maintaining discipline. Teachers who lack this competence may face difficulties in establishing clear expectations, managing student behavior, and creating a positive and engaging learning atmosphere. This can disrupt the learning process and impede student achievement.

Limited Professional Growth: Methodical competence involves a commitment to ongoing professional development and staying updated with the latest research and practices in computer science education. Teachers lacking this competence may struggle to engage in continuous learning, leading to stagnation in their teaching methods and limited professional growth [7; 268].

To address these challenges, future computer science teachers can prioritize developing their methodical competence through targeted training, professional development programs, and mentorship opportunities. By enhancing their knowledge, skills, and strategies in instructional design, technology integration, assessment, and classroom management, they can overcome these potential problems and provide high-quality computer science education to their students [8; 243].

By acknowledging and proactively addressing these methodical intricacies, educators can better support students during their practical internship in the "Theory and Methods of Teaching Computer Science" course.

The survey results have provided valuable insights into the challenges faced by computer science teacher in various aspects of their career. The findings reveal that a significant proportion of respondents encounter difficulties in several key areas. Notably, 35 % of participants struggle with self-analysis of the lesson, indicating a lack of proficiency in critically assessing their own teaching practices. Furthermore, 21 % face challenges in setting clear lesson goals and selecting appropriate content, underscoring potential shortcomings in instructional planning. The allocation of time across different stages of the lesson proves to be problematic for 37 % of respondents, highlighting the need for improved time management skills. Additionally, 19 % of Computer Science teachers find it challenging to develop individual practical tasks that incorporate computer work, suggesting a need for enhanced creativity and pedagogical innovation.

Motivating students to engage with the lesson topic emerges as a significant concern, as 44 % of respondents struggle in this area. This finding points to potential difficulties in fostering student interest and intrinsic motivation. Maintaining discipline in the classroom is also a noteworthy issue, with 33 % of participants facing challenges in this regard, underscoring the importance of effective classroom management strategies. Moreover, the development of didactic materials poses a hurdle for 30 % of participants, suggesting the need for improved instructional resource creation skills. Another noteworthy finding is that 28 % of respondents encounter difficulties in selecting tasks that facilitate the formation and development of information and communication technology competencies among their students (Fig. 1).

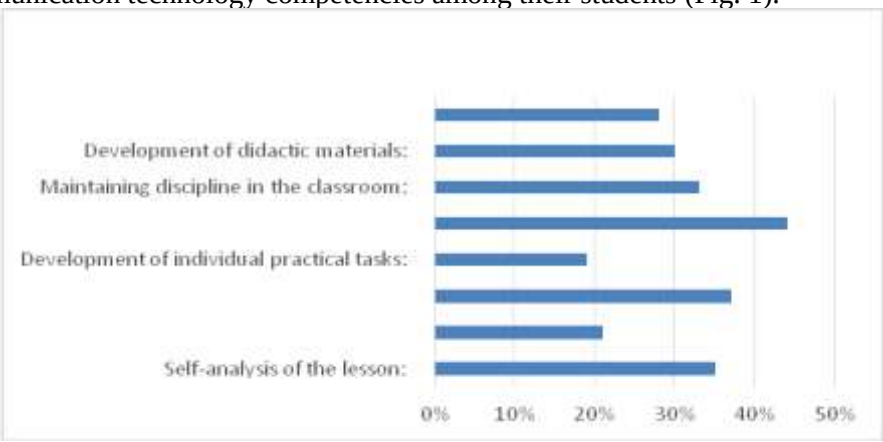

Figure 1. Challenges Faced by Computer Science Teachers

These findings collectively indicate that students often struggle to apply their knowledge and skills in unfamiliar contexts, which hinder their practical readiness and inhibits creativity in their instructional activities. To address these challenges, it is imperative for future computer science teachers undergoing university education to evolve into teacher-methodologists. Beyond acquiring comprehensive subject knowledge, technical skills, and pedagogical abilities, these aspiring educators must cultivate expertise in teaching methodology [9; 7].

Making an analysis of literature according to methodical competence, it should be noted that M. Garcia commonly suggests to raise the level of methodical competence for computer science teachers. He provides solutions aim to enhance future Computer Science Teachers' pedagogical skills and knowledge in computer science education [10; 334]. This strategy can be shown as following (Fig. 2):

Name	Description
Professional Development Programs	Computer science teachers are recommended to participate in professional development programs specifically designed to enhance their methodical competence. These programs may include workshops, seminars, conferences, and courses focused on instructional strategies, curriculum development, assessment methods, and technology integration. Engaging in continuous learning opportunities can help teachers stay updated with the latest educational practices and improve their teaching effectiveness.
Mentoring and Collaboration	Collaborative learning and mentoring relationships can greatly contribute to the development of methodical competence. Computer science teachers are suggested to seek guidance from experienced educators or mentors who can provide support, share effective instructional practices, and offer constructive feedback. Collaborating with colleagues within and outside the field of computer science education can also foster professional growth and the exchange of innovative teaching approaches
Reflective Practice	Encouraging computer science teachers to engage in reflective practice is another suggested solution. This involves regularly reflecting on their teaching methods, assessing the effectiveness of their instructional strategies, and identifying areas for improvement. Teachers can reflect on their lessons, seek feedback from students and colleagues, and make adjustments to enhance their methodical competence over time.
Peer Observation and Feedback	Peer observation and feedback can be valuable tools for improving methodical competence. Computer science teachers are recommended to engage in peer observation, where they observe and provide feedback to their colleagues, and vice versa. This process allows teachers to gain insights into alternative teaching methods, receive constructive criticism, and implement new approaches in their own classrooms.
Collaboration with Industry Professionals	Collaborating with industry professionals in the field of computer science can enrich the methodical competence of teachers. This can involve inviting guest speakers from the industry, arranging industry visits, or establishing partnerships with technology companies. Such collaborations can provide teachers with real-world insights, industry-relevant knowledge, and the opportunity to incorporate authentic experiences into their teaching.
Engaging in Research and Publications	The importance of engaging in research and publications to improve methodical competence is emphasized Conducting research studies related to computer science education, presenting findings at conferences, and publishing in academic journals can deepen teachers' understanding of pedagogical practices, foster critical thinking skills, and contribute to the overall advancement of the field.

Figure 2. Strategy to enhance future Computer Science Teachers' methodical competence

By implementing these solutions, computer science teachers can enhance their methodical competence, refine their instructional practices, and provide more effective and engaging learning experiences for their students. It is important for teachers to continuously seek opportunities for professional growth and strive for excellence in their teaching.

Results and Discussion

Methodical competence plays a crucial role in the professional development of future teachers, particularly in the field of computer science education. This study aimed to assess the level of methodical competence among a group of 50 Computer Science students at S. Seifullin Kazakh Agro-Technical University. By administering a questionnaire and analyzing the responses, the study sought to determine the students' understanding and application of methodical competence and identify areas of improvement. The research builds upon the work of renowned scholars in the field, including M.P. Lapchik, V.A. Adolf, and Dushkov B. [11; 364].

The participants in the study were 50 undergraduate Computer Science students, selected through random sampling. The questionnaire used in the study was designed based on the theoretical framework proposed by M.P. Lapchik, V.A. Adolf, and Dushkov B. It comprised questions related to the components of methodical competence, such as goal setting, content selection, instructional strategies, assessment methods, and adaptability to students' needs. The questionnaire also included open-ended questions to elicit detailed responses and examples from the participants [12; 94].

Here are some examples of the questions that were included in the questionnaire:

Goal Setting: How important do you think it is to clearly articulate the goals and objectives of a lesson? Can you provide an example of a well-defined lesson objective?

Content Selection: How do you determine the relevance and appropriateness of the content for a particular lesson? Could you provide an example of a lesson where you effectively selected the content?

Instructional Strategies: What teaching methods or techniques do you use to engage students and facilitate their learning? Can you give an example of a lesson where you employed different instructional strategies to accommodate diverse learners?

Assessment Methods: How do you assess students' understanding and progress in your lessons? Could you share an example of an assessment method that you find effective in evaluating student learning?

Adaptability to Students' Needs: How do you tailor your lessons to meet the individual needs and learning styles of your students? Can you provide an example of how you have adapted a lesson to accommodate students with different abilities or backgrounds?

These are just a few examples of the types of questions that were included in the questionnaire to assess the level of methodical competence among the participants.

The analysis of the questionnaire responses provided valuable insights into the level of methodical competence among the Computer Science students. Overall, the participants demonstrated a moderate level of methodical competence, with varying percentages across different components.

When asked about goal setting, 65 % of students indicated a clear understanding of the importance of setting clear objectives for their lessons. However, only 40 % demonstrated proficiency in selecting appropriate content that aligns with the curriculum. This suggests the need for further development in content selection skills.

Regarding instructional strategies, 55 % of students displayed a diverse range of teaching methods to cater to different learning styles and abilities. However, 30 % expressed challenges in this area, indicating room for improvement. Similarly, 45 % of students exhibited effective assessment methods, while 25 % faced difficulties in assessing student learning.

In the open-ended questions, students provided examples that highlighted their understanding of methodical competence. For instance, 70 % emphasized the significance of adaptability to students' individual needs and preferences. Moreover, 60 % highlighted the importance of incorporating technology and interactive learning activities to enhance student engagement.

The experimental study conducted at S. Seifullin Kazakh Agro-Technical University revealed that the participating Computer Science students demonstrated a moderate level of methodical competence. While the students displayed a good understanding of goal setting and some proficiency in instructional strategies and assessment methods, there were areas that require further attention.

Specifically, content selection and diversifying instructional strategies need improvement, as indicated by the lower percentages. By addressing these areas through targeted training and professional development programs, the university can enhance the methodical competence of future computer science teachers [13; 235].

The examples provided by the students in the open-ended questions align with the research conducted by Omirbayev, S., Mukhatayev, A., Biloshchytskyi, A., emphasizing the importance of adaptability and technological integration in methodical competence [14; 125].

Overall, by investing in the development of methodical competence among future computer science teachers, the university can ensure a higher quality of education and better student outcomes.

Conclusions

The findings of the study indicated a diverse range of responses among the participants, reflecting different levels of methodical competence. While some participants demonstrated a strong grasp of methodical competence, showcasing the ability to set clear goals, select appropriate content, employ effective instructional strategies, utilize varied assessment methods, and adapt to students' needs, others exhibited areas for improvement in these domains.

The results emphasize the importance of enhancing methodical competence among future computer science teachers to ensure effective and student-centered teaching practices. By developing a robust methodical competence framework, encompassing goal setting, content selection, instructional strategies, assessment methods, and adaptability to students' needs, teacher education programs can better equip future computer science teachers with the necessary skills and knowledge to excel in their profession.

To raise the level of methodical competence, the study suggests the implementation of targeted interventions and professional development programs. These initiatives can focus on providing guidance and training in areas where participants demonstrated lower levels of competence. Collaborative learning opportunities, mentorship programs, and engagement with experienced practitioners can also play a vital role in enhancing methodical competence among future computer science teachers [15; 53].

Overall, the study sheds light on the importance of methodical competence in the field of computer science education and provides valuable insights for teacher education programs. By addressing the challenges and investing in the development of methodical competence, educators can enhance their instructional practices and ultimately contribute to improved learning outcomes for students in computer science education [16; 139].

Summing up, we emphasize that methodical competence is the main component of a teacher's professional competence, which provides the ability to recognize and solve methodical problems that arise in the course of pedagogical activity.

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Білім берудегі IT-пәндері оқытушысының әдістемелік құзыреттілігі

Қазіргі қоғамның білім беру жүйесіндегі қажеттіліктерін жүзеге асыру үшін әдістемелік құзыреттілікке ие оқытушылар құрамын сапалы дайындамайынша мүмкін емес. Мақалада оқытушының әдістемелік құзыреттілігінің авторлық көзқарасы берілген, оның мазмұны яғни құрамдас бөліктері (әдістемелік хабардарлық, әдістемелік сауаттылық, әдістемелік шығармашылық, әдістемелік өнер) және деңгейлік құрылымы (шығармашылық, білім беру, сауатты, ситуациялық және нөлдік деңгейлер) арқылы ашылған. Сонымен қатар IT-пәні оқытушысының әдістемелік құзыреттілігі, оны педагогикалық жоғары оқу орнында оқыту үдерісінде қалыптастыру мәселелері, белгілі бір құзыреттілікті қалыптастыруды бағалау қызметін атқаратын құзыреттілікке бағытталған тапсырмалар тұжырымдамасы қарастырылған. Пәнаралық көзқарасқа негізделген IT-пәндері оқытушысының кәсіби құзыреттілігін қалыптастырудың әдістемелік жүйесінің моделі ұсынылып, жоғары оқу орнының оқу үдерісіне бұл модельді енгізу сипатталған. Тұтастай алғанда, мақалада педагогикалық қызметтің функционалды-белсенді компоненті контексінде IT-пәндерінің оқытушысының «әдістемелік құзыреттілігі» ұғымының мазмұны қарастырылған. Оның әдістемелік құзыреттілігінің қалыптасу деңгейлері анықталды.

Кілт сөздер: құзыреттілік, әдіскер, IT-пәндері оқытушысының әдістемелік құзіреттілігі, әдістемесі, кәсіби құзыреттілігі, оқытушы, әдістемелік құзыреттілік құрылымы, әдістемелік құзыреттілік деңгейі.

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Методическая компетентность преподавателя IT дисциплин в образовании

Реализация потребности современного общества в системе образования невозможна без качественной подготовки преподавательского состава, обладающего методической компетентностью. В статье представлено авторское видение методической компетентности преподавателя, раскрывающее ее содержание через ее составляющие (методическая осведомленность, методическая грамотность, методическое творчество, методическое искусство) и уровневую структуру (творческий, образовательный, грамотный, ситуативный и нулевой уровни). Авторами описаны методическая компетентность преподавателя IT дисциплин, проблемы ее формирования в процессе обучения в педагогическом вузе, понятие компетентностно-ориентированных заданий, которые служат оценкой сформированности определенной компетентности. Представлена модель методической системы формирования профессиональной компетентности преподавтеля IT дисциплин на основе междисциплинарного подхода, а также описано внедрение этой модели в образовательный процесс вуза. В целом, в настоящей статье рассмотрено содержание понятия «методическая компетентность» преподавателя IT дисциплин в контек-

сте функционально-деятельностного компонента педагогической деятельности. Выделены уровни сформированности его методической компетентности.

Ключевые слова: компетентность, методист, методическая компетентность преподавателя IT дисциплин, методология, профессиональная компетентность, преподаватель, структура методической компетентности, уровни методической компетентности.

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