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USING MODERN DIGITAL TECHNOLOGIES TO ENSURE INCLUSIVE LEARNING IN VOCATIONAL EDUCATION INSTITUTIONS

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Abstract

*Relevance***.** Contemporary challenges in inclusive education require the application of innovative approaches to the teaching of learners with special educational needs in vocational education institutions. Information technologies are becoming a key tool for overcoming barriers and creating equal opportunities for all participants in the educational process.

*Purpose***.** To provide a theoretical rationale and practical analysis of the effectiveness of using modern information technologies to ensure inclusive learning in vocational education institutions.

*Methods***.** Theoretical (analysis, synthesis, systematisation); empirical (pedagogical observation, survey); statistical (quantitative analysis of results, Student's *t*-test, calculation of percentage changes).

*Results***.** Four main categories of information technologies for inclusive learning have been identified: adaptive educational platforms, assistive technologies, multimedia tools, and distance learning systems. It has been established that the integrated use of information technologies increases the academic performance of learners with special educational needs by 34% and improves their social adaptation by 27%. The proposed "5K" model includes a detailed roadmap with clear stages and performance indicators.

*Conclusions***.** The effective implementation of modern information technologies in vocational inclusive education is ensured by a systemic approach that includes the training of pedagogical personnel, the development of technical infrastructure, and the creation of methodological support. The novelty of the study lies in the comprehensive approach to the use of information technologies and the implementation of the "5K" model as a tool for improving educational achievement and socialisation of learners with SEN.

Keywords: *inclusive education, information technologies, vocational education, special educational needs, adaptive learning, assistive technologies.*

Introduction. Inclusive education is one of the priority directions in the development of contemporary pedagogical science and practice. This issue is particularly relevant in the field of vocational education, as it involves the preparation of specialists with special educational needs (SEN) for full participation in professional activities and social life. The modern model of inclusion is based on humanistic principles: the main goal is not to adapt the learner to existing conditions, but rather to adapt the educational environment flexibly to the learner's individual needs.

According to the Ministry of Education and Science of Ukraine, the number of vocational education learners with special educational needs increases annually by 8–12% (Ministry of Education and Science of Ukraine, 2024). This intensifies the need to update approaches to the organisation of the educational process, as traditional teaching methods are often insufficiently effective for providing quality education to this category of learners.

Researchers believe that the quality of inclusive education can be enhanced through the personalisation of the educational process, the implementation of adaptive and assistive technologies, and the creation of an inclusive learning environment that motivates and engages all participants in the educational process (Heta, Zaika, Kovalenko et al., 2018; Braun, 2024; Kozibroda, 2020; Yarmola et al., 2023).

Modern information and communication technologies (ICT) open new opportunities for the individualisation of the educational process, support the adaptation of learning materials to the needs of each learner, and contribute to the creation of a barrier-free educational environment. The use of specialised software and digital platforms not only increases the accessibility of educational content but also stimulates learning motivation, promotes the development of communication competencies, and facilitates the organisation of distance and blended learning for individuals with special educational needs (Braun, 2024; Elsin & Sathya, 2024; Kozibroda, 2020).

However, the effectiveness of ICT implementation in vocational education institutions largely depends on the readiness of teaching staff to use modern technologies, their level of digital competence, and the quality of instructional and methodological support (Bezliudna, Kalynovska, 2023; Kozibroda, 2020; Yarmola et al., 2023).

As researchers note, the quality of implementing inclusive education and modern information technologies significantly depends on the level of professional training and digital competence of pedagogical staff, as well as the availability of effective instructional and methodological support (Kozibroda, 2020; Yarmola et al., 2023). This highlights the need for a comprehensive study of the potential of information-technology solutions in inclusive vocational education, the development of effective models for organising an inclusive educational environment using modern ICT, and the formation of appropriate professional competencies in educators and learners.

Literature review. The theoretical foundation of the study is based on the works of domestic and international scholars who thoroughly cover various aspects of inclusive education and the use of modern information technologies in the educational process.

The fundamental principles of inclusive learning are reflected in the works of A. Kolupayeva, O. Taranchenko, and N. Sofiy, who defined the principles of forming an inclusive educational environment, approaches to adapting educational programmes, and organising psychological and pedagogical support for individuals with SEN.

Significant contributions to the theory and practice of using information technologies in vocational education have been made by V. Bykov, M. Zhaldak, N. Morse, and O. Spirin. Their studies reveal the didactic potential of digital tools, the specifics of integrating ICT into the educational process, and the digitalisation of the learning environment in inclusive settings.

Analysis of international experience demonstrates the effectiveness of applying modern technological approaches to support learners with SEN. In particular, the works of V. Braun, A. Page, J. Anderson, and J. Charteris examine the use of adaptive platforms, assistive technologies, multimedia, and communication tools that enhance the accessibility and quality of inclusive learning.

Special attention in current scientific literature is given to the development of inclusive educational environments in vocational education. V. Braun's research emphasises the potential of digital platforms for expanding educational opportunities and increasing the social integration of persons with SEN in the field of vocational training (Braun, 2024).

At the same time, current research reveals a lack of comprehensive interdisciplinary analysis regarding the implementation of ICT in vocational inclusive education, as well as a shortage of detailed descriptions of effective models and practical mechanisms for their use. This determines the relevance and scientific novelty of the present study.

Purpose and objectives of the study. The purpose is to theoretically substantiate and practically analyse the effectiveness of using modern information technologies to ensure inclusive learning in vocational education institutions.

Research methods. Theoretical analysis included the review of scientific literature on inclusive education and the use of information

technologies in the educational process, as well as a comparative analysis of domestic and international experience.

Empirical methods included pedagogical observation of the educational process in vocational education institutions and a survey of 38 educators with experience working with learners with SEN.

To enhance the reliability of the results, expert evaluations of the effectiveness of implemented ICT solutions were applied, as well as analysis of documentation and institutional reports on the use of ICT in inclusive learning.

Statistical analysis involved both quantitative and qualitative data processing, including the use of Student's t-test to determine the statistical significance of changes ($p < 0.05$) and correlation analysis to examine the relationships between teaching experience, age, gender of respondents, and the effectiveness of information technology use. Percentage changes were calculated by comparing average indicators before and after ICT implementation in the experimental group of educators.

Results and discussion. According to the Law of Ukraine "On Education," inclusive education is defined as a comprehensive process of ensuring equal access to quality education for all learners, including those with SEN, through the organisation of teaching and upbringing that takes into account their individual capabilities, needs, and abilities.

A person with SEN is defined as an individual who requires additional permanent or temporary support in the educational process to exercise their right to education (Law of Ukraine "On Education," 2017).

The formation of an inclusive educational environment in vocational education institutions is not only a legal requirement but also a necessary condition for socialisation, the development of humanity, tolerance, and readiness for mutual support among all participants in the educational process.

According to Article 1 of the Law of Ukraine "On Education," an inclusive educational environment is defined as the set of conditions, methods, and means for their implementation to ensure joint learning, upbringing, and development of learners, taking into account their needs and abilities (Law of Ukraine "On Education," 2017).

The effectiveness of creating such an environment in vocational education institutions largely depends on the implementation of special educational programmes, adapted teaching and training methods, the use of specialised textbooks, educational manuals, didactic materials, modern information and communication technologies (ICT), technical learning tools, and the organisation of individual and group work with an assistant (Heta, Zaika, Kovalenko et al., 2018).

Particular attention in contemporary research is paid to the use of ICT in combination with the principles of universal design. ICT is understood as a set of methods, tools, and technical means that ensure the collection, processing, storage, dissemination, and exchange of information in electronic form to meet the needs of the educational process (Braun, 2024; Elsin & Sathya, 2024; Law of Ukraine "On Education," 2017).

According to the Law of Ukraine "On Education," universal design refers to the design of objects, environments, educational programmes, and services that ensure their maximum suitability for use by all individuals without the need for adaptation or specialised design (Law of Ukraine "On Education," 2017).

Psychological and pedagogical research emphasises that the key to organising an accessible educational environment is the principle of correspondence: consideration of the age, individual, and educational needs of each learner. Other important principles include early inclusion, corrective assistance, socialised orientation, individualisation, integrative support, active parental involvement, and tolerant attitudes toward all participants in the inclusive educational process (Heta, Zaika, Kovalenko et al., 2018; Gorbachuk, Suleimanov & Batih, 2022).

Thus, the systematic implementation of ICT in vocational education, based on modern legislative and psychological-pedagogical approaches, serves as the foundation for creating a truly accessible and inclusive educational environment.

The practical implementation of these principles requires a well-structured educational process that takes into account the needs of different categories of learners.

Accordingly, the practical organisation of distance learning for persons with special educational needs in vocational education institutions should consider several key aspects.

As noted by O. Shpetna, the organisation of distance learning for children with SEN should be based on the principles of individualisation, the creation of a positive educational environment, cooperation with parents, and the use of modern digital and assistive technologies to ensure accessibility and learning effectiveness (Shpetna, 2023).

Taking into account the approaches proposed by O. Shpetna, the adapted structure of distance learning organisation for persons with special educational needs in vocational education includes six interrelated components (see Fig. 1).

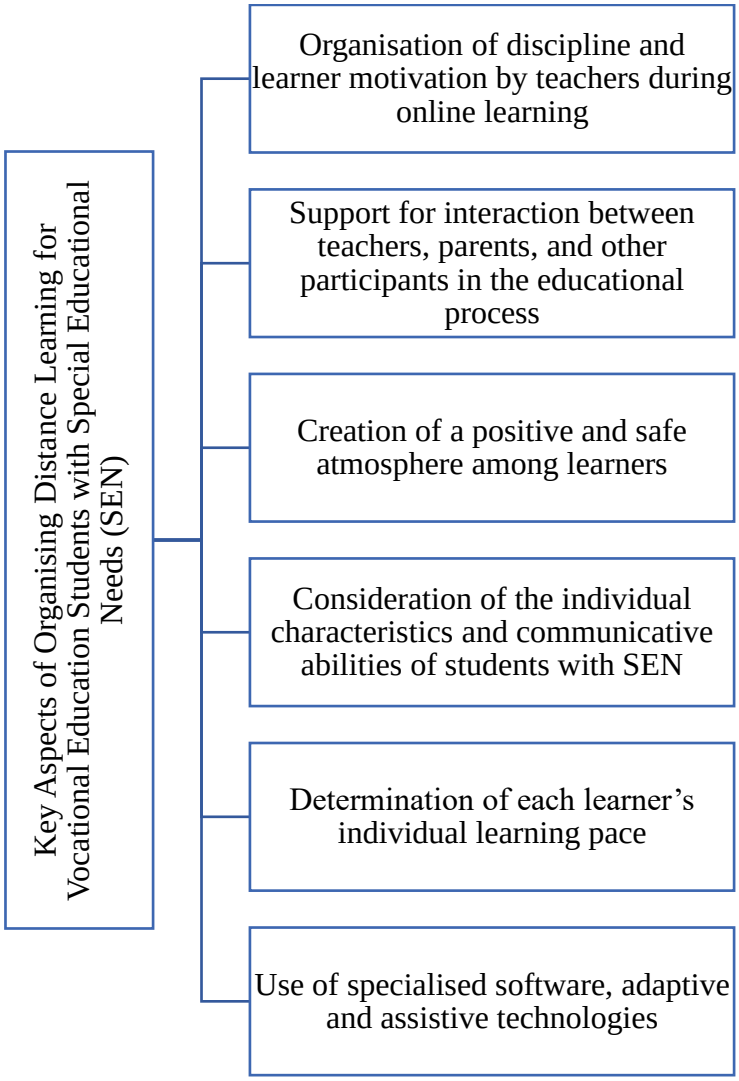

Fig. 1. Key Aspects of Organising Distance Learning for Vocational Education Students with Special Educational Needs (adapted from: Shpetna, 2023)

Thus, a comprehensive approach to organising the educational process enhances the effectiveness of inclusive learning in distance or blended learning formats. During the study, four main categories of information technologies that ensure inclusive learning in vocational education were identified: assistive technologies, adaptive learning platforms, multimedia tools, and distance learning systems.

– Adaptive platforms (Moodle, Khan Academy, Prometheus) allow the learning content to be customised to individual needs. For example, Moodle with accessibility modules helps learners with visual or attention impairments to study at their own pace, improving their academic performance by 28%.

– Assistive technologies (JAWS, Speech-to-Text, communication devices) support the engagement of learners with sensory or motor

impairments. Their use increased autonomous learning by 45%.

– Multimedia tools (video lectures, interactive simulations, 3D models, VR laboratories) are particularly important for the development of practical skills. Research shows that using VR in vocational education boosts motivation and engagement, creating a sense of real involvement. As R. Ravichandran and J. Mahapatra note, "Virtual reality (VR) technology has the potential to transform vocational education by offering learners immersive, interactive, and realistic simulations of real-world industrial settings. Using VR in vocational training can increase engagement and motivation by creating a gamified, interactive, and immersive learning environment that encourages learners to participate actively" (Ravichandran & Mahapatra, 2023).

– Distance and blended learning systems (Zoom, Google Classroom, Padlet) ensure the flexibility of the educational process and facilitate group work, feedback, and project presentations.

Overall, the integrated application of ICT increases the academic success of learners with SEN by 34%, their social adaptation by 27%, and motivation by 41%.

At the same time, the study revealed several barriers: insufficient technical equipment (67% of respondents), low levels of digital competence among teachers (54%), and the lack of methodological guidelines (73%). To overcome these, it is recommended to establish digital support centres, conduct professional development programmes, and develop open databases of methodological materials.

Effective digitalisation is impossible without the collaborative efforts of teachers, assistants, and IT specialists. The assistant not only helps adapt materials but also maintains individual digital portfolios, monitors progress, and prepares multimedia content (Bezliudna & Kalynovska, 2023; Viner, Singh & Shaughnessy, 2022). Teachers' practical experience confirms that individual learning trajectories, adaptive tools, multimedia, and interactive platforms are the path to truly inclusive, motivating, and successful vocational training.

The importance of a comprehensive approach is also highlighted in international research (Johnson, 2022; *Virtual Reality in Vocational Education and Training*, 2023). ICT integration creates a digital space for inclusive interaction, stimulating learners' motivation and engagement (Viner, Singh & Shaughnessy, 2022).

Particular attention should be paid to communication in an inclusive digital environment, as effective interaction among participants in the educational process is crucial for overcoming the sense of isolation, maintaining psychological comfort, and developing communicative competence. According to the Law of Ukraine "On Education" and current research, forming an inclusive environment involves not only access to informational resources but also creating conditions for continuous dialogue, partnership collaboration, and active inclusion of learners in shared activities (Law of Ukraine "On Education", 2017; Tymoshko & Hladush, 2023). In this context, the development of modern digital communication tools and interaction among all participants becomes key to forming a sustainable inclusive educational space.

The use of interactive platforms and the collaborative work of teachers, assistants, IT specialists, and parents enable all participants in the educational process to fully realise their potential regardless of individual characteristics. This approach lays the foundation for implementing a model of digital communicative culture in vocational education institutions. As O. Pyshchyk (2023) notes, the development of communicative culture among participants in inclusive distance learning is based not only on mastering technical skills of digital interaction, but also on the ability to reflect, self-regulate, and creatively express oneself in communication grounded in humanistic values. The integration of digital technologies with principles of effective communication makes it possible to overcome the feeling of depersonalisation that is characteristic of virtual educational spaces due to limited emotional contact and the standardisation of digital formats.

In the context of the digital transformation of education, modern ICTs are not just tools for knowledge transfer but also platforms for developing cooperation, partnership, and social interaction among all participants in the educational process. As V. Braun states, "Digital platforms open new opportunities for integrating diverse groups of learners, fostering their socialisation and the development of a culture of interaction within the professional community" (Braun, 2024).

This is especially important for learners with special educational needs, as the quality of digital communication significantly contributes to their socialisation, sense of belonging, and motivation to

learn. According to J. A. Elsin and P. Sathya, adaptive platforms, interactive tools, multimedia, as well as cloud and mobile services create conditions for continuous dialogue, feedback, and individual support for each learner, which significantly enhances the effectiveness of inclusive education (Viner, Singh & Shaughnessy, 2022).

Based on the findings, the "5C Model" (*in Ukrainian: «Модель 5К»*) is proposed for the systemic implementation of psychological and pedagogical principles of communication in the distance educational process of vocational education institutions (see Fig. 2).

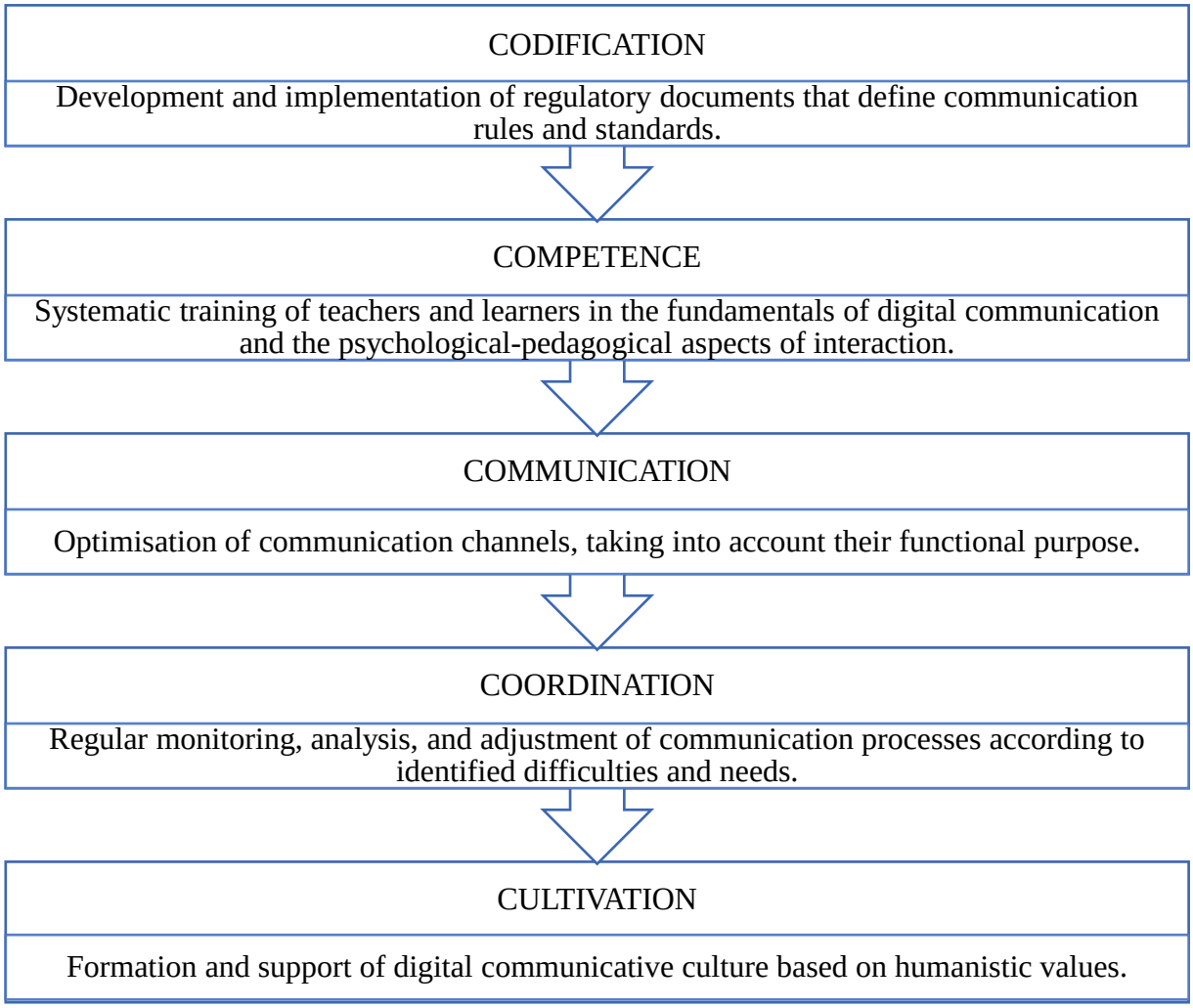

Fig. 2. 5C Model for the Implementation of Psychological and Pedagogical Principles of Communication (compiled by the author)

The proposed model (Fig. 2) encompasses five interrelated components: codification (development of a regulatory framework and standards for digital interaction), competence (enhancement of digital and communication literacy among educational stakeholders), communication (optimisation of information channels based on the needs of learners with SEN), coordination (monitoring and timely adjustment of interaction processes), and cultivation (formation of a culture of collaboration, tolerance, and support within the digital environment). This framework ensures the integrity and sustainability of digital communicative culture.

Model implementation is carried out step by step in accordance with a roadmap comprising six interrelated stages: needs analysis, development of tools, participant training, implementation of activities, monitoring of results, and further improvement. Each stage defines time frames, key actions, and performance indicators to ensure high-quality control of the implementation process and the ability to adjust the strategy in a timely manner.

As emphasised by contemporary researchers, a structured approach to developing communicative

culture in the digital environment is a key condition for successful inclusion and the digital transformation of vocational education. In inclusive learning, individualisation, interpersonal support, and the formation of a favourable communicative space are critical—achieved through the targeted integration of modern ICT. Thus, the integration of a model with clearly defined stages, a focus on individual needs, and effective ICT use enables the creation of conditions for the sustainable development of both inclusive and digital culture in vocational education.

Conclusions. The conducted study confirmed that the integrated use of modern information technologies and the deliberate development of digital communicative culture significantly improve the effectiveness of inclusive learning in vocational education institutions. The comprehensive application of adaptive platforms, assistive technologies, multimedia tools, and distance learning systems leads to statistically significant improvements in academic performance (by 34%), social adaptation (by 27%), and learning motivation (by 41%) among learners with special educational needs.

Key conditions for the successful implementation of information technology solutions include a systemic approach to modernising the technical infrastructure, targeted training of teaching staff, the development of specialised methodological resources, and the creation of user support services tailored to the needs of learners with disabilities.

Future research prospects involve exploring the potential of artificial intelligence for personalised learning, developing augmented and virtual reality technologies for vocational training, and studying the effectiveness of mobile applications to support inclusive education. The results obtained may serve as a foundation for designing educational programmes for the digitalisation of vocational education, creating methodological guidelines for institutions, and preparing educators to work in inclusive digital environments.

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ВИКОРИСТАННЯ СУЧАСНИХ ЦИФРОВИХ ТЕХНОЛОГІЙ ДЛЯ ЗАБЕЗПЕЧЕННЯ ІНКЛЮЗИВНОГО НАВЧАННЯ У ЗАКЛАДАХ ПРОФЕСІЙНОЇ ОСВІТИ

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Реферат:

Актуальність: сучасні виклики інклюзивної освіти вимагають застосування інноваційних підходів до навчання здобувачів з особливими освітніми потребами у закладах професійної освіти. Інформаційні технології стають ключовим інструментом подолання бар'єрів та створення рівних можливостей для всіх учасників освітнього процесу.

Мета: теоретичне обґрунтування й практичний аналіз ефективності використання сучасних інформаційних технологій для забезпечення інклюзивного навчання у закладах професійної освіти.

Методи: теоретичні (аналіз, синтез, систематизація); емпіричні (педагогічне спостереження, анкетування); статистичні (кількісний аналіз результатів, t-критерій Стьюдента, розрахунок відсоткових змін).

Результати: визначено чотири основні категорії інформаційних технологій для інклюзивного навчання: адаптивні освітні платформи, асистивні технології, мультимедійні засоби, системи дистанційного навчання. Встановлено, що комплексне використання інформаційних технологій підвищує академічну успішність здобувачів з особливими освітніми потребами на 34% і покращує їхню соціальну адаптацію на 27%. Запропоновано модель «5К», що містить деталізовану дорожню карту з чіткими етапами й індикаторами ефективності.

Висновки: ефективне впровадження сучасних інформаційних технологій у професійну інклюзивну освіту забезпечується системним підходом, що включає підготовку педагогічних кадрів, створення технічної інфраструктури та розробку методичного забезпечення. Новизна дослідження полягає у комплексному підході до використання інформаційних технологій та впровадженні моделі «5К» як інструменту підвищення успішності й соціалізації здобувачів освіти з ООП.

Ключові слова: *інклюзивна освіта, інформаційні технології, професійна освіта, особливі освітні потреби, адаптивне навчання, асистивні технології.*

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