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Attitudes of Slovenian School Teachers Towards Smart Educational Humanoid Robots in the Classroom

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Robots are becoming an increasingly important part of our everyday lives and, consequently, of the education landscape. They can take many forms in education, from simple robots that students assemble and program to more complex (humanoid) robots that can, for example, travel distances when working remotely. The attitude of Slovenian teachers towards the introduction of smart educational humanoid robots into everyday school life was explored. A questionnaire was designed, and the current state of teachers' attitudes was analysed based on the responses of participating teachers. The results show that negative attitudes towards the use of robots in the classroom prevail and that teachers do not feel qualified to integrate smart educational humanoid robots in education. Statistically significant differences between male and female teachers also emerge in some of the statements. However, teachers expressed positive attitudes towards concrete examples of robot use.

Keywords: education, humanoid robots, smart educational robots, STEM, teachers' attitudes

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Stališča slovenskih učiteljev do pametnih izobraževalnih humanoidnih robotov v razredu

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Roboti postajajo vse pomembnejši del našega vsakdanjega življenja in tudi izobraževanja. V izobraževanju uporabljamo robote različnih vrst – od preprostih robotov, ki jih učenci sestavijo in programirajo, do zapletenejših pametnih izobraževalnih humanoidnih robotov, ki lahko na primer pri delu na daljavo premagujejo razdalje med učencem in učiteljem ter sošolci. V prispevku smo raziskali odnos slovenskih učiteljev do uvajanja pametnih izobraževalnih humanoidnih robotov v šolsko okolje. Za namen raziskave je bil razvit anketni vprašalnik, na podlagi odgovorov sodelujočih učiteljev pa je bilo analizirano stanje odnosa učiteljev slovenskih šol. Rezultati kažejo, da prevladuje negativen odnos do uporabe robotov v izobraževanju in da se učitelji ne čutijo usposobljene za vključevanje pametnih izobraževalnih humanoidnih robotov v izobraževanje. Pri nekaterih trditvah se kažejo tudi statistično pomembne razlike med učitelji in učiteljicami. Kljub temu so učitelji izrazili pozitiven odnos do konkretnih primerov uporabe robotov, kot je premostitev razdalje pri dolgotrajno bolnih učencih.

Ključne besede: izobraževanje, humanoidni roboti, pametni izobraževalni roboti, STEM, stališča učiteljev

Introduction

The word 'robot' first appeared in 1920 in the novel 'Rossum's Universal Robots (RUR)' by the Czech writer Karel Čapek, but the first industrial robot did not appear until 1948 when George Devol patented a programmable manipulator, which was later considered to be the first industrial robot (Gasparetto & Scalera, 2019; Hockstein et al., 2007). Consequently, robotics does not appear in mainstream education (except perhaps in subjects related to engineering and technology, where students are involved in building such mechatronic systems and programming) and is, therefore, unknown to teachers. A robot is a machine consisting of at least three elements: 1) sensors to detect the environment, 2) processors that analyse the collected parameters and make decisions based on them and 3) implementers that allow the robot to operate in the real world (Devillers, 2021). The ISO 8373 definition is also similar, with the word *robot* defined as a 'programmed actuated mechanism with a degree of autonomy […] to perform locomotion, manipulation or positioning" (International Organization for Standardization, 2021).

Robotics is defined as the science or practice of designing, building, and training robots (Devillers, 2021). The following will focus on humanoid robots and examine teachers' attitudes towards using such robots in the educational process. It will also present whether teachers see the use of robots as an implementation option.

Education and robots

Education has been changing in recent years. Robotics as a new technology could become an integral part of the learning process, just as robots could become an integral part of education. Therefore, a new definition has emerged: *Educational Robotics* (ER), which covers all fields related to robotics and education. ER is a field of research that seeks to improve human learning experiences by developing and implementing activities, technologies and artefacts in which robots play an important role (Angel-Fernandez & Vincze, 2018). Robots can be integrated into education in a variety of ways.

The robot as a *learning object* is a category of educational activity in which it is studied as a subject in its own right. It includes a variety of educational activities designed to configure a learning environment that will actively engage learners in problem-solving activities focusing on robotics-related topics. This means that students learn how to construct (assemble) and program robots.

The robot as a *learning tool*, in which the robot is a tool for teaching and learning content. This is usually seen as an interdisciplinary, project-based

learning activity, mainly in science, mathematics, IT and technology, and offers many new educational benefits (Alimisis & Kynigos, 2009).

Robots in education can have other different roles, such as 1) robot as a teaching assistant (the robot could replace the teacher by taking his/her position and lecturing or assisting in teaching), 2) robot as peer and co-learner (the students have to train the robot, as it is shown as a student with whom they are learning together), 3) robot as companion (the robot, created to facilitate real or virtual social interaction between students), 4) robot as entertainer (the robot that engages students, especially during free time in the classroom), 5) telepresence robot (in this scenario, the telepresence robot is an avatar of the teachers in the classroom, allowing a remote instructor to operate the robot and actively engage students), and 6) the robot as learning platform (Alvez-Oliveira et al., 2016; Belpaeme & Tanaka, 2021; Hrastinski et al., 2019; Mubin et al., 2013; Mubin & Ahmad, 2016; Reuters, 2022).

Theoretical background

Robots are increasingly present in education today. Sometimes, they even take on the role of teacher. Intelligent ER is a tool that provides support for learning. It can cultivate creativity and other skills among diverse learners (Aoun, 2017). According to Rao and Ab Jalil (2021), ER can serve as a learning assistant to subject teachers in the classroom by explaining the curriculum and facilitating extracurricular activities that improve students' attention and focus. Thus, the robot does not take on the role of a teacher but rather is the student's learning companion. It follows the concept of *edutainment* and allows learning to occur separately from space and time, as the interaction between the student and the robot can continue outside the classroom (Rao & Ab Jalil, 2021). Because of the characteristics of new technologies, formal and informal learning are also becoming increasingly blended (Lebeničnik et al., 2015). Several researchers (Conti et al., 2017; Kory-Westlund & Breazeal, 2019; Rao & Ab Jalil, 2021) underline the fact that integrating smart educational robots into the educational process has positive effects and that integrating robots into education promotes the development of a wide range of skills, practically at all levels of education. Smart educational robots are expected to become an integral part of education. Robots in education could thus improve children's learning in the future, as robots would be able to operate autonomously (Serholt et al., 2017).

In various forms, ERs are potentially useful as teaching assistants (Conti et al., 2017; Kennedy et al., 2015; Kory-Westlund & Breazeal, 2019). According to the following research, the results of using robots in teaching have been favourable. Pre- and post-test scores, facial expressions, and indirect verbal responses were

used to assess the effectiveness of the Nao robot's human-assisted correction of mathematical concepts in instruction. The findings of the research showed that students were significantly more cooperative with the Nao robot, indicating favourable attitudes towards the use of humanoid robots in schools, although there were no significant differences in test scores (Mubin et al., 2019). Another use of the Nao robot in the classroom illustrates the benefits of robotics in education, as research has shown that children with special needs (such as autism) also responded favourably to the presence of a robot in the classroom. They showed more interest and enthusiasm (Yousif, 2021). Moreover, using robots in the classroom helps motivate students (Chevalier, 2016). Social and adaptive behaviour is often desirable in the educational process. To this end, as Kennedy et al. (2015) suggest, social robots could be used to influence learning support and increase learning opportunities. In a study by these authors, the presence of a robot using a mentoring strategy increased the effect of social behaviour, which also influenced learning. At the same time, it was found that students who interacted with a robot that used social and adaptive behaviour in addition to the mentoring strategy did not learn much. Therefore, significant considerations must be made before introducing robots into the educational process. Another study shows the positive impact of integrating smart educational robots into the educational process; Kory-Westlund and Breazeal (2019) state that their research shows the importance of children's peers for learning and development. They highlight the interaction with peers (especially more advanced peers) that can accelerate the speech development of preschool children. Their paper explores the relationship that significantly modulates language learning in children with peer social robots. The results showed that children who imitated more robot phrases during storytelling (child-robot interaction) scored higher on a vocabulary posttest.

Another study found that students love learning with smart educational robots, but teachers are reluctant to use them in the classroom. In a study where teachers and students interacted with a smart educational humanoid robot called Nao, teachers expressed concerns about integrating robots into education. Teachers expressed that they do not want the robot to take full autonomy in the classroom but want the robot to have a limited role in the educational process. Teachers also overwhelmingly expressed the belief that they want to have full control over the robot. However, the authors caution that the results may be related to a technological bias, as teachers are generally unaware of the presence of robots in education. Interestingly, the teachers in the study also stressed that they do not want the robot to take on full autonomy in the classroom but rather to act and behave as a learning 'friend' of the children rather than as a teacher. The authors thus conclude that it is much more likely that

robots will be used for some time as learning objects in the educational process rather than as learning tools in the classroom (Mubin & Ahmad, 2016).

Kory-Westlund et al. (2016) describe the case of an autonomous social robot that learns as a companion. A study was conducted using a social robot in three preschool classrooms for two months. Teachers were surveyed before and after the introduction of the robots in the educational process. The survey showed that teachers' expectations about their experience of working with an autonomous social robot companion in the classroom often did not match their actual experience. It turned out that teachers expected the robot to disrupt the educational process, but the opposite was true. Teachers also reported the positive potential of an autonomous social robot companion as a new educational tool (Kory-Westlund et al., 2016). According to a study by Reich-Stiebert and Eyssel (2016), teachers expressed a more pessimistic view of the use of educational robots in the classroom. Interestingly, teachers in the survey gave their opinion on whether robots should be used more often in STEM (science, technology, engineering and mathematics) subjects (Reich-Stiebert & Eyssel, 2016). Negrini (2020) reports similar results, as the findings of their study show that teachers are curious about educational robotics and are aware of the potential of using robots to promote interdisciplinary competences. Cost, the amount of time needed to prepare activities, and the fact that technology is already so prevalent in our daily lives are among the reasons that inhibit the introduction of robots in schools (Negrini, 2020). Similarly, Istenic et al. (2021) observed that pre-service teachers also have negative attitudes.

The presence of robots in education has both advantages and disadvantages. Therefore, teachers express optimism and concern, seeing many opportunities and potential challenges. Robots in the educational process often help to overcome personal problems related to shyness, reticence, self-consciousness and frustrations that can arise when interacting with a human teacher. The example illustrates all of these that no matter how many mistakes a student makes, the robot will not tire (Mubin & Ahmad, 2016; Tuna & Tuna, 2019). Despite this optimism, according to Serholt et al. (2017), we are not yet close to the reality of smart educational humanoid robots being used autonomously in schools for several reasons. These include ethical concerns around privacy, the robot's role in replacing humans, the effects of interaction on children, and liability. Despite the rapid and continuous technological development and the expectation that robots will replace teachers, this is not expected in the near future. At the moment, we are more focused on the goal of making robots work as learning tools and maximising the added value they can bring as stimulating and interesting educational tools. To make this possible, we must first provide appropriate interface

mechanisms (software, hardware or even mobile apps) that allow the teacher to control the robot with minimal training (Mubin & Ahmad, 2016). Robots have the potential to be helpful in the classroom and will eventually become more autonomous and competent, but they do not behave and think like humans. People working with them must think about their work in new ways (Macmurray, 2012).

Research problem and research questions

After reviewing the literature, it was found that much research refers to educational robots as learning objects. This means that students study the robot as an object and assemble and program it. However, some researchers, such as Mubin et al. (2013), Konijn et al. (2020), and Reich-Stiebert and Eyssel (2015), point out that robots in education are also used for language, science or technology education, where they take on the role of an educational tool. Most also point out that a robot can be a mentor, tool, or peer in a learning activity.

This study explores Slovenian teachers' perspectives on using intelligent educational humanoid robots as a learning tool in the classroom. It is a very relevant issue in today's educational environment. This study is significant because it can add insightful information to the discussion of pedagogy and educational technology. Additionally, the study's regional context guarantees its applicability to Slovenia's educational system, offering a nuanced viewpoint that can benefit teachers and policymakers. This study offers current data on teachers' views and impressions of intelligent educational humanoid robots, laying the groundwork for additional research and discussion in this field. Furthermore, the paper identifies the major obstacles to properly integrating robots into the classroom and offers potential answers. This can help formulate policies that will advise teachers, educational institutions, and policymakers on how best to incorporate technological innovation into the teaching and learning process. Moreover, the question of whether teachers' gender impacts attitudes towards including humanoid robots in teaching has been explored. The results of such an analysis allow decision-makers to provide appropriate guidelines for further implementing this technology in the educational process.

As robots will become an increasingly important part of our everyday lives and ultimately become part of the educational environment, it is necessary to explore teachers' attitudes towards implementing robots in the educational process. Therefore, this study was designed to explore the attitudes of Slovenian teachers towards the integration of robots in the classroom, with the robot being included as a teaching tool to help students with, for example, learning difficulties, for assistance, for possible distance education, as was the case during the Covid-19 pandemic, and also as a teacher's assistant in the classroom,

in administrative and organisational matters. The following research questions were formulated:

Q1: Do teachers generally have positive attitudes towards integrating smart educational humanoid robots into the educational process, and how does this differ according to the gender of the participants?

Q2: Do teachers generally report that they feel empowered to integrate smart educational humanoid robots into the educational process, and how does this differ according to the gender of the participants?

Q3: Do teachers generally show positive attitudes towards concrete ways of implementing humanoid robots in education, and how does this differ according to the gender of the participants?

Method

Participants

A total of 255 Slovenian primary and secondary school teachers started the questionnaire, of which 49 did not complete it in full. Thus, 206 responses were taken into account. Regarding gender, 78.71% of the participants were women, and 20.87% were men (1.94% did not want to disclose their gender). The questionnaire covered different groups of teachers according to their years of teaching experience: less experienced teachers who have just started teaching and teachers with more than 30 years of experience. Regarding grade level, 9% of the participating teachers teach in the first cycle of primary school (grades 1-3), 6% in the second cycle (grades 4-6) and 34% in the third cycle (grades 7-9), 15% teach in vocational secondary schools and 17% in gymnasium. The teachers included in the study were randomly selected from a range of teaching fields (teachers of social studies, teachers of science, teachers of vocational subjects, teachers of primary education and teachers of secondary education). The teachers generally had no previous experience of teaching with educational robots.

Instrument

For the purpose of this research, a review of the literature on the research field was first carried out. During the review, we traced various questionnaires (Negrini, 2020; Rao & Ab Jalil, 2021; Saari et al., 2022; Serholt & Barendregt, 2014; Xia & LeTendre, 2020) that were adapted for our study. Statements from some of the studies were used for this study, and some statements were added at our discretion and judgment. This strategy was used to fill the research gaps and to modify the questionnaire according to the objectives and research questions of the study. The possibility of customising the questionnaire allows for

the collection of information directly related to the topic of the study and offers insights specific to the research objectives. In addition, modifying the statements of existing surveys allows the use of information and experience already written and ensures the inclusion of established and validated measures.

The first part of the questionnaire consisted of 13 statements concerning teachers' views on integrating smart educational humanoid robots in the educational process. This part consisted of statements exploring the intention of robots making decisions instead of humans, the idea of including robots with human characteristics in the educational process, the presence of robots in preschool education, the analysis of students' emotions and feelings by robots during lessons, the assessment of students' knowledge and work by robots, the possible complete replacement of teachers in the classroom by robots, and the recording of all classroom activities by robots.

The second part of the statements addressed teachers' views on the expression of empowerment to integrate smart educational humanoid robots into teaching and the specific purposes of using smart educational humanoid robots in education. This part consisted of five statements in the beginning, where participants were asked to respond to statements that examined whether teachers are empowered to use robots in the classroom. The statements addressed the possibility of using robots in the classroom as soon as possible, expressions of interest in involvement, the potential for involvement and whether teachers monitor progress in the development of humanoid robots for teaching purposes. This part also included four statements examining the potential use of robots as teaching assistants for students with disabilities, their support for distance learning and their support for administrative tasks for teachers. The questionnaire ended with demographic questions. Participants were asked to indicate their agreement with the statements on a five-point scale, namely 1 = *do not agree at all*, 2 = *disagree*, 3 = *undefined*, 4 = *agree,* and 5 = *strongly agree*. The study aimed to explore teachers' attitudes towards introducing smart humanoid robots in the educational process. It did not specifically focus on whether or not teachers had previous experience using robots in the classroom. Before answering the first part of the questionnaire, participants were asked to give their opinion on the idea of implementing such robots in the classroom, and for the second part, participants were asked to think about themselves and the situation in which they would be accompanied by a humanoid robot in the classroom. In this context, they were then asked to express their views on the statements in the second part of the questionnaire. Before completing the questionnaire, participants did not receive any training or additional information on using robots in the classroom. The focus was solely on their views or

opinions on implementing robots in the educational process, regardless of their previous experience.

Research design

The study was conducted at the beginning of the 2022/2023 school year. A questionnaire was developed and uploaded to the Slovenian open-source online survey application 1ka.si. A link to the questionnaire was sent by e-mail to randomly selected Slovenian primary and secondary school teachers. The link to the online survey questionnaire was also posted on the forum of the Association of Innovative Teachers of Slovenia together with the invitation. The online questionnaire was completely anonymous, and by starting to answer the questions, the participants expressed their consent to participate in the study (they were warned about this before they started answering the online questionnaire). This questionnaire has been subjected to a reliability test. The scale's internal consistency is acceptable for this sample, as indicated by a Cronbach's alpha of .948. The data from the online questionnaire were analysed using descriptive statistics, calculating mean values (*M*) and standard deviations (*SD*). In order to test for statistically significant differences between the statements according to the teachers' gender, a non-parametric Mann-Whitney U-test was performed on the sample to compare the results between two independent groups (gender) at the 95% confidence level. Before carrying out the test, the conditions of use were tested. The Mann-Whitney test was chosen because it does not require a normal data distribution. All analyses were carried out using IBM SPSS statistical software.

Results

The results for the two statements where participants directly agreed or disagreed with the inclusion of robots in education are as follows: for the statement 'Robots should be included in teaching', it can be observed that the majority of the teachers were opposed to the statement, which indicates that there is a prevailing opinion that robots should not be included in the educational process (the results of the descriptive statistical analysis show that $M = 2.09$, $SD = 1.09$). The Mann-Whitney test for this statement did not show statistically significant differences according to the teachers' gender. Even stronger opposition is shown for the statement 'Robots should be present in kindergarten' (the results of the descriptive statistical analysis show that $M = 1.60$, $SD = .94$). Again, the test did not show statistically significant differences according to the gender of the teachers. The results of the other statements in this set are presented in Table 1.

It is clear that teachers are largely reluctant to let robots make decisions for them ($M = 1.35$, $SD = .65$), but they did express some minor disagreement with the statement that they could actually trust a robot ($M = 2.05$, $SD = 1.05$). Teachers show much more agreement with statements relating to emotional interaction with robots. Teachers expressed less disagreement that robots should show emotions ($M = 2.87$, $SD = 1.44$), with similar results for the statement that robots should analyse the emotions of both teachers ($M = 2.61$, $SD = 1.38$) and students ($M = 2.76$, $SD = 1.40$). It is important to point out that the mean is still less than 3, which means that teachers are still not very favourably disposed to these statements. The results are also very similar for the statement that robots could assess students' knowledge ($M = 2.67$, $SD = 1.38$) and that robots could work with the teacher to teach ($M = 2.69$, $SD = 1.23$). For this statement, the Mann-Whitney test also showed a statistically significant difference according to the gender split of the teachers ($U = 2685$, $p = .025$). The analysis shows that male teachers are more likely to agree with the statement than female teachers. Teachers are slightly less favourable to statements concerning the possibility of robots becoming evaluators of the learning process ($M = 1.58$, $SD = .85$), the possibility of robots replacing teachers completely ($M = 1.25$, $SD = .64$) and the need for robots to record everything that happens in the classroom ($M = 1.71$, $SD = .98$). The only statement where teachers expressed agreement with the statement is the one saying that robots should take responsibility for their actions when used in teaching ($M = 3.04$, $SD = 1.53$). This statement also showed a statistically significant difference according to the teachers' general level of agreement ($U = 2664$, $p = .022$), with male teachers expressing more agreement with the statement than female teachers.

Table 1

The opinion of teachers towards the inclusion of robots in the educational process

Inclusion of robots	*M*	*SD*	Gender	Mean Rank	Mann-Whitney U Test
Robots should take decisions instead of humans.	1.35	.65	female	99.05	*U* = 3028.5
			male	110.57	*z* = -1.440
					p = .150
Robots should be included in teaching.	2.09	1.09	female	97.50	*U* = 2783
			male	116.28	*z* = -1.955
					p = .051
Robots should be present in kindergarten.	1.60	.94	female	99.03	*U* = 3026
			male	110.63	*z* = -1.341
					p = .180
I could trust the robot.	2.05	1.05	female	98.05	*U* = 2870.5
			male	114.24	*z* = -1.692
					p = .091

Inclusion of robots	*M*	*SD*	Gender	Mean Rank	Mann-Whitney U Test
Robots should show emotions.	2.87	1.44	female male	102.23 98.80	*U* = 3302.5 *z* = -.349 *p* = .727
Robots should analyse the feelings of the teacher.	2.61	1.38	female male	103.12 95.50	*U* = 3160.5 *z* = -.782 *p* = .434
Robots should analyse the feelings of the students.	2.76	1.40	female male	103.61 93.70	*U* = 3083 *z* = -1.016 *p* = .310
Robots should assess the student's knowledge.	2.67	1.38	female male	100.97 103.45	*U* = 3334.5 *z* = -.256 *p* = .798
Robots should fully assume the role of an evaluator.	1.58	.85	female male	98.22 113.64	*U* = 2896.5 *z* = -1.743 *p* = .081
Robots could completely replace a teacher.	1.25	.64	female male	100.88 103.78	*U* = 3320.5 *z* = -.438 *p* = .662
Robots could deliver lessons alongside a teacher.	2.69	1.23	female male	96.89 118.56	*U* = 2685 *z* = -2.235 *p* = .025
Robots should record everything that happens in the classroom.	1.71	.98	female male	98.31 113.29	*U* = 2911.5 *z* = -1.664 *p* = .096
Robots should be held accountable for their actions.	3.04	1.53	female male	96.75 119.05	*U* = 2664 *z* = -2.285 *p* =.022

The results of the analysis of teachers' empowerment to integrate humanoid robots into teaching are presented in Table 2. The gender analysis showed a statistically significant difference for all five statements. For all statements, further interpretation of the results showed that male teachers in Slovenian schools are more willing to integrate humanoid robots in teaching than female teachers (average ranks are higher for male teachers than for female teachers for all statements). A more detailed examination of the results shows that the averages of agreement with the statements are low, indicating that teachers generally disagree with the statements. This is the case for the statements if teachers want to use robots in teaching as soon as possible (M = 2.41, SD = 1.17), if they see a high potential in using robots in teaching (M = 2.66, SD = 1.20), and if they see a high potential in using robots in teaching (M = 2.66, SD = 1.20), if they see great potential in the use of robots in teaching in their subject field (M = 2.55, SD = 1.22) and if they follow progress in this field (M = 2.37, SD = 1.20), except for the statement that teachers are interested in the integration and use of robots in teaching (M = 3.00, SD = 1.35). Only this statement has a mean of 3.00, indicating teachers' neutral attitudes towards this statement.

Table 2

Teachers' opinion on the expression of empowerment for the inclusion of robots in education

Empowerment for the inclusion	*M*	*SD*	Gender	Mean Rank	Mann-Whitney U Test
I want to use robots as soon as possible.	2.41	1.17	female	94.64	$U = 2327.5$ $z = -3.332$ $p < .001$
			male	126.87	
I am interested in the field of using and including robots.	3.00	1.35	female	95.11	$U = 2402.5$ $z = -3.091$ $p = .002$
			male	125.13	
I see great potential in the use of robots in teaching.	2.66	1.20	female	95.17	$U = 2412$ $z = -3.059$ $p = .002$
			male	124.91	
I see great potential in the use of robots in teaching in my subject field.	2.55	1.22	female	97.30	$U = 2751$ $z = -2.026$ $p = .043$
			male	117.02	
I am following the progress in this field.	2.37	1.20	female	96.03	$U = 2548.5$ $z = -2.643$ $p = .008$
			male	121.73	

When examining the specific use of robots in the classroom, the results showed statistically significant differences according to gender for the claim that robots could be used for students with special needs ($U = 2695.5$, $p = .027$) and that robots could help interact with students participating in lessons remotely ($U = 2777$, $p = .046$). In both statements, male teachers expressed more agreement with the statement than female teachers. The results of the descriptive statistical analysis show that teachers are generally quite supportive of the use and integration of humanoid robots in teaching in the cases, as shown by the statements in Table 3. For most of the statements, teachers expressed a higher level of agreement with the statement, while disagreement (or a neutral opinion) prevailed. Teachers expressed fairly high agreement with the statement that robots would be rebellious in administrative work ($M = 3.60$, $SD = 1.17$), which is, therefore, basically unrelated to actual classroom teaching.

Table 3

Teachers' views on concrete proposals for implementing robots in education

Concrete proposals for implementing	*M*	*SD*	Gender	Mean Rank	Mann-Whitney U Test
Teaching robots could be used for students with special needs.	3.00	1.18	female	96.95	*U* = 2695.5 *z* = -2.207 *p* = .027
			male	118.31	
Robots could help to interact with students who participate in lessons remotely (for example, due to illness).	3.20	1.14	female	97.47	*U* = 2777 *z* = -1.999 *p* = .046
			male	116.42	
Robots in education could only be used to help the teacher.	3.30	1.12	female	99.41	*U* = 3086 *z* = -1.029 *p* = .303
			male	109.23	
In education, robots could also be used in the administrative work of teachers.	3.60	1.17	female	98.36	*U* = 2919.5 *z* = -1.552 *p* = .121
			male	113.10	

Discussion

The research aimed to determine how teachers feel about integrating intelligent educational humanoid robots into the educational process. The results showed that teachers are somewhat opposed to the idea of smart educational humanoid robots becoming part of everyday school life. In fact, the majority of them believe that smart educational humanoid robots do not belong in the school environment. This opposition is also reflected in the argument that smart educational humanoid robots should already be present in kindergarten.

Further analysis of the results shows that teachers would not trust a robot in the educational process. Teachers show a negative attitude towards the statement that smart educational humanoid robots should be able to analyse the feelings of the teacher and/or the student in the classroom. It is very similar to statements concerning assessment. As van Ewijk et al. (2020) mentioned, the reasons could mainly be found in teachers' concerns regarding privacy, especially when the robot monitors and analyses individuals in the classroom. Here again, teachers expressed opposition and negative attitudes towards the use of robots in this field.

Teachers also disagree with the statement that robots could completely replace the teacher at school. As stated by Selwyn (2019), teachers remain confident they will not be replaced by modern intelligent tools. Although there is slightly less opposition to the statement that smart educational humanoid robots could teach alongside the teacher, negative attitudes are still prevalent.

The results showed that teachers do not have a positive attitude towards integrating smart educational humanoid robots into the educational process.

The results show that the majority of teachers have a negative attitude towards the use of robots in the classroom. Other studies, such as the one by Reich-Stiebert and Eyssel (2016), also reported similar findings. While it is important to point out that this is the opinion of the majority, it is nevertheless possible to trace among the results that some expressed very positive attitudes towards the statements, thus expressing the opinion that they are ready for the presence of smart educational humanoid robots in education. There are probably many reasons why the majority are opposed. It is particularly meaningful to point out that the vast majority of teachers have not had the opportunity to work with robots and consequently have no idea what such teaching would look like.

The results showed only a statistically significant gender difference in the two statements. Interestingly, male teachers showed more favourable attitudes towards the inclusion of robots in the classroom, while female teachers showed less favourable attitudes.

Almost half of teachers say they do not want to start using intelligent educational humanoid robots in their teaching immediately. It is assumed that teachers would first want to get more information about this type of teaching before using it and probably also to get examples of good uses of this type of teaching. This would help them prepare for robot-assisted teaching and overcome any fears that might be likely to arise when switching to robot-assisted education. As the results show, while teachers are interested in using robots for education, unfortunately, few are following up on this issue. This probably explains the results of this research, as it seems that teachers are not yet sufficiently familiar with the use of robots in education. Consequently, they do not see the potential of using robots in education. However, the analysis by gender of teachers in this set of statements showed statistically significant differences for all statements. A more detailed analysis shows that male teachers show a greater expression of empowerment to integrate and work with humanoid robots in teaching than female teachers. Based on the results, it was found that teachers do not feel empowered to integrate smart educational humanoid robots into education. However, it should be noted that male teachers expressed more empowerment than female teachers.

The results in concrete situations where robots could be used in education are also interesting. Teachers expressed the view that smart educational humanoid robots could be useful in concrete situations, such as assisting students with special needs and students who are ill and consequently unable to follow classroom lessons (and are present remotely). Teachers also see the usefulness of smart educational humanoid robots in their administrative work. In this case, the gender analysis showed that male teachers showed a greater

preference for implementation for teaching purposes, as there was a statistically significant gender difference in this case. However, no statistically significant difference was detected in the case of the statements concerning the robot's assistance to the teacher. The results of the data analysis show that teachers have positive attitudes towards certain robot implementation options.

Conclusions

The study comprehensively analyses Slovenian teachers' attitudes towards integrating smart educational humanoid robots into teaching. The key findings reveal a predominantly negative attitude towards using these robots in teaching, with teachers expressing a lack of confidence in their ability to integrate such technology into their teaching practices. However, there is a marked tendency towards positive attitudes when considering specific, concrete applications of robots in education, such as supporting students with learning difficulties and assisting in distance education.

Other research has also raised concerns about teachers' technological and pedagogical readiness, which is consistent with the results of this study. An important strength of this study is its regional focus, which provides a specific insight into the Slovenian educational context, which is under-represented in global research. However, the study's limitations include the relatively small sample size and potential biases due to the voluntary nature of participation, which could attract participants with stronger opinions on the topic. This study aimed to shed light on these views and identify areas for improvement, highlighting the importance of addressing teachers' concerns and improving their preparedness through targeted training programmes.

This study highlights the potential importance of educational robots in improving teaching and learning processes. Future research should focus on larger, more diverse samples, investigate the long-term effects of integrating robots into classrooms, and explore strategies to effectively support teachers in this technological transition.

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