Integrating humanoid robots into School Education: A Preliminary Evaluation of Outcomes from a Teacher Training Program

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Abstract

This paper presents preliminary findings from a survey evaluating an online Moodle-based teacher training program conducted within the Erasmus+ project "My Robot, My LearnMate". The program aims to equip teachers with the skills to use the NAO robot as a didactical tool in schools. The study's objectives were to assess the usability and accessibility of the training program, measure its impact on teachers' confidence and readiness, and identify areas for improvement. To achieve these aims, an online survey was conducted with the first 13 teachers who completed the program. The questionnaire comprised 18 items from the Intrinsic Motivation Inventory (IMI) subscales "Interest/Enjoyment," "Perceived Competence," and "Effort/Importance," a measure of recommendation likelihood using the Net Promoter Score (NPS), and several open-ended questions for qualitative feedback. The results indicated that teachers valued hands-on, practical modules over theoretical content. A significant difference between countries was found in the 'Perceived Competence' subscale, with teachers from Croatia reporting higher scores than those from Poland and Portugal. Despite the novelty and implementation demands of social robots in school education, the training program achieved a positive NPS of 30.8, indicating good acceptance and willingness to recommend the program. These preliminary results suggest that the training program effectively supports teachers in learning about and applying humanoid robots in education. However, continued evaluation and refinement are necessary to enhance satisfaction and ensure the program's long-term effectiveness.

Keywords

Humanoid Robots, Educational Robots, School Education, Teacher Training

1. Introduction

In an era defined by rapid technological evolution, the integration of robots into educational contexts has become a central theme in educational research. Robots are increasingly recognized not only as tools for instruction but as active agents capable of enhancing learning processes across disciplines [1–4]. A growing body of research has demonstrated that educational robots, such as the humanoid robot NAO, contribute effectively to the development of language competencies [1–6], computational thinking [2, 7], literacy [8, 9], and mathematics [10, 11]. Across these contexts, numerous studies reported improved student motivation, engagement, and academic performance when interacting with robotic technologies [1–3, 5, 7, 10, 12–15]. Among the available robotic platforms, NAO stands out as one of the most widely adopted social robots in education, valued for its versatility, accessibility, and human-like features that promote meaningful human-robot interaction [2, 4, 5, 10, 11, 16, 17].

Despite the increasing use of educational robots (ER), several studies report persistent barriers to their effective classroom integration. A large European study with 849 school teachers from four

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European countries (Poland, Germany, Portugal, and Croatia) identified the lack of training opportunities and limited awareness among educators regarding strategies for integrating robots into teaching practices as key obstacles [18].

While participants across all countries reported positive motivation to engage in ER training, the findings also highlighted a strong correlation between access to training and teacher motivation [18]. Similar findings highlight additional barriers such as lack of time, insufficient technical resources and the absence of curriculum-linked educational materials, all of which negatively affect usability and acceptability of ER for teachers [19, 20]. Consequently, restricted training opportunities for teachers and the absence of clear guidelines continue to limit the potential of humanoid robots in enriching students' learning experiences [18, 19, 20, 21]. This is particularly relevant given that recent research has also highlighted the potential of educational robotics to support the learning of students with learning difficulties or disorders [22].

The Erasmus+ project "My Robot, My LearnMate" – https://myrobot-mylearnmate.eu – responds to these challenges by introducing a multilingual, self-paced online Moodle-based teacher training program designed to build educators' pedagogical and technical competence in employing the NAO robot as a didactic tool. The program focuses on equipping teachers with both the theoretical foundations and practical skills necessary to integrate robots effectively within diverse classroom contexts, especially within cross-curricular sustainability education. The present study reports on the initial evaluation of this training program, drawing on feedback from the first thirteen teachers participating in the course, representing Poland, Croatia, and Portugal.

2. "My Robot, My LearnMate"

2.1. Design of the teacher training program

The 30-hour, self-paced online training program, developed under the Erasmus+ project "My Robot, My LearnMate" is an online course available on the open Moodle LMS platform - https://learn.foi.hr/course/view.php?id=76. It aims to empower educators to integrate educational robotics into classroom practice, with particular emphasis on sustainability and climate change education. The course is available in five European languages (i.e. English, German, Polish, Croatian, and Portuguese) and was designed based on teachers' professional needs and educational contexts [18]. It addresses two key target groups: (a) trainers (multipliers), who complete the full program to support and mentor others, and (b) teachers, who participate through guided workshops and adapted versions of the training. The course is structured into three sequential modules focusing on foundational knowledge, technical proficiency, and pedagogical application with the NAO robot:

- *Module 1:* Provides an overview of educational robots, emphasizing their pedagogical potential, ethical considerations, and risks associated with their classroom use. Participants explore how robots like NAO can enhance engagement and learning across subjects and review real-world examples of successful implementations in schools. The module primarily includes structured reading assignments, case studies, videos, podcasts, exercises and quizzes designed to assess participants understanding of the content.
- *Module 2:* Offers hands-on experience using the Choregraphe software to program the NAO robot. Participants learn about the robot's hardware and software features, acquire basic programming skills, and practice creating interactive classroom applications. The module also covers essential aspects of troubleshooting and system maintenance to ensure successful classroom integration. It is mainly comprised of step-to-step guidelines on connecting NAO, installing and using Choregraphe, and building app projects.
- *Module 3:* Supports teachers in developing, analyzing, and applying subject-specific teaching scenarios that integrate NAO. Participants explore best practices and case studies

in robotics-based education, focusing particularly on cross-curricular topics such as sustainability. Guided activities encourage participants to design and adapt lesson plans that effectively align robotic activities with curricular goals and diverse learner needs. The module contains reading assignments, creation of teaching scenarios, opportunities for collaboration and communication with colleagues, and a final quiz.

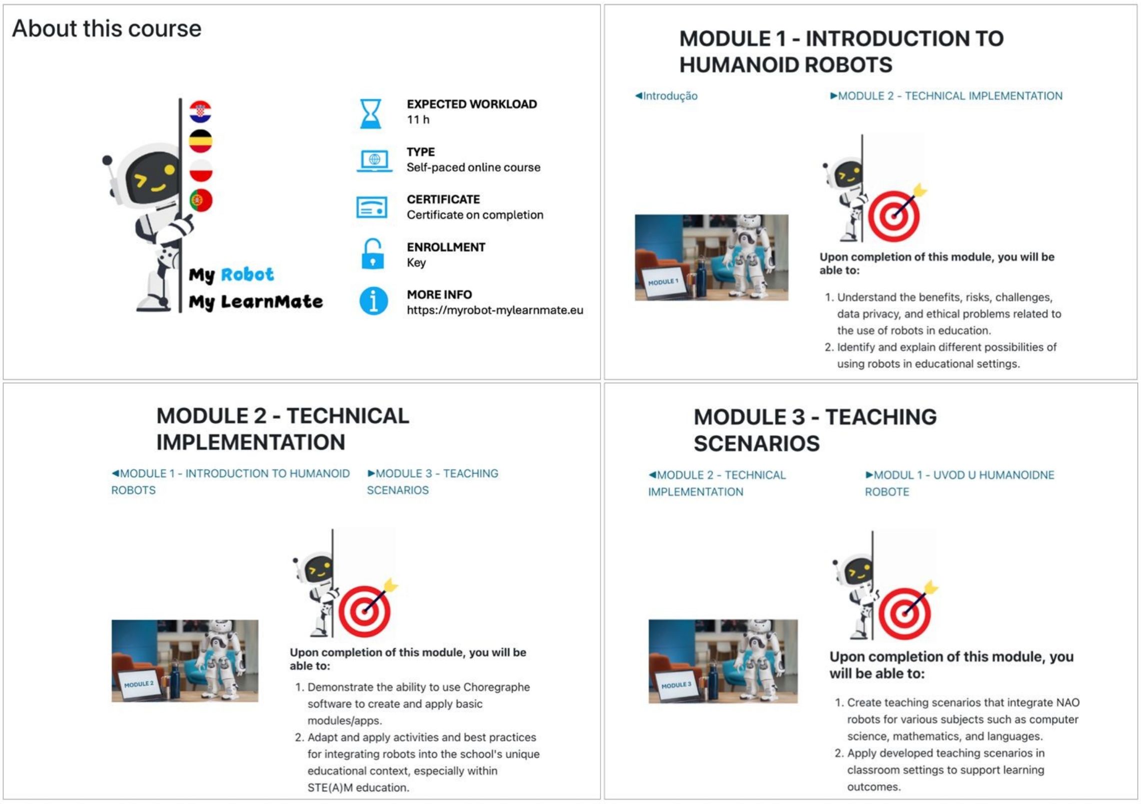

Figure 1: Structure and learning objectives of the three modules of the teacher training program.

The program's overall objectives are to strengthen teachers' digital competence, foster collaboration among educators, and promote the meaningful integration of robots into school curricula.

2.2. Research Questions

Aligned with the project's goal of promoting the integration of ER into classroom practice, this study addressed the following research questions:

1. *RQ1: How do teachers perceive the usability, accessibility, and overall quality of the Moodle-based training program?* This question specifically examines the effectiveness of the program's self-paced, multilingual online design, which was developed to ensure accessibility for teachers across different European countries and educational contexts.
2. *RQ2: To what extent does the training influence teachers' confidence and readiness to apply newly acquired knowledge in their classroom?* This question examines whether the program enhances teachers' pedagogical and technical self-efficacy in integrating the NAO robot into classroom activities and whether the combination of hands-on technical instruction and pedagogical guidance supports the transfer of knowledge into practice.
3. *RQ3: Which training modules are considered most useful, engaging, and relevant, and what recommendations do teachers offer for improving future iterations of the program?* The final question aims to identify how teachers assess the individual modules in order to identify

which aspects of the program are most valuable and which should be improved in future iterations to achieve broader cross-country implementation and long-term durability.

3. Methodology

3.1. Participants

This preliminary survey served as the initial evaluation of the "My Robot, My LearnMate" teacher training program, aiming to assess its impact and gather feedback from participants. A total of 13 teachers participated in the study, of whom 9 were female (69.2%), with a mean age of 46.23 years (SD=8.18). Participants represented three countries, namely Croatia (n=5), Poland (n=3), and Portugal (n=5), with their primary languages corresponding accordingly.

In terms of school type, six participants taught at primary schools, four at secondary schools, two in special education, and one in another educational setting. Most teachers (n=8) reported prior experience with using robots in education, while five indicated no previous experience. Overall, the sample consisted mainly of experienced educators with diverse professional backgrounds across different educational levels.

3.2. Survey Design

Data were collected through an online survey implemented in Google Forms, comprising three main sections. The first section collected demographic information, including age, country, type of school, and prior experience with educational robots. The second section assessed participants' experiences and perceptions of the training using 18 items adapted from the Intrinsic Motivation Inventory (IMI) [23, 24]. These items covered the subscales Interest/Enjoyment, Perceived Competence, and Effort/Importance, and were rated on a 5-point Likert scale. Each IMI subscale was followed by two open-ended questions to obtain qualitative insights which were analyzed using a qualitative content analysis approach. The final section assessed participants' likelihood of recommending the training program using the Net Promoter Score (NPS) [25] and included open-ended questions about whether teachers have already applied course content in their classrooms. The use of the IMI and NPS is grounded in the assumption that teacher motivation is a key prerequisite for the sustainable adoption and dissemination of educational robotics. Previous research has shown that access to training strongly correlates with teacher motivation and the likelihood of integrating robots into teaching practice [24]. Accordingly, the evaluation of the training program not only assesses usability, but also whether the course fosters intrinsic motivation and willingness to apply and recommend the approach. To ensure consistency across participating countries, the questionnaire was administered in English for all participants. The entire survey took approximately 10–15 minutes to complete.

4. Results

To control for possible demographic influences, mean differences in the IMI subscales were analyzed according to gender, age and country. No significant differences were found according to gender or age. A significant difference was observed between countries regarding the Perceived Competence subscale, $F(2,9) = 5.32$, $p = .017$, $\eta^2 = .549$. Post-hoc comparisons (Bonferroni) revealed that participants from Croatia reported higher scores than those from Poland (p=.036) and Portugal (p=.024). Country-level descriptives for the IMI subscales and NPS scores are shown in Table 1.

The IMI subscale results indicated a strong engagement among participants. As shown in Table 2, the Interest/Enjoyment (M=4.165/5, SD=0.816) and Effort/Importance (M=4.169/5, SD=0.751) dimensions received high ratings, while Perceived Competence scored moderately (M=3.526/5, SD=1.01). This suggests that participants felt motivated and invested in the training but somewhat less confident in their newly acquired skills. The overall Cronbach's alpha for the intrinsic motivation was .961. For the IMI subscales, the values ranged from .85 to .953. Accordingly, the results provide a reliable representation of participants' perceived motivational experiences during the training program.

Table 1
Country-level descriptives for IMI Subscales [23, 24] and NPS [25] scores

Country	N	Interest/ Enjoyment Means	Perceived Competence Means	Effort/ Importance Means	NPS Means
Croatia	5	4.743	4	4.48	9.4
Poland	3	3.762	3.167	3.537	7.667
Portugal	5	3.829	3.267	4.16	7.4

Table 2
Mean scores and standard deviations of the 18 items from the three IMI Subscales [23, 24]

IMI Subscale	Means (n=13)	SD
Interest/Enjoyment	4.165	0.816
Perceived Competence	3.526	0.751
Effort/Importance	4.169	1.01

Open-ended responses were analyzed using a qualitative content analysis approach. Iterative review identified recurring themes related to module usefulness, duration, usability, and suggestions for improvement. Given the exploratory nature and small sample size, the analysis focused on a descriptive thematic summary, using representative excerpts to highlight key themes and module preferences. Overall, Module 2 (Choregraphe programming) was rated as the most engaging and enjoyable, primarily due to its practical, hands-on approach. One participant highlighted a preference for "[w]orking with Choregraphe to program the NAO Robot", while others similarly identified the whole Module 2 as the part they liked the most (n=6). In addition, participants frequently reported "Programming the NAO Robot and working with Choregraphe" as one of the most important competencies gained (n=9) and as the most valuable part of the program (n=5).

Module 1 (Introduction to Robots in Education) was also positively received and recognized as the least time-demanding. One participant highlighted "getting to know the possibilities and usage of humanoid robots" as the most valuable part of the module.

In contrast, Module 3 (Designing Teaching Scenarios) was perceived as the most challenging and time-consuming, largely because of its extensive reading requirements. One participant noted that "Some parts of the teaching course are very exhausting and time consuming to complete", while others simply named Module 3 as the most time consuming module (n=10). However, Module 3 was also recognized as highly valuable by a few participants. Specifically, it was praised for "[t]he most important elements of a teaching scenario and recognizing these elements in examples" and for fostering exchange, such as "[e]xchanging ideas, problems with other teachers who participated in the course and sharing teaching scenarios".

When asked to identify the least valuable part of the training, some participants (n=5) referred to Module 3, citing “a lot of theory/reading, some very extensive texts” as the main reason. However, several respondents stated that there were no least valuable parts (n=3), noting that “[e]verything was valuable”. One participant explicitly stated that the basic information on teaching scenarios was of least value to them, as they were already familiar with it. Beyond technical skills, one participant also emphasized a “bigger development of ecological awareness and critical thinking” as a key outcome of the course. Overall, the results point to high motivation and commitment among the participating teachers, moderate perceived competence gains, and a clear preference for interactive, practice-oriented learning experiences.

At the time of the survey, most respondents (10 out of 13) had not yet applied the acquired knowledge in their classrooms. This outcome is likely due to the short time interval of approximately three weeks between course completion and the administration of the questionnaire, which limited opportunities for practical implementation. One participant critically reflected that “the interaction of the NAO Robot is not that great with the students”, underscoring the need for further evaluation of classroom applicability. In contrast, other participants reported initial implementation efforts, such as using the acquired knowledge “for creation of a teaching scenario on sustainable development for students with intellectual disabilities,” while another noted, “I haven't for now because classes are over, but I will.”

The Net Promoter Score (NPS) was used to assess participants’ overall satisfaction and likelihood of recommending the training program. NPS is calculated by subtracting the percentage of detractors (ratings 0–6) from the percentage of promoters (ratings 9–10), excluding passive responses (ratings 7–8), resulting in a score between −100 and +100. In this study, one participant was classified as a detractor, seven were passive and five were promoters, yielding NPS=30.8/100. This score indicates that promoters outnumbered detractors, suggesting that participants are more likely to recommend the program than to criticize it. According to benchmarks in higher or medical education, an NPS around 30 is considered a solid positive outcome, reflecting clear overall satisfaction and perceived value of the training, though it does not yet indicate a high level of advocacy [26, 27, 28]. This outcome is particularly encouraging, as the evaluation was a first pilot project and involved teachers working with an unfamiliar technology, namely a social robot.

5. Discussion

The preliminary findings of this study indicate that the “My Robot, My LearnMate” training program has the potential to successfully engage teachers in learning about and applying humanoid robots in educational contexts. Participants reported high motivation and enjoyment, particularly with the hands-on modules, suggesting that the program effectively fosters active learning and practical competence development. These findings resonate with prior research emphasizing that well-designed ER training can positively influence teachers’ self-efficacy and engagement to apply ER concepts through guided and metacognitive practice [29–32].

As indicated by the qualitative analysis, future iterations of ER training programs should continue to prioritize practical, interactive, and adaptive learning formats. In addition, individual participant remarks regarding the limited added value of basic content on teaching scenarios, together with repeated references to the time-consuming nature of Module 3, point to the potential benefits of a more individualized training structure that takes into account teachers’ diverse professional backgrounds, time availability, and learning preferences.

Additionally, feedback on the more reading-intensive module suggests a need to reduce the theoretical workload and instead deliver essential concepts through applied, example-driven activities. Interactive components such as peer collaboration, guided projects, or real-time demonstrations appear to be crucial for sustaining motivation and ensuring meaningful learning outcomes. This approach mirrors findings from other ER programs highlighting the benefits of collaboration and active participation in teacher training [33]. These aspects may also contribute to increasing the NPS, as the current results, when compared to benchmarks for highly engaging educational programs, suggest potential for improvement, particularly in converting passive participants into more enthusiastic advocates of the course.

While the results provide valuable insights, several limitations must be acknowledged. This study represents an initial evaluation with a small sample (n=13), which restricts the generalizability of the findings. Additionally, because only a few participants had yet implemented the acquired skills in their classrooms, the evaluation does not capture the full extent of real-world application. Consequently, it remains difficult to assess the program's long-term effectiveness or the sustained impact of the training. Future research should therefore adopt a mixed-methods design that combines quantitative and qualitative data, including longitudinal analyses to examine knowledge retention, classroom integration, and potential impacts on student learning outcomes. In particular, qualitative data from interviews and observations could shed light on teachers' decision-making processes, contextual constraints (e.g., time, curriculum alignment, technical support), and changes in perceived competence and confidence over time. Classroom observations could further reveal how students interact with the NAO robot, how teachers facilitate robot-supported activities, and which pedagogical challenges emerge during real implementation, as well as how these interactions influence engagement and learning.

Extending the course to additional languages could further enhance accessibility and intercultural exchange. Moreover, documenting success stories of teachers who have effectively integrated NAO into their classrooms could inspire new participants and illustrate the specific benefits of the program in practice. Establishing a collaborative teacher network, as suggested by previous ER research [33], may further support sustained engagement and mutual learning beyond the training course itself.

The authors are currently conducting a second evaluation phase aimed at collecting additional teacher feedback. To enhance the robustness of the evaluation, this phase will incorporate adapted measures from established instruments such as the System Usability Scale (SUS) [34], or the Online Student Experience (OSE) survey [35]. The second study phase will provide deeper insights into classroom implementation, module-specific effectiveness, and areas for improvement.

6. Conclusion

The preliminary evaluation of the "My Robot, My LearnMate" training program demonstrates that a structured, multilingual online platform can successfully introduce teachers to the pedagogical and practical aspects of educational robots. Teachers reported high levels of motivation and engagement, particularly in the practical module focused on NAO programming. These results confirm that interactive, experiential learning fosters participants' confidence and readiness to integrate robots into classroom practice.

Nevertheless, this initial study also revealed areas that require further development. Increasing interactivity, balancing theoretical and practical content, and diversifying learning formats may further enhance teacher satisfaction. Moreover, since only a small number of participants had the opportunity to apply their learning in classrooms, future research should include follow-up assessments to evaluate long-term outcomes and real-world transfer of skills.

In conclusion, the "My Robot, My LearnMate" program represents a promising approach toward integrating humanoid robots like NAO into school education. By continuing to refine the training content based on participant feedback, expanding linguistic and cultural accessibility, and assessing the longitudinal effects on teaching and learning, this program has the potential to become a sustainable model for teacher training in educational robotics.

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Declaration on Generative AI

During the preparation of this work, the authors used DeepL and Chat-GPT-4 in order to: Grammar and spelling check. After using these tools, the authors reviewed and edited the content as needed and are taking full responsibility for the publication's content.

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