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ASSESSMENT OF CHILDHOOD EDUCATORS' KNOWLEDGE AND READINESS TO UTILIZE EDUCATIONAL ROBOTICS FOR CLASSROOM INSTRUCTION IN ILORIN METROPOLIS, KWARA STATE, NIGERIA

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Abstract

The study determined the extent to which childhood educators have the knowledge and the readiness to utilize robotics for classroom instruction in Ilorin metropolis. The design employed for this study was a descriptive survey research design. The population of the study consisted of all primary school teachers in Ilorin metropolis, while the target population was basic (1-5) public and private and primary school teachers in Ilorin metropolis. A sample size of 240 teachers was selected from the target population using a Simple random sampling technique. A researcher self-designed instrument titled "Robotic Education Teachers Test and Questionnaire on Teachers Readiness 1o utilize robotics" was used for data collection. Which was face and content validated, and the reliability index was 0.67. The demographic characteristics of respondents were described using descriptive statistical Tools of percentage and frequency, while mean and standard deviation was used to answer the research questions. The inferential statistical tool of ANOVA was used to test the formulated hypothesis at 0.05 level of significance. The findings indicated that teachers have low knowledge but are moderately ready to utilize educational robotic irrespective of their qualification and School type. Recommendation was made for the government to encourage local universities, technology hubs and professional to support the integration of robotics in primary schools.

Introduction

Advancements in technological across various parts of the world over the years and in recent times has prompted and facilitated the incorporation of technology into education. This integration is anticipated to foster direct engagement, exploration, and experiential learning to enhance cognitive development as well as basic social skills. Activities serve as a significant factor in acquiring and retaining knowledge. These activities involve learning through hands-on methods, utilizing objects

that can lead to more robust, deeper comprehension and enduring memories. Since the initial application of LEGO in education, the utilization of robotics as a technological tool has gained prominence. Robotics supports learning by emphasizing construction and design, motivating students to engage in challenges and solving problems. Robotics-based learning typically includes activities such as designing, assembling, and programming robots. Most educational robots, like LEGO components, are equipped with various control units, sensors, motors, and visual programming systems. The incorporation of robotics into learning activities alters the roles of teachers and students.

Traditionally, teachers convey knowledge through lectures to passive learners. However, robotics provides students with a more active role, with teachers acting as facilitators. In primary education, robotics is often limited to supplementary activities, such as summer camp training. In several countries, robotics has started to be embedded into school curricula (Alimisis, 2019). In contemporary education, grasping the complex interplay of multiple factors is essential for embedding robotics into classroom practices. This research examines how teachers' expertise and competence in robotics influence their teaching methods and students' academic outcomes. It investigates the dynamic connection between educators' knowledge and the effective implementation of robotics, emphasizing the roles of institutional backing, curriculum alignment, and professional development programs. By studying these interrelated variables, the research seeks to identify pathways for effectively incorporating robotics into education, thereby offering insights to refine teaching methods and shape educational policies.

Robotics is a multidisciplinary field that encompasses the creation, construction, operation, and application of robots. These machines are programmable to autonomously or semi-autonomously execute a sequence of tasks (Siciliano & Khatib, 2016). Educational robotics integrates a diverse range of technologies and applications, such as artificial intelligence (Al), machine learning, sensor systems, and human-robot interaction. Al and machine learning algorithms allow robots to adapt to their surroundings and enhance their functions over time, while sensors enable them to detect and respond to external stimuli. Human-robot interaction focuses on crafting user-friendly interfaces that promote smooth collaboration between humans and robots. These innovations aim to improve efficiency, precision, and functionality across multiple fields, highlighting the transformative capabilities of robotics today (Thrun, Burgard, & Fox, 2005). In education, robotics offers experiential learning in STEM (science, technology, engineering, and mathematics), fostering critical thinking, problem-solving, and creativity among students (Eguchi, 2014).

Teachers' understanding of robotics in classroom instruction refers to the knowledge and abilities educators possess regarding the use of robotic tools in education. This encompasses various competencies, such as familiarity with the hardware and software of robots, effective integration into the curriculum, and teaching strategies that support hands-on, interactive student learning experiences (Jaipal-Jamani & Angeli, 2017). Teachers' application of robotics for classroom instruction involves the practical incorporation of robotic technologies into teaching practices to enhance student learning. This includes several core aspects: planning and executing robotics-based lessons, promoting student involvement in robotics activities, and using robotics to fulfill educational objectives across different subjects (Alsoliman,2018). As teachers may implement robotics in lessons to illustrate scientific concepts, such as physics or engineering principles, by guiding students to build and program robots to accomplish specific tasks (Bers, 2008).

Tang et al (2020) explored university teachers' perceived opportunities and challenges associated with using educational robotics (ER) in management education across three interconnected dimensions: curriculum, pedagogy, and technological domains, using narrative analysis. Their findings highlight ER's potential to cultivate subject-specific knowledge, technical skills, and transferable abilities among management students. This research enhances ongoing conceptual discussions about teachers' perceptions as determinants of technology adoption and ER's role in engaging students through Vygotskian social constructivism. Practically, the study provides insights into the possibilities and limitations of integrating ER into management in education.

Seckel et al (2021) argued that understanding the perceptions of primary school teachers regarding robotics use in classrooms is a critical first step toward its adoption. To explore this, a study employing mixed methods through a descriptive survey was conducted. The survey combined closed-ended (Likert-scale) and open-ended questions and involved 83 primary school teachers in two Chilean districts teaching students in grades one through four. Results indicated a generally positive attitude toward incorporating robotics into the teaching of mathematical concepts, though challenges such as large class sizes and limited classroom space hindered implementation. Negrini (2020) observed that teachers' attitudes toward educational robotics significantly influence adoption in schools. A study of 174 teachers analyzed their attitudes, considering factors such as region, gender, age, educational level, and subject areas. Findings revealed an interest in robotics, with educators recognizing its potential for fostering transversal skills. However, barriers to implementation included the cost of equipment, preparation time for activities, and reluctance to introduce more technology into classrooms due to its ubiquity in daily life.

In the rapidly evolving landscape of education, the integration of technology, particularly robotics, has become increasingly important for enhancing student learning and preparing them for future challenges. However, the effective adoption and utilization of robotics in classroom instruction are contingent upon several factors, including teachers' knowledge, skills, and attitudes toward Educational Robotics in Ilorin metropolis, Kwara State, there is a growing recognition of the potential benefits that robotics can bring to education, yet the extent to which teachers are equipped and willing to integrate robotics into their teaching practices remains unclear.

Empirical findings indicate that teachers' competence in robotics greatly influences their capacity to integrate Educational Robotics effectively into the classroom. For instance, a study by Eguchi (2014) demonstrated that teachers with higher levels of knowledge and confidence in robotics were more inclined to execute robotics-based activities that encourage active learning and student participation. Similarly, Bers (2008) highlighted the significance of teacher training in robotics to ensure its successful incorporation into early childhood education, noting that without sufficient knowledge and skills, teachers may find it challenging to apply these technologies to their full potential.

Despite the growing availability of robotic kits and resources in countries like Finland, many teachers may lack the requisite knowledge and skills to efficiently employ these tools in their classrooms. A survey by Mataric, Koenig, and Feil-Seifer (2007) revealed that one of the main obstacles to the integration of robotics in education was the inadequate training and support provided to teachers. This deficiency in expertise can lead to underuse of available technology,

restricting students' chances to participate in practical, interactive learning experiences that develop critical thinking, problem-solving, and creativity. Additionally, institutional support, including professional development and curriculum alignment, plays a key role in enabling teachers to embrace and maintain the use of robotics in education. Research by Hsu, Lin, and Yang (2017) revealed that teachers who engaged in continuous professional development and were part of a supportive learning community were more likely to incorporate robotics effectively into their teaching practices. This highlights the necessity for comprehensive support systems to assist teachers in addressing the challenges linked to robotics integration.

Therefore, this study seeks to investigate the teachers' knowledge and utilization of robotics for classroom instruction in Ilorin metropolis. It aims to identify the specific challenges and barriers that teachers face in integrating robotics into their teaching, as well as the factors that facilitate successful implementation. By understanding these dynamics, the research will provide insights into how educational stakeholders can better support teachers in harnessing the educational potential of robotics, ultimately enhancing the quality of education in Kwara State. The main purpose of this study is to investigate teachers' knowledge and readiness to utilize robotics for classroom instruction in Ilorin metropolis, Kwara State. Also, it examined the difference in the teachers' knowledge and readiness to utilize educational robotics for classroom instruction in Ilorin metropolis based on qualification and school type.

Research Purpose

The study assessed childhood educators' knowledge and readiness to utilize educational robotics for classroom instruction in Ilorin Metropolis, Kwara State, Nigeria. Specifically, the study examined:

1. the level of primary school teachers' knowledge of educational robotics for classroom instruction in Ilorin metropolis?
2. the level of primary school teachers' readiness to utilize educational robotics for classroom instruction in Ilorin metropolis?

Research Questions

The following questions were answered in this study:

1. What is the level of primary school teachers' knowledge of educational robotics for classroom instruction in Ilorin metropolis?
2. What is the level of primary school teachers' readiness to utilize educational robotics for classroom instruction in Ilorin metropolis?

Hypotheses

The following hypotheses was tested in this study:

Ho_1: There is no significant difference in the primary school teachers' knowledge of educational robotics for classroom instruction in Ilorin metropolis based on qualification and school type.

Ho_2: There is no significance difference in the primary school teachers' readiness to utilize educational robotics for classroom instruction in Ilorin metropolis based on qualification and school type.

Methodology

The research design that was employed for this study is a descriptive research design survey. This type of research allows for a variety of methods to recruit participants, collect data, and utilize various methods of instrumentation. Descriptive research involves the use of techniques such as questionnaires, observation and interview. This research design is therefore deemed relevant and applicable, since it assisted in assessing teachers' knowledge and utilization of robotics for classroom instruction in Ilorin metropolis, Kwara State. The population of the study consisted of All 3,465 primary school Teachers in Ilorin metropolis, while the target population will be basic one-five (1-5) schoolteachers in Ilorin metropolis. A sample size will be selected using simple random sampling technique as there are three local governments area in Ilorin metropolis, a total of sixteen schools will be selected from each local government (Eight public primary schools and eight private primary schools) and a total of five teachers was selected in each of the schools to make a total of 240 respondents. The instrument employed to collect data for the study has three parts. Section A gathered demographic information of the respondents, Section (B) collected on the teachers' knowledge of robotics for classroom instruction, while Section (C) elicited information on teachers' level of readiness to utilize robotics for classroom instruction. Section B was constructed with the following values as it consists of 10 items (two marks for each): (0-5) =1, (6-10) =2, (11-15) =3 while (15-20) = 4. Section C on the other hand, was constructed in a four-likert scale format with the following values: Very True = 4, True = 3, Not True = 2 and Not Very true = 1. Face and content validity of the instrument was ascertained by experts in educational research and the reliability of 0.67 was obtained using Pearson Product Moment Correlation (PPMC). Descriptive statistical tools of percentage and frequency was used to describe the demographic characteristics of the respondents, while research questions 1 and 2 was answered using mean and rank order. The inferential statistical tool of two-way Analysis of Variance (ANOVA) was used to test the formulated hypotheses at 0.05 level of significance. This implies that, if the calculated P-value is less than 0.05 the null hypothesis would be rejected, but if otherwise, it will be retained.

Results

The data collected were analyzed using Statistical Package for Social Sciences (SPSS 23.0). Descriptive statistics of percentage was used in analyzing the data contained and answering the research questions raised while Analysis of Variance was used to test the research hypotheses formulated respectively at 0.05 level of significance. The results of the findings are shown below;

Research Question One: What is the level of primary school teachers' knowledge of robotics for classroom instruction in Ilorin Metropolis?

In order to answer this research question, the data collected from the respondents on the items relating to level of teachers' knowledge on robotics for classroom instruction in Ilorin metropolis were analyzed using descriptive statistics. The total responses of the respondents which were in continuous data were summed up and converted to categorical data, thereby having a total minimum point of zero (0) and maximum points of ten (10). Hence, the range is 10 points. This was categorized into three levels. The points between 0 to 3 is Low, 4 to 7 is Moderate, and 8 to 10 high. Therefore, the summary of result on the level of teachers' knowledge of robotics for classroom instruction in Ilorin, Nigeria is presented in the table below.

Table 1
Summary of Descriptive statistics on level of primary school teachers' knowledge of educational robotics in Ilorin metropolis

	Frequency	Percent	Valid Percent	Remark
Low	122	50.8	50.8	***
Moderate	117	48.8	48.8	
High	1	.4	.4	
Total	240	100.0	100.0	

The above table revealed that most of the teachers 122 (50.8%) had a low level of knowledge on of robotics for classroom instruction, 117 (48.8%) of the respondents showed a moderate level of knowledge on of robotics for classroom instruction, while 1(0.4%) of the respondents had a high level of knowledge on of robotics for classroom instruction. This indicates that primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis is low.

Research Question Two: What is the level of primary school teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis?
In order to answer this research question, the data collected from the respondents on the items related to primary school teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis were analyzed using descriptive statistics. The result of the analysis is presented in the table below.

Table 2
Summary of Descriptive statistics on level of primary school teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis

	Frequency	Percent	Valid Percent	Remark
Low	24	10.0	10.0	
Moderate	173	72.1	72.1	***
High	43	17.9	17.9	
Total	240	100.0	100.0	

The above table revealed that most of the teachers 173 (72.1%) had moderate level of readiness to utilize robotics for classroom instruction, 43 (17.9%) of the respondents showed high readiness to utilize robotics for classroom instruction, while 24 (10%) of the respondents had low readiness to utilize robotics for classroom instruction. This revealed that the majority 173 (72.1%) of the primary teachers had a moderate level of readiness to utilize robotics for classroom instruction in Ilorin.

Hypotheses Testing
In testing the research hypotheses formulated to guide this study, the data collected were statistically analyzed using Analysis of variance statistical method for the hypotheses formulated.

H_{01}: There is no significant difference in the primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis based on qualification and school type

In order to test this research hypothesis, the response to all the items were summed together and the data collected were subjected to Analysis of Variance statistics. The result of the analysis is presented in the table below.

Table 3

Summary of ANOVA statistics on teachers' knowledge of robotic for classroom instruction based on qualification and school type

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Remark
Corrected Model	69.08	10	6.91	2.75	.003	
Intercept	429.67	1	429.67	171.07	.000	
Qualification	32.19	5	6.44	2.57	.028	Significant
School type	.147	1	.15	.059	.809	Not Significant
Qualification * School type	27.30	4	6.83	2.717	.031	Significant
Error	572.67	228	2.51			
Total	3573.00	239				
Corrected Total	641.75	238				

a. R Squared = .108 (Adjusted R Squared = .069)

The result of analysis shown on the table above revealed that the F-value of 2.57 showing significant difference in the primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis based on qualification is significant at 0.05 alpha level ($p < 0.05$). Hence, the primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis depends on qualification of the teachers. Contrarily, from the above, it was shown that the F-value of 0.059 indicating significant difference in the primary school teachers' knowledge of robotics for classroom instruction based on school type is not significant at 0.05 alpha level ($p > 0.05$). This mean that the primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis does not depend on school type. Also, from the above table the F-value of 2.717 indicating significant difference in the primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis based on qualification and school type is significant at 0.05 alpha level ($p < 0.05$). Hence, the above stated null hypothesis is not retained. This mean that there is significant difference in the primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis based on qualification and school type.

H_{02}: There is no significant difference in primary school teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis based on qualification and school type.

In order to test this research hypothesis, the response to all the items were summed together and the data collected were subjected to Analysis of Variance statistics. The result of the analysis is presented in the table below

Table 4

Summary of ANOVA statistics on teachers' readiness to utilize robotics for classroom instruction based on qualification and school type

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Remark
Corrected Model	304.72	10	30.47	1.32	.221	
Intercept	29283.49	1	29283.49	1.27	.000	
Qualification	198.32	5	39.66	1.72	.132	Not significant
School type	22.43	1	22.43	.97	.326	Not significant
Qualification * School type	86.52	4	21.61	.936	.444	Not significant
Error	5268.33	228	23.17			
Total	171640.00	239				
Corrected Total	5573.45	238				

a. R Squared = .055 (Adjusted R Squared = .013)

The result of analysis shown on the table above revealed that the F-value of 1.72 showing no significant difference in the primary school teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis based on qualification is significant at 0.05 alpha level ($p > 0.05$). Hence, the primary school teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis does not depends on qualification of the teachers. Also, in line with the above, it was shown that the F-value of 0.97 indicating the difference in the primary school teachers' readiness to utilize robotics for classroom instruction based on school type is not significant at 0.05 alpha level ($p > 0.05$). This mean that the primary teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis does not depend on school type. Also, from the above table the F-value of 0.444 indicating significant difference in the primary teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis based on qualification and school type is significant at 0.05 alpha level ($p < 0.05$). Hence, the above stated null hypothesis is not retained. This mean that there is significant difference in the primary school teachers' readiness to utilize robotics for classroom instruction in Ilorin metropolis based on qualification and school type.

Discussion of the Findings

The researcher discovered through the findings that there was low level of knowledge of primary school teachers on the use of robotics for classroom instruction in Ilorin, Nigeria. It shows that primary school teachers does not know much about the use of robotics for classroom instruction which is agreement with Fabiyi, et al (2016) which asserted that most teachers lack knowledge and competence in the use of educational robotics in STEM education in schools, which might be as a result of the robotic education not been incorporated in the teachers in training course content

during their program me and also practicing teachers not been exposed to robotic teaching aid/ equipment and also in line with Eguchi (2014) who said teachers need to understand that technical aspect of robotics, such as how robots are built, programmed and operated. This includes knowledge of various robotics platforms and kits commonly used in educational settings, such as LEGO Mindstorms or VEX robotics. The researcher also discovered that primary school teachers in Ilorin were moderately ready to utilize robotics for classroom instruction in Ilorin metropolis which is a very good approach and this shows they are ready to accept and adapt to any robotic facility been incorporated to the educational sector or in schools which is also in agreement with Negrinni (2020) who investigated teachers attitude towards educational robotics in compulsory schools , In their study they asserted that Teachers are generally interested and ready to use robotics in classroom.

Furthermore the findings also revealed that the primary school teachers' knowledge of robotics for classroom instruction in Ilorin metropolis depends on their qualification in Ilorin , which connotes that some categories of qualification (M.Ed) are well familiar and have knowledge on the use of robots for classroom instruction, which might be as a result of robotics not been incorporated in the basic teachers training colleges like NCE and B.Ed/B.Sc and also The government need to provide facilities to enhance the teaching of robotics in Tertiary Teachers institution which is in line with (Tsoy et al, 2017) whose study deduced that masters students tends to perform better in educational robotics than people with bachelor's degree. The findings also showed that there was no significant difference in the readiness of primary teachers in Ilorin to utilize robotics for classroom instruction based on qualification and schools, This connotes that primary teachers of qualifications and of all school types in Ilorin are moderately ready to utilize robotics for classroom instructions and just to be provided with necessary knowledge and adequate facilities to learn and teach with the use of robotics which is in line with Negrini (2020) whose study results shows that teachers are interested in educational robotics .

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Conclusion

Based on the findings of this study, it has been established that primary school teachers in Ilorin metropolis are not so knowledgeable about educational robotics. However, their readiness to utilize robotics in the classroom is appreciable. This connotes that if they are provided with an opportunity to acquire knowledge about robotics for classroom instruction as well as robotic tools and facilities, majority of the teachers were ready to equip themselves and integrate robotics in their classroom instructions.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Government should make sure Teachers are provided adequate training on how to use educational robots and integrate them into their respective field and lessons especially in area of Adequate lesson planning, Time and Classroom management.
2. Ensure schools organize refresher courses and have the necessary and adequate Space and necessity such as electricity and access to internet to fully support and encourage the use of educational robots.
3. The government should encourage engaging local universities, technology hubs and professionals to support the integration of robotics in primary schools.

4. The ministry of education should conduct awareness campaign to educate parents. Educators and policymakers about the benefits of educational robots.

References

Alimisis D. (2019). Educational robotics: open questions and new challenges. *Themes in Science and Technology Education*, 6(1):63–71.

Bers, P. (2008). Design and impact of a teacher training course, and attitude change concerning educational robotics. *International Journal of Social Robotics, 10:669–685. https://doi.org/10.1007/s12369-018-0475-6*

Eguchi, A. (2014). Educational Robotics for Promoting 21st Century Skills. *Journal of Automation, Mobile Robotics & Intelligent Systems*, *8*(1), 5–11. https://doi.org/10.14313/jamris_1-2014/1

Fabiyi, S. D., Abdulmalik, A. O. & Tiamiu, H. A. (2016). Introducing robotics into the nigerian secondary schools' curriculum: likely impacts, challenges and possible solutions. *International Journal of Engineering Research and General Science.* 4(4).6-10. Retrieved from https://pnrsolution.org/Datacenter/Vol4/Issue4/1.pdf

Hu, C.-C., Yeh, H.-C., & Chen, N.-S. (2022). Teacher development in robot and IoT knowledge, skills, and attitudes with the use of the TPACK-based Support-Stimulate-Seek approach. *Interactive Learning Environments*, 31(9),1–20. https://doi.org/10.1080/10494820.2021.2019058

Mataric, P. (2004). Digital fabrication and 'making' in education: the democratization of invention. In J WalterHerrmann & C Büching (eds). FabLabs of machines, makers, and inventors (pp.203–221). Bielefeld: Transcript Publishers. https://doi.org/10.14361/transcript.9783839423820.203

Mataric, P., Koenig, B. & Feil-Seifer, F. (2007). Female students' achievement using Edmodo in the eleventh -grade economic geography curriculum in Oman, *Journal of Technology and Information Education,* 11(1): 38–46. *https://doi.org/10.5507/jtie.2019.003*

Negrini, L. (2020). Teachers' attitudes towards educational robotics in compulsory school. *Italian Journal of Educational Technology*, *28*(1), 77–90. https://doi.org/10.17471/2499-4324/1136

Papadakis, S., Vaiopoulou, J., Sifaki, E., Stamovlasis, D., & Kalogiannakis, M. (2021). Attitudes towards the Use of Educational Robotics: Exploring Pre-Service and In-Service Early Childhood Teacher Profiles. *Education Sciences*, *11*(5), 204. https://doi.org/10.3390/educsci11050204

Seckel, M. J., Breda, A., Font, V., & Vásquez, C. (2021). Primary School Teachers' Conceptions about the Use of Robotics in Mathematics. *Mathematics*, *9*(24), 3186. https://doi.org/10.3390/math9243186

Sherwani, F., Asad, M. M. and Ibrahim, B. S. K. K. (2020). Collaborative Robots and Industrial Revolution 4.0 (IR 4.0). 2020 International Conference on Emerging Trends in Smart Technologies (ICETST), Karachi, Pakistan pp. 1-5, doi: 10.1109/ICETST49965.2020.9080724.

Siciliano & Khatib, (2016). *Springer handbook of robotics*. 2nd Edition. Retrieved from http://handbookofrobotics.org/

Tang, A. L. L., Tung, V. W. S., & Cheng, T. O. (2020). Teachers' perceptions of the potential use of educational robotics in management education. *Interactive Learning Environments*, 31(1), 1–12. https://doi.org/10.1080/10494820.2020.1780269

Thrun, S., Burgard, W., & Fox, D. (2002). Probabilistic robotics. *Communications of the ACM*, 45(3). https://doi.org/10.1145/504729.504754

Tsoy, T., Sabirova, L. & Magid, E. (2017). Towards effective interactive teaching and learning strategies in robotics education. *10th International Conference on Developments in eSystems Engineering (DeSE)*, Paris, France, pp. 267-272, doi: 10.1109/DeSE.2017.38.