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Why Physics Matters: A Student View on Building Better Healthcare Professionals in Croatia

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ABSTRACT

A comprehensive understanding of fundamental physical laws is essential for effectively using modern medical devices and comprehending the biological processes of organisms. This underscores the necessity of physics as a mandatory course in medical and healthcare studies. However, there is a lack of research regarding medical students' motivation to learn physics and their awareness of its importance in healthcare, particularly among students in radiology and physiotherapy programmes. Therefore, the aim of this study is to assess students' motivations for enrolling in healthcare programmes, their opinions about physics, and their perceived value of physics education for future career competencies. The sample comprised 157 undergraduate students from the physiotherapy and radiologic technology programmes at the Faculty of Health Studies, University of Rijeka, Croatia. Data were collected using a standardised questionnaire and analysed using the non-parametric Mann–Whitney U test and Kruskal–Wallis test. The research findings indicate that most students are enthusiastic about learning physics when they see its practical applications, especially in therapeutic and diagnostic procedures. Additionally, students are primarily motivated by a desire to help others, positive high school experiences, career aspirations, and family influence. Final-year students particularly recognise the significance of physics in diagnostics and therapies. Furthermore, professors' professionalism and the curriculum's relevance to future job skills are key motivators. These findings can be used to develop diverse teaching strategies to enhance student interest, ultimately cultivating experts who can advance healthcare and improve disease diagnosis and treatment.

Keywords: *Education, Physics, Physiotherapy students, Radiologic technology students, Quality of healthcare*

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INTRODUCTION

Over the past three decades, research in physics education has grown significantly, driven by the need for more effective physics instruction across all levels and educational settings (1, 2). The main goal is to better understand the challenges students face when learning physics. Since the conceptual understanding of physics is essential for acquiring the knowledge, skills, and competences required for quality education in many professions, such as engineering, science, and healthcare, students' interest in learning physics has become a topic that has also led to numerous studies and the development of complex theories in the fields of education, medicine, and psychology (3–5). The conclusions of these studies emphasise that effective teaching must be interesting, enriched with concrete practical examples, and relevant to everyday life. As a result of these findings, a recognised need for new teaching strategies has emerged, as the traditional approach often reduces knowledge acquisition to memorisation and the reproduction of content without fostering a true understanding (6). Furthermore, research in the field of physics education emphasises the need to improve the quality of physics teaching (7). This is especially important because the understanding of abstract physical concepts in engineering and medical curricula requires greater intellectual engagement from students (8, 9). Thus, at all levels of education, students were newly placed at the centre of the learning process, actively participating in the teaching process rather than just receiving information from the teacher (9, 10). This new approach helped students develop critical thinking and problem-solving skills that they could apply in everyday situations.

Although the quality of the teaching strategy can raise students' motivation to learn physics, practical experience shows that this is not always enough (11). This is underpinned by the fact that, according to the results of the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) tests, students' skills in science, technology, engineering, and mathematics (STEM) are insufficient (12, 13). On the contrary, they are decreasing and not improving compared to previous test results, despite the increasing use of modern strategies (14). For this reason, systematic efforts must be made to increase interest in physics and other STEM subjects from primary school to university (15, 16).

In this context, it is worth noting the importance of learning physics for its applications in fields such as medicine, telecommunications, electronics, and many others. Understanding the laws of physics is necessary to properly apply new technologies (17–19). For example, knowledge of the principles of various medical devices used to diagnose, monitor, and treat diseases, such as magnetic resonance imaging, computed tomography, or electrocardiograms, is of paramount importance for their safe use (20, 21). However, most undergraduate medical students do not believe that physics is relevant to their future careers (22, 23). High-quality physics education is therefore essential to ensure that future medical personnel are aware of the importance of physics and its contribution to the development of more efficient diagnostic and therapeutic methods, as emphasised in Sprawl's research (24). An adaptation of physics teaching that emphasises its connection to medicine is crucial to enhancing the motivation of students enrolled in medical and health studies, such as those training to become radiologic technologists and physiotherapists (25, 26). Physics is a compulsory course that is included in the radiologic technology degree programme at a total of 90 teaching hours (60 hours of lectures and 30 hours of seminars) and in the physiotherapy degree programme, with 40 teaching hours (30 hours of lectures and 10 hours of seminars) (27, 28).

However, there are some differences in these programmes' curricula. Physiotherapists should have a thorough knowledge of human anatomy and physiology and the ability to adapt therapy to the patient's specific needs. Their primary goal is to relieve pain and improve bodily mobility and functionality. To this end, they should be trained to perform therapy methods such as thermotherapy, ultrasound therapy, or iontophoresis (28). On the other hand, since the basic tool in medical imaging of the body is ionising radiation, radiologic technologists should know the various types of interactions between radiation and the substances through which it passes, and how they occur. They also need to know the techniques, principles, and laws on which radionuclide imaging tests are based, as well as diagnostics that do not use ionising radiation, such as magnetic resonance (27). By having the necessary skills and competencies, healthcare professionals can adopt a holistic approach to patient care, considering all aspects of a patient's well-being and health. This approach is further strengthened through collaboration with other healthcare professionals in multidisciplinary teams.

In Croatia, studies have explored how positive attitudes of physiotherapy students towards physics affect their understanding of physical concepts (29), and their capacity to apply physical laws in physiotherapy practices (30). Additionally, as part of a student final thesis, the attitudes of radiology and physiotherapy students regarding learning physics were explored (31). However, there has not been extensive research on the perspectives of these students regarding the impact of physics on their acquisition of professional qualifications, educational outcomes, and motivation to enrol in these programs. This gap in research is particularly important as it relates to enhancing professionalism in healthcare and improving education to meet labour market demands.

This study aims to provide crucial insights into radiologic technologists' and physiotherapy students' awareness of the importance of physics in understanding the physical principles that govern biological and physiological processes in the human body, as well as the principles of operating medical devices. In addition, this article presents valuable perspectives from healthcare students on the importance of physics education in developing essential skills for their future careers. Furthermore, the results on the motivational factors reported by the students offer an important opportunity to improve the quality of physics education. By introducing more engaging and interactive teaching methods that align with these motivational elements, educators can create learning environments that not only pique students' interest but also promote a deeper understanding of the subject matter (32, 33).

METHODS

Participants

A total of 157 radiology and physiotherapy students took part in the study. The participants represented all academic years, genders, and age groups and accounted for 96% of all full-time students enrolled in these study programmes at the Faculty of Health Studies (FHS), University of Rijeka, Croatia, from academic year 2020/2021 to academic year 2023/2024. To encourage active participation and promote deep engagement, students were encouraged to participate through their representatives and a dedicated online student group. Exclusion criteria included individuals enrolled in other study programmes in the same faculty, students who had not given informed consent to participate, and those who had not completed the questionnaire in full. In addition, exchange students were excluded from the study due to differences between their home education systems and the Croatian education system. Students with previous higher education in physics or related subjects were also excluded to avoid bias.

Procedures and Materials

The data were collected at the end of the first semester of the 2023/2024 academic year using a questionnaire designed to address the research objectives. The questionnaire consisted of four sections. The first two sections and the last one contained open-ended questions, while the third section contained closed-ended questions. In the first section, sociodemographic information, including age, gender, type of secondary school completed, current degree programme, and year of study, was collected. In the second section, the students explained their motivations for pursuing careers as radiologic technologists or physiotherapists and their reasons for enrolling at the FHS. In the third section, students rated the statements offered on a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree). This section explored students' views on the importance of physical laws in understanding the principles of medical devices used to diagnose, monitor, and treat diseases and processes in organisms. It also examined whether students believe that physics education provides them with relevant skills for their future careers. It should be noted that the statements were developed based on the results of a study by Alsufyani (2). Two professors who conducted the survey also checked the content for clarity. None of the 157 students reported any comprehension problems. In the last part of the questionnaire, respondents were allowed to leave a comment or suggestion for improving the teaching of physics according to Cohen's guidelines (34). In this part, students could also indicate what motivates and demotivates them to learn physics. A mixed-methods approach was used, integrating descriptive, qualitative, and quantitative research designs (35, 36). The participants' qualitative responses to the open-ended questions were included to deepen, clarify, and illuminate the results specific to the Croatian context.

Statistical Analysis

The data obtained were entered into an Excel spreadsheet and analysed using the statistical software Statistica, version 14.0.0.15 (TIBCO Software Inc.). The participants' sociodemographic characteristics were analysed using descriptive statistics. This method was also used to calculate the absolute frequency and percentage of responses to the statements in the third part of the questionnaire, as well as to evaluate the results from the second and fourth parts. The reliability of the third part was determined using Cronbach's α coefficient, and its validity was verified by two university professors. The internal consistency coefficient indicated the questionnaire's high reliability, as evidenced by Cronbach's alpha value of 0.82. The correlation coefficients between the items ranged from 0.77 to 0.81, indicating a strong correlation and confirming that all items assessed the same construct. The Kolmogorov–Smirnov test was used to examine the normality of the data distribution. Since the p-value was < 0.001, it was concluded that the distribution deviated from normality. Because the data collected from the Likert scale were ordinal in nature, the Mann–Whitney U test was used to analyse the differences in responses to the statements in the third part of the questionnaire among two different study groups such as radiologic technology and physiotherapy. This analysis was also conducted separately for each academic year within the entire sample. Additionally, the non-parametric Kruskal–Wallis test was employed to examine the same issue across the overall sample with respect to the different years of study (year of study compared to ordinal data). In addition, the calculated effect sizes that compare students' opinions from different study programmes on how learning physics impacts their professional skills in the overall sample provided valuable insights that allowed us to draw informed conclusions about the results obtained. All statistical tests were performed at a statistical significance level of 0.05.

RESULTS

A total of 157 students from radiology and physiotherapy degree programmes took part in the study. The participants represented all academic years, genders, and age groups and accounted for 96% of all full-time students enrolled in these programmes from academic year 2020/2021 to academic year 2023/2024. Most of the respondents were female (n = 105, 67%), while male participants accounted for more than a third of the sample (n = 52, 33%) (Table 1).

Table 1: Basic sociodemographic characteristics of the participants

Characteristics	n	%
Gender		
Men	52	33
Women	105	67
Study programme		
Physiotherapy	83	53
Radiologic technology	74	47
High school completed		
Gymnasium	69	44
Medical school	88	56
Year of study		
1	72	47
2	43	27
3	42	26

In the sample, 83 participants (53%) were physiotherapy students, and 74 participants (47%) were radiologic technology students. In addition, 69 students (44%) had a high school diploma, and 88 students (56%) had a medical school diploma. Most of the participants, totalling 72 (47%), were in their first year of study, while 43 students (27%) were in their second year, and 42 students (26%) were in their third year. The distribution of respondents across the different years of study was relatively balanced (Figure 1), which allowed us to draw valid conclusions about the students' opinions on physics education in their study groups.

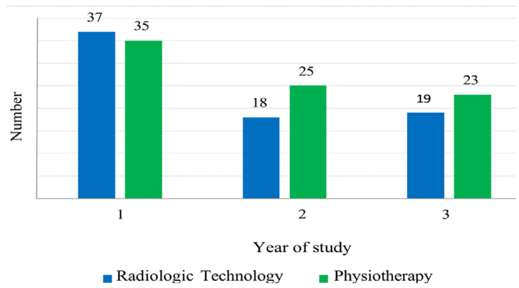

Figure 1: The number of radiologic technologists and physiotherapists students regarding the study year.

The students in the observed sample mostly gave similar reasons for their decision to pursue careers as radiologic technologists or physiotherapists (Figure 2).

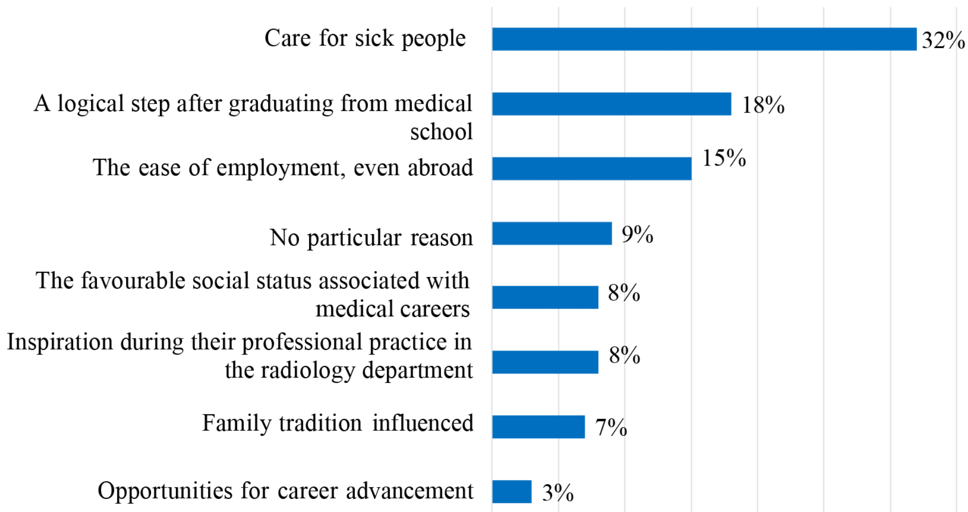

Figure 2: Percentage representation of the most common reasons for choosing the profession of radiologic technologist or physiotherapist.

The data analysis revealed that a strong desire to help and care for sick people (32%), a logical step after graduating from medical school (18%), and employment prospects, including at the international level (15%), were the most common motives. At the same time, a smaller number of students were encouraged to enrol in medical school by the favourable social status associated with a medical career (8%) and by opportunities for advancement (3%), while 7% were influenced by family tradition.

Students' Perspectives on the Importance of Acquiring Relevant Skills in Physics for Future Careers

The following analysis presents responses from all participants (n = 157) across five categories—strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree—for Statements 1 to 6. The results are summarised in Table 2, which provides the absolute frequency and percentage of each response. These statements reflect the students' views on the importance of physics education in cultivating various skills and competencies that will benefit them in their future careers, including the proper use of medical devices and accurate data interpretation. Each response is scored on a 5-point Likert scale, as described in the Procedures and Materials section.

Table 2: The number of students presented in absolute frequencies and percentages based on their chosen statements were offered in the third part of the questionnaire

Statements	n (%)				
	Strongly disagree (1)	Disagree (2)	Neither agree nor disagree (3)	Agree (4)	Strongly agree (5)
The content of the Physics course will be useful to me in my future workplace.	15 (10)	14 (9)	12 (8)	82 (52)	34 (21)
Understanding the laws of physics is necessary to know the working principles of the various devices used in medicine, to diagnose, monitor, and treat diseases.	7 (4)	3 (2)	8 (5)	99 (63)	40 (26)
An understanding of the basic laws of physics are necessary to correctly interpret biological and physiological processes in the human body, such as respiration, circulation, speech, or the mechanism of temperature regulation.	22 (15)	28 (19)	17 (10)	72 (45)	18 (11)
An understanding of the basic laws of physics is necessary for professional and high-quality performance of physical diagnostic procedures such as ultrasound or X-ray diagnostics.	16 (10)	25 (16)	21 (13)	86 (55)	9 (6)
An understanding of the basic laws of physics is necessary for professional and high-quality implementation of physical procedures in therapy.	21 (13)	16 (10)	18 (11)	90 (58)	12 (8)
Physical content is used in various fields of medicine.	11 (7)	18 (11)	6 (3)	111 (72)	11 (7)

The results of the Mann–Whitney U test (U = 120.001; p = 0.002), which was conducted to analyse the total scores of the ordinal data collected using a Likert scale from both radiologic technologist and physiotherapist students (evaluated separately), indicated a significant difference between these two study groups, with a large effect size (d = 0.81). This suggests that students from different majors have distinct perspectives on the value of physics (see Table 3).

Table 3: The results of the Mann-Whitney U test based on the total scores obtained separately by radiologic technologist and physiotherapist students, including medians and interquartile ranges for each study group

Study programme	U	*p*-value	d	Median	IQR
Radiologic technology				22	5
	120.001	0.002	0.81		
Physiotherapy				20	7

Note: IQR = interquartile range; d = effect size

Moreover, the results of this test (Table 3), presented as medians (MD), indicated that radiologic technology students (MD = 22, IQR = 5) had more pronounced and consistent positive attitudes compared to physiotherapy students (MD = 20, IQR = 7).

The results of a further Mann–Whitney U test, which was utilised to analyse the differences in responses to the statements in the third part of the questionnaire between the two study groups for each year of study (separately), are presented in Table 4. They showed no statistically significant difference in total scores from the ordinal data on the Likert scale between the two groups.

Table 4: The results of the Mann-Whitney U test based on the total scores obtained by radiologic technologist and physiotherapist students, analysed by each year of study separately

Year of study	Study programme	U	*p*-value
1	Radiologic technology Physiotherapy	1307.200	0.601
2	Radiologic technology Physiotherapy	5517.101	0.788
3	Radiologic technology Physiotherapy	2044.111	0.152

However, the Kruskal–Wallis non-parametric test, which assessed the responses to the statements in the third part of the questionnaire in the overall sample across various years of study, revealed a significant effect ($p = 0.035$, d = 0.84) related to this issue (see Table 5).

Table 5: The results of the Kruskal-Wallis test based on total scores from the entire sample regarding the various years of study, including medians and interquartile ranges for each study year

Year of study	Median	IQR	*p*-value	d
1	18	5	0.035	0.84
2	19	5		
3	23	3		

Note: IQR = interquartile range; d = effect size

To further investigate these results, Dunn's post hoc analysis with Bonferroni correction for multiple comparisons was conducted. This analysis identified significant differences between first-year and third-year students (p = 0.001) as well as between second-year and third-year students (p = 0.022). In contrast, the difference between first-year and second-year students was not significant (p = 0.420). The medians, including the interquartile ranges for the respective years, were as follows: median = 18, IQR = 5 for first-year students, median = 19, IQR = 5 for second-year students, and median = 23, IQR = 3 for third-year students (Table 5). These findings suggest that third-year students exhibited the strongest understanding of how a solid foundation in physics can enhance their qualifications for future careers.

Motivating and Demotivating Factors in Learning Physics

Finally, the students emphasised their most important motivating and demotivating factors in learning and teaching physics. These are listed in order of percentage in Table 6. The most motivating factor was 'the relevance of the teaching content to the profession'. The most important demotivating factor for students' learning was 'a large span of teaching content'. It should be noted that although indicating motivating or demotivating factors for learning physics was not mandatory in the questionnaire, every participant commented on this topic.

Table 6: Percentage representation of motivating and demotivating factors in learning and teaching physics stated by the students

Factors	Student statements	%
Motivating factors	The relevance of teaching content to the profession	32
	Conduct of laboratory exercises	21
	Emphasising the connection between teaching content and everyday situations	16
	Professor professionalism	11
	Positive approach and motivation of the professor	10
	Availability of teaching materials and other learning resources	7
	Quality of instruction	3
Demotivating factors	A large span of teaching content	51
	Too much theory to be memorised	31
	Mathematisation of physics	12
	Lack of self-confidence	6

DISCUSSION

Students' Reasons for Choosing the Radiologic Technologist or Physiotherapist Profession

The intrinsic motives that led students to enrol in radiologic technology or physiotherapy courses may have a stimulating effect on their learning, as Fuente-Vidal et al. (37) and Saeedi et al. (38) found in their studies. Indeed, students who have enrolled in a particular course because they want to practice the profession for which they are being trained have a desire to acquire a broad range of knowledge (38). This also includes taking exams in supporting general education subjects, such as physics. It is therefore encouraging that 32% of students in the observed sample were intrinsically motivated because they find healthcare work meaningful in terms of helping sick people. The students' responses to our open-ended question on this topic gave us deeper insight. One of the most common answers was, "all my life, something inside me has driven me to help other people. I like doing it because it makes me feel good." This finding is consistent with previous studies, such as those by Fuente-Vidal et al. (37) and Arrigoni et al. (39) which indicate that an intrinsic desire to help and care for others is the most important motivating factor for students pursuing a career as a physiotherapist or radiologic technologist. Furthermore, the importance of professional practice experiences during high school is emphasised by the fact that 8% of participants were inspired to go into the healthcare field as a result of these experiences. In addition, some students (2%) stated that the professors who supervised their practice exemplified the values of humanity and altruism, thereby cultivating a passion for the profession. This is supported by the following comment: "During my high school internship in the radiology department, I realised that I wanted to become a radiologic technologist, inspired by a professor who allowed us to participate in ultrasound exams." Consequently, instructor professionalism proves to be a crucial intrinsic motivating factor, which is often not sufficiently emphasised in the existing literature, as Witter et al. (40) state.

The other motivational factors identified in this study are predominantly extrinsic. However, they are mostly related to success and career advancement (3%) and employability (15%), as indicated by some students: "I enrolled in this faculty because I can get a job in Croatia, but also in other European countries, and get an excellent salary." These findings, which are in line with those of a study on social roles in the United States, are the most widespread among students worldwide (5, 41). In addition, the students indicated that respect for the medical profession and admiration for health professionals are important motivators (8%). However, such extrinsic motivations can be detrimental and potentially undermine the quality of healthcare, which is an essential element of social wellbeing (15, 16, 37). This shift occurs when the focus moves from patient care to personal economic gain. Gotlib et al. (42) therefore note that it is important to encourage students to prioritise intrinsic altruistic motivations that are focused on helping others. In addition, family influence was found to be a crucial factor in participants' decisions to pursue a health degree (3). Specifically, 7% of our respondents indicated that a family tradition of healthcare professionals, that is, people who had worked in healthcare for a long time, served as a source of inspiration, even if there was no direct pressure to study healthcare. This finding is illustrated by the following comment: "I enrolled to study radiologic technology because both my mother and grandmother are doctors." In addition, a small percentage of students (1%) expressed a desire to pursue a degree in radiologic technology to care for family members, particularly grandparents. One student explained, "I grew up with my grandmother, who is sick now, and I want to help her." A similar conclusion was reached in studies such as those by Stowers et al. (3) and Witter et al. (40) in which the presence of relatives with health problems was cited as a motivating factor influencing students' decision to apply for a health degree, either to provide direct care or to alleviate the financial burden of professional health services.

Students' Opinions About the Importance of Learning Physics to Acquire Better Qualifications for Future Professional Careers

Understanding the importance of studying physics in the health sector is essential for future healthcare professionals, as many researchers, such as Alsufyani (2) emphasise. It can have a significant impact on the career paths of radiologic technology and physiotherapy students. Most students in this study (73%) believed that the content they learned in a physics course would be useful in their future careers. In addition, radiologic technology students showed a slightly more positive attitude towards the subject than physiotherapy students. This could be because the radiologic technology study group has a more extensive curriculum compared to physiotherapy (27, 28). As they have twice as many physics' lessons, these students have acquired additional knowledge and skills and consequently have a more positive attitude toward physics. On the contrary, 19% of respondents disagreed with this statement. This is consistent with the results of previous studies, such as those by Saavedra et al. (43) and Fagerstrom et al. (19), which indicate that traditional pedagogical approaches can hinder the perceived relevance of physics education in the real world. In such approaches, teachers often act as the primary source of knowledge, leaving students as passive recipients rather than active participants in their learning experience. Actively engaging students in their education could help bridge this gap, enabling them to better recognise the importance of physics to their future careers in healthcare. Furthermore, 89% of students in the overall sample recognised that knowledge of the laws of physics is essential for the proper use of medical equipment. In addition, 56% of respondents recognised that an understanding of physical laws is necessary to correctly interpret many processes in the human body. It is noteworthy that high school students dominated both results. This is in line with Alsufyani's (2) study, which shows that students' awareness of the positive effects of studying physics is more pronounced among those who have studied the subject longer, especially high school students. However, 34% of respondents held the opposite view, which is consistent with the conclusions of the same study. In particular, the students' view that physics lacks concrete medical applications points to the use of traditional teaching methods. Importantly, these results highlight that students are better able to recognise the medical applications of physics when the subject is taught in a way that directly relates it to real-life medical scenarios.

On the other hand, a clear majority of students were aware that an understanding of the laws of physics is a prerequisite for correct and professional diagnoses (61%) and treatments (64%). Therefore, it is not surprising that 79% of all respondents in the observed sample, as also shown in existing studies, believed that the contents of a physics course can be applied to various fields of medicine (18, 44). Again, radiologic technology students accounted for a larger proportion (48%) of the results. This is to be expected, as they had more opportunities to participate in the aforementioned treatments in practice than physiotherapy students, which is consistent with studies conducted by Alsufyani (2) and Saavedra and colleagues (43). In particular, the authors of these studies point out that students recognise the importance of applying the knowledge acquired in physics when working with the medical equipment available to them. This emphasises the fact that quality knowledge must combine the practical and theoretical parts of teaching (45, 46). In addition, third-year students showed greater awareness of how to apply the knowledge gained in their physics course to the effective performance of medical procedures than students in earlier years. However, when examining respondents from the same year of study, no significant differences were found between the two study groups. This finding is likely due to the extensive study and active participation of third-year students in required professional courses, such as nuclear medicine and tomographic imaging (27). Through these programmes, students acquire invaluable firsthand experience that highlights the need to grasp fundamental physics concepts, including those related to radioactivity or ionising radiation.

Motivating and Demotivating Factors to Learning Physics as Stated by the Students

The analysis of the data collected revealed that one-third of the respondents (32%) named the relevance of the course content to their professional career as the most important motivating factor for learning physics. In addition, 16% of students were motivated to learn when the connection between the course content and real life was emphasised. These results are supported by the comments of some students, such as "I learned that the body is coated with a special gel during an ultrasound examination to reduce the reflection of ultrasound energy and increase the clarity of the image of the corresponding organs." These results are consistent with a previous study by Latif and Miles (47), who indicate that presenting topics using real-life problems can significantly increase student motivation. In addition, as in previous studies, 21% of our respondents indicated that applying knowledge acquired in medical practice and laboratory exercises was an important motivating factor for them (42, 48, 49). This confirms the assertion made in the previous section that students value practical experience in their professional practice because it increases their interest in learning.

Furthermore, 11% of students found their professor's professionalism inspiring, while 10% were motivated by the professor's positive attitude. This conclusion can be drawn from the following student comment: "The professor tries to explain the content of physics to us in a way that includes many relevant examples from real life, and therefore physics is much more interesting to me." This is in line with studies that emphasise professors' influence in increasing students' interest in physics by providing timely feedback, showing enthusiasm during lectures, and enriching them with concrete examples from their own experience (50–52). The availability of various learning resources (7%) and the quality of teaching (3%) also had a positive influence on students, as reflected in studies by Saeedi et al. (38) and Su et al. (48). Overall, professors play a crucial role in fostering the creative education process. They are not only responsible for their professional development but also the success of the students. Therefore, the implementation of interactive professionalism, as proposed by Stoll (53), should be considered an essential aspect of modern educational practices. Furthermore, emphasising this approach can lead to more engaging and effective learning environments that benefit both teachers and students.

On the other hand, the following demotivating factors, which are already known in the literature, were mentioned most frequently: a wide range of teaching content (51%), too much theory that has to be learned by heart (31%), the mathematisation of physics (12%), and a lack of self-confidence (6%) (47, 54–57). According to the studies listed, these factors are interlinked. In particular, the extensive course content requires more teaching hours, which ultimately leaves less time for practising numerical examples. In this scenario, students tend to focus on memorisation rather than developing a deep understanding of the material. As a result, enthusiasm for the subject wanes and self-confidence drops. Reducing and reorganising the scope of teaching is a necessary prerequisite for achieving higher-quality teaching and reducing student demotivation. The students themselves also said, "I will never need some of the math formulae in my future job."

In addition, the first two factors are related to a decline in the quality of physics teaching in secondary schools, as well as problems related to the curriculum and outdated teaching methods (58, 59). Research conducted in Croatia and other countries on the scope of the curriculum and the assessment of educational resources confirms this conclusion (60, 61). These factors are also closely related to cognitive load and academic performance. To improve student achievement, it is crucial to apply modern teaching methods and continuously evaluate educational resources (62, 63). By addressing cognitive load and adapting methods, educators can better support students in mastering complex topics, leading to better academic outcomes.

However, a deep conceptual understanding of physics can be difficult to achieve if teachers lack the necessary experience to foster critical thinking skills in their students. To address this problem, it is important to focus on physics teachers' development of new skills (64, 65). One promising strategy could be to increase collaboration between universities and high schools, facilitate internships, provide comprehensive teaching support, engage in educational research, ensure effective teacher training, and promote continuous professional development (64). By investing in these initiatives, the quality of physics education can be improved while empowering teachers and students to achieve excellent teaching outcomes. A comprehensive understanding of the above factors is also essential for adapting curriculum content and teaching strategies to 21st-century educational policy, especially in the context of rapidly evolving technologies (61). For example, incorporating immersive technologies into the curriculum has been shown to increase learning outcomes by 40% and student engagement by 36.4%. Such tools are vital for complex subjects such as physics, as they enable interactive learning experiences and align education with technological advances (6, 64). By focusing on these strategies, the next generation can be better prepared for the challenges of healthcare.

Study Limitations

This study has several limitations. The participants were students from a single faculty, so the results cannot be generalised to all students of health studies in Croatia. The use of a questionnaire carries the risk of subjective and socially desirable responses. Qualitative analysis allows a deeper examination of responses, but it is simultaneously limited by the length and clarity of participants' written statements. The study was conducted at the end of an academic term, suggesting that the results may reflect specific experiences related to physics education during this period.

Practical Implications

These research findings may provide useful guidelines for adapting physics teaching in healthcare degree programmes, with a particular focus on the practical applicability of physical principles in everyday clinical practice. This approach can increase student motivation and consequently improve the level of competence for future work in healthcare.

CONCLUSION

Understanding physical principles is essential for the proper use of medical devices and gaining insight into biological processes in the human body. Therefore, it is important to identify the factors that can motivate students to learn physics. Most radiology and physiotherapy students recognise the importance of physics education, but its practical applicability in everyday clinical practice and its potential to improve diagnostics and therapy for the benefit of patients are the main motivations for learning. Particular sources of encouragement for students are their desire to help others, their professional ambition, and the influence of their families, which together provide a strong foundation for training highly skilled healthcare professionals.

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ETHICAL APPROVAL

The research was conducted in accordance with prevailing international ethical standards and with approval from the Ethics Committee of the Faculty of Health Studies, University of Rijeka, Croatia (Klasa:600-05/24-01/0123, Ur.br.:2170-1-65-24-1). Additionally, adherence to the ethical principles outlined in the Declaration of Helsinki was rigorously maintained throughout the research process.

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