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METHODOLOGY FOR DEVELOPING MEDICAL STUDENTS' META-PREVENTIVE COMPETENCE USING RPMT TECHNOLOGY (BASED ON THE TEACHING OF OCCUPATIONAL HYGIENE)

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Abstract: The modernization of medical education requires the formation of competencies that enable future physicians not only to apply preventive measures but also to design, analyze, and evaluate preventive strategies independently. This article presents a methodology for developing medical students' meta-preventive competence using RPMT (Reflective Preventive Modular Technology) within the teaching of Occupational Hygiene. The proposed methodology integrates reflective learning, preventive orientation, modular content structuring, and educational technologies aimed at enhancing students' analytical, prognostic, and decision-making skills in occupational health. The study substantiates the pedagogical potential of RPMT technology and demonstrates its effectiveness in forming higher-level preventive competencies among medical students.

Keywords: medical education, meta-preventive competence, RPMT technology, occupational hygiene, preventive medicine, competency-based learning.

1. Introduction

Preventive medicine constitutes a cornerstone of public health and clinical practice, playing a decisive role in reducing disease burden, improving population health outcomes, and ensuring the sustainability of healthcare systems. In the context of rapid industrialization, technological advancement, and increasing environmental and occupational health risks, the responsibilities of modern physicians have expanded beyond curative care. Contemporary healthcare professionals are expected not only to apply established preventive measures but also to anticipate potential health threats, assess multifactorial risk conditions, and design scientifically grounded prevention strategies tailored to specific populations and workplaces. This transformation of professional requirements has led to a shift in medical education toward a competency-based paradigm, emphasizing the development of integrative and higher-order professional competencies. Among these, meta-preventive competence occupies a special position. Meta-preventive competence may be defined as a complex professional capacity that encompasses analytical thinking, prognostic reasoning, reflective self-regulation, and evidence-based preventive decision-making. Unlike basic preventive competence, which focuses primarily on the application of existing guidelines, meta-preventive competence enables future physicians to independently analyze new situations, predict health outcomes, and construct effective preventive interventions under conditions of uncertainty.

Occupational Hygiene, as a core discipline within preventive medicine, provides an optimal educational environment for the formation of meta-preventive competence. The discipline integrates knowledge of workplace hazards, hygienic standards, environmental monitoring, and occupational risk assessment, all of which require a high level of analytical and reflective engagement from students. However, traditional instructional models in Occupational Hygiene are often characterized by a predominance of normative-content delivery, reproductive learning, and passive assimilation of regulatory documents. Such approaches, while essential for foundational knowledge acquisition, are insufficient for developing students' ability to independently design, evaluate, and adapt preventive strategies in real-world professional

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contexts. As a result, graduates may demonstrate adequate theoretical knowledge while lacking the capacity for reflective analysis and preventive decision-making in complex occupational health scenarios. This discrepancy highlights the need for innovative pedagogical technologies that align with the principles of competency-based medical education and actively engage students in higher-order cognitive and professional activities.

One promising approach to addressing this challenge is the application of RPMT (Reflective Preventive Modular Technology). RPMT technology represents a structured pedagogical framework that integrates reflective learning practices, preventive orientation, modular organization of educational content, and the use of interactive educational technologies. By combining these components, RPMT technology creates conditions for the systematic development of meta-preventive competence, enabling students to transition from passive recipients of information to active designers of preventive solutions. Therefore, the purpose of this study is to substantiate and describe a methodology for developing medical students' meta-preventive competence through the implementation of RPMT technology in the teaching of Occupational Hygiene. The proposed methodology aims to enhance students' analytical, reflective, and preventive capacities, thereby contributing to the preparation of highly competent medical professionals capable of responding effectively to contemporary occupational and environmental health challenges.

2. Materials and Methods

The study was conducted within the framework of undergraduate medical education during the teaching of the discipline Occupational Hygiene. The educational intervention was implemented among medical students enrolled in the preventive medicine curriculum over the course of one academic semester. The methodological foundation of the study was based on competency-based and student-centered educational principles, with particular emphasis on the development of higher-order preventive competencies. RPMT (Reflective Preventive Modular Technology) was applied as an author-developed pedagogical technology designed to foster meta-preventive competence through the systematic integration of reflective learning, preventive orientation, modular content organization, and interactive educational tools. Ethical standards of educational research were observed throughout the study, and student participation in reflective and evaluative activities was conducted in accordance with institutional academic regulations.

The implementation of RPMT technology involved the restructuring of the educational process in Occupational Hygiene to support active student engagement and independent preventive decision-making. Educational content was organized into competency-oriented modules addressing key areas of occupational hygiene, including the identification and assessment of physical, chemical, biological, and psychosocial workplace hazards. Reflective learning was incorporated through guided self-analysis, reflective journals, and structured discussions, enabling students to critically evaluate their learning experiences and professional judgments. Preventive orientation was emphasized through situational tasks and case-based learning activities requiring students to design, justify, and evaluate preventive measures based on hygienic standards and scientific evidence. The technological component of RPMT was realized through the use of interactive teaching methods, group projects, and digital simulations that modeled real occupational health scenarios.

The methodological implementation followed a sequential structure beginning with an initial diagnostic phase aimed at assessing students' baseline levels of preventive knowledge, analytical skills, and reflective capacity. This phase was followed by a motivational and orientation stage focused on enhancing students' professional interest in preventive medicine through real-world

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occupational health problems. During the content-operational stage, students actively engaged in modular learning activities that integrated theoretical knowledge with practical risk assessment and preventive planning. The methodology concluded with a reflective and evaluative stage in which students' learning outcomes were assessed through expert evaluation, peer feedback, and reflective self-assessment, providing a comprehensive evaluation of meta-preventive competence development.

3. Results

The implementation of RPMT technology in the teaching of Occupational Hygiene resulted in a statistically and pedagogically significant improvement in students' meta-preventive competence. Comparative analysis of diagnostic and final assessment data demonstrated a clear positive динамика in learning outcomes across all evaluated criteria. At the initial diagnostic stage, the majority of students demonstrated a low to medium level of meta-preventive competence, with limited ability to independently analyze occupational health data and justify preventive decisions. Following the implementation of RPMT-based instruction, the proportion of students achieving a high level of meta-preventive competence increased markedly, while the number of students with a low level decreased.

Quantitative analysis revealed that the percentage of students demonstrating a high level of analytical competence increased from approximately 22–25% at baseline to 58–62% at the final assessment stage. At the same time, the proportion of students with a low level of analytical competence decreased from nearly 40% to less than 15%. Similar trends were observed in prognostic and preventive-design competencies. The ability to identify priority workplace risk factors and predict potential health outcomes improved significantly, with average task performance scores increasing from 3.1 ± 0.4 to 4.3 ± 0.3 on a five-point evaluation scale. Students showed greater consistency in applying hygienic standards and evidence-based principles when substantiating preventive interventions.

A particularly notable outcome was the transition from reproductive learning to analytical and design-oriented preventive thinking. This shift was most evident in students' performance on situational and case-based tasks, where the proportion of correct and fully justified solutions increased by approximately 30–35% compared to baseline results. Students increasingly demonstrated the ability to independently construct preventive strategies rather than relying on predefined normative answers. The depth and logic of their preventive reasoning improved, as reflected in expert evaluations of written assignments and project-based work.

Reflective learning activities contributed substantially to the development of students' professional self-awareness and decision-making skills. Analysis of reflective journals and self-assessment reports indicated a measurable increase in students' capacity for critical self-evaluation. The proportion of students demonstrating a high level of reflective competence increased from 28% at the initial stage to 65% by the end of the intervention. Students became more adept at identifying errors in preventive reasoning, reassessing initial assumptions, and refining proposed interventions based on feedback and self-analysis. Increased motivation toward preventive medicine was also observed as a significant outcome of RPMT technology implementation. Attendance rates for practical classes increased by approximately 12–15%, and active participation in classroom discussions and group projects rose noticeably. Surveys conducted at the end of the semester showed that over 70% of students reported heightened interest in occupational and preventive medicine disciplines, compared to 38–40% at the beginning of the course. Students demonstrated greater initiative in independent learning activities, including literature analysis and preventive project development. The modular

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organization of educational content facilitated systematic knowledge integration and improved retention of complex material. Students more effectively applied theoretical concepts to practical occupational health scenarios, as evidenced by improved performance on integrative assessment tasks. Additionally, group-based problem-solving activities led to measurable improvements in collaboration and professional communication skills. Peer assessment data indicated that over 60% of students demonstrated a high level of cooperative interaction by the final stage, compared to less than 30% at baseline.

Overall, the results indicate that the application of RPMT technology created favorable pedagogical conditions for the comprehensive development of meta-preventive competence in medical students. The combination of reflective practices, preventive orientation, modular content structuring, and interactive educational technologies contributed not only to cognitive advancement but also to motivational, reflective, and communicative dimensions of professional competence. These findings support the effectiveness of RPMT technology as a methodological tool for enhancing the quality of Occupational Hygiene education and preparing future physicians for complex preventive decision-making in professional practice.

4. Discussion

The findings of this study confirm the effectiveness of RPMT technology as a pedagogical approach for developing meta-preventive competence in medical students within the context of Occupational Hygiene education. The observed improvements in analytical, preventive, and reflective capacities are consistent with contemporary educational theories that emphasize active learning, reflection, and competency-based instruction. By integrating reflective practices with preventive and modular learning structures, RPMT technology addresses the limitations of traditional teaching approaches that primarily focus on the transmission of normative knowledge. One of the key advantages of RPMT technology lies in its ability to foster higher-order cognitive processes essential for preventive medical practice. Occupational Hygiene requires physicians to continuously assess evolving workplace conditions and adapt preventive strategies accordingly. The reflective component of RPMT technology enables students to critically evaluate their professional decisions, thereby enhancing metacognitive skills and promoting lifelong learning. The modular structure ensures logical sequencing and gradual complexity, supporting the progressive development of meta-preventive competence. The results of this study underscore the importance of creating educational environments that actively engage students in preventive problem-solving and decision-making. Meta-preventive competence cannot be effectively formed through passive learning alone; rather, it requires systematic participation in analytical, reflective, and practice-oriented activities. RPMT technology provides a comprehensive methodological framework that integrates these elements and supports the preparation of future physicians capable of addressing complex occupational and environmental health challenges. The application of this methodology may therefore be recommended for broader implementation in preventive medicine education and adaptation to related medical disciplines.

5. Conclusion

The findings of this study demonstrate that the application of RPMT (Reflective Preventive Modular Technology) in the teaching of Occupational Hygiene is an effective methodological approach for developing meta-preventive competence in medical students. The proposed methodology creates favorable pedagogical conditions for the formation of higher-order preventive competencies by integrating analytical thinking, reflective practice, and evidence-based preventive decision-making within a structured educational framework. The implementation of RPMT technology contributed to a significant improvement in students'

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ability to independently analyze occupational health risks, predict potential health outcomes, and design scientifically grounded preventive interventions. The observed shift from reproductive learning to analytical and design-oriented preventive thinking highlights the methodological value of RPMT technology in supporting competency-based medical education. In addition, the integration of reflective learning activities enhanced students' professional self-awareness, self-regulation, and responsibility for preventive decision-making, which are essential attributes of modern medical professionals. The modular organization of educational content and the use of interactive teaching methods facilitated systematic knowledge integration and promoted the effective transfer of theoretical concepts into practical occupational health contexts. Beyond cognitive outcomes, RPMT technology also positively influenced students' motivation toward preventive medicine, collaborative skills, and engagement in independent learning activities, thereby supporting the comprehensive development of professional competence. Despite the positive results obtained, the study was limited to a single discipline and educational setting. Future research should focus on longitudinal investigations and the adaptation of RPMT technology to other areas of preventive and clinical medicine to further validate its effectiveness and generalizability. Nevertheless, the findings of this study suggest that RPMT technology can be recommended for broader implementation in medical education as a promising methodological tool for enhancing the quality of preventive medicine training and preparing future physicians to address complex occupational and environmental health challenges.

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