PIXEL BIT

Nº 60 ENERO 2021
CUATRIMESTRAL

e-ISSN:2171-7966
ISSN:1133-8482

Revista de Medios y Educación

PIXEL BIT

PIXEL-BIT

REVISTA DE MEDIOS Y EDUCACIÓN

Nº 60 - ENERO - 2021

https://revistapixelbit.com

Pixel-Bit. Revista de Medios y Educación. 2021 - ISSN: 1133-8482. e-ISSN: 2171-7966.

EDITORIAL
UNIVERSIDAD DE SEVILLA

PIXEL-BIT
REVISTA DE MEDIOS Y EDUCACIÓN
ENERO 2021

Nº 60

EQUIPO EDITORIAL (EDITORIAL BOARD)

CONSEJO DE REDACCIÓN

Pixel-Bit. Revista de Medios y Educación. 2021 - ISSN: 1133-8482. e-ISSN: 2171-7966.

Pixel-Bit. Revista de Medios y Educación. 2021 - ISSN: 1133-8482. e-ISSN: 2171-7966.

FACTOR DE IMPACTO (IMPACT FACTOR)

SCOPUS (CiteScore Tracker 2020: 1,8)- FECYT: Ciencias de la Educación. Cuartil 1. Posición 16. Puntuación: 39,80- DIALNET MÉTRICAS (Factor impacto 2019: 1,336. Q1 Educación. Posición 12 de 226) ERIH PLUS - Clasificación CIRC: B- Categoría ANEP: B - CARHUS (+2018): B - MIAR (ICDS 2019): 9,9 - Google Scholar (global): h5: 23; Mediana: 44 - Criterios ANECA: 20 de 21

Píxel-Bit, Revista de Medios y Educación está indexada entre otras bases en: SCOPUS, Fecyt, Iresie, ISOC (CSIC/CINDOC), DICE, MIAR, IN-RECS, RESH, Ulrich's Periodicals, Catálogo Latindex, Biné-EDUSOL, Dialnet, Redinet, OEI, DOCE, Scribd, Redalyc, Red Iberoamericana de Revistas de Comunicación y Cultura, Gage Cengage Learning, Centro de Documentación del Observatorio de la Infancia en Andalucía. Además de estar presente en portales especializados, Buscadores Científicos y Catálogos de Bibliotecas de reconocido prestigio, y pendiente de evaluación en otras bases de datos.

EDITA (PUBLISHED BY)

Grupo de Investigación Didáctica (HUM-390). Universidad de Sevilla (España). Facultad de Ciencias de la Educación. Departamento de Didáctica y Organización Educativa. C/ Pirotecnia s/n, 41013 Sevilla.
Dirección de correo electrónico: revistapixelbit@us.es . URL: https://revistapixelbit.com/
ISSN: 1133-8482; e-ISSN: 2171-7966; Depósito Legal: SE-1725-02
Formato de la revista: 16,5 x 23,0 cm

PIXEL-BIT
REVISTA DE MEDIOS Y EDUCACIÓN

Nº 60
ENERO 2021

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Pixel-Bit. Revista de Medios y Educación. 2021 - ISSN: 1133-8482. e-ISSN: 2171-7966.

PIXEL-BIT
e-ISSN: 2171-7966
REVISTA DE MEDIOS Y EDUCACIÓN
MEDIA & EDUCATION JOURNAL

Design and validation of an instrument for the taxonomy of floor robots in Early Childhood Education

Diseño y validación de un instrumento para la taxonomía de los robots de suelo en Educación Infantil

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Recibido: 2020/03/19; **Revisado:** 2020/04/29; **Aceptado:** 2020/07/03; **Preprint:** 2020/10/23; **Publicado:** 2021/01/01

ABSTRACT
Educational robotics is increasingly present in our educational system. And the stage of Early Childhood Education in particular is no stranger to it. Increasingly, teachers are turning to easy-to-use, low-cost resources such as floor robots to introduce robotics to the classroom. In order to carry out a planned and coherent implementation, it is necessary to analyze and reasonably choose the resource that best suits the educational needs of the students. With the intention of providing an instrument that allows this, a FAREI file was designed and validated by 50 experts in educational robotics, the result of this research, which allows each individual to enter the world of floor robotics and its educational potential in the development of skills and competences of Early Childhood students. With the contributions of the experts, it was possible to cover all the possibilities that this world of robotics can offer to education and put them at the service of the teachers who are going to make a planned use of it.

RESUMEN
La robótica educativa cada vez se encuentra más presente en nuestro sistema educativo. Y la etapa de Educación Infantil en particular no es ajena a ello. Cada vez más, el profesorado recurre a recursos de fácil uso y bajo coste como los robots de suelo, para introducir la robótica en las aulas. Para realizar una implementación planificada y coherente, se hace necesario analizar y escoger razonadamente aquel recurso que mejor se adapte a las necesidades educativas del alumnado. Con la intención de dotar de un instrumento que permitiese esto, se diseñó y validó por 50 expertos en robótica educativa, una ficha, FAREI, resultado de esta investigación, que permite para cada particularidad adentrarse en el mundo de la robótica de suelo y sus potencialidades educativas en el desarrollo de habilidades y competencias del alumnado de Educación Infantil. Con las aportaciones de los expertos se consiguió abarcar todas las posibilidades que este mundo de la robótica puede ofrecer a la educación y ponerlas al servicio del profesorado que vaya a hacer un uso planificado de la misma.

KEYWORDS · PALABRAS CLAVES
Educational Robotics; Early Childhood Education; Floor Robots; Taxonomy; Computational Thinking.
Robótica educativa; Educación Infantil; Robots de suelo; Taxonomía; Pensamiento Computacional.

1. Introduction

The use of educational robotics is a practice that, far from being a fashion, seems to be consolidating its position. At present, besides being included in some curricula and considered by several educational administrations, also in many classrooms and by teachers interested in this topic, robotics is starting to be implemented in daily classes. Actually, in Spain there are many regions which include it in their curricula in specific educational stages. Therefore, instead of being just a simple extracurricular activity, in government-regulated education, educational robotics is beginning to be regarded as an educational resource which provides students with many benefits in their learning process. It has been widely proven that robotics, programming, and computational thinking improve the development of analytical skills, initiative, and knowing how to face problems, all of which promote creativity and cooperative work among students, and definitely produce an improvement in their learning (Di Lieto, Inguaggiato, Castro, Cecchi, Cioni, Dell'Omo, Laschi, Pecini, Santerini, Sgandurra & Dario, 2017; Eguchi, 2016; Ioannou & Makridou, 2018; Vavassori, 2012). Either using it a specific way (Sullivan & Bers, 2016) or in a multidisciplinary one (Elkin, Sullivan & Bers, 2016; Jung & Won, 2018), robotics improves and motivates students' learning, and also allows the development of basic competences which cover much more than digital competence, since they promote socialisation, creativity, initiative, learning to learn, and so on.

In Spain, robotics has smoothly arrived at Primary and Secondary Education and, in contrast, it is becoming more difficult in Early Childhood Education. So far, its implementation in Early Childhood Education has been below the levels it has reached in the other two stages of compulsory education, although it has been proven that it benefits the students' learning and the development of their computational thinking. (García-Valcárcel & Caballero-González, 2019). In the last few years, and due to the proliferation of a great number of resources which are economical and easy to implement, i.e. robots, educational robotics is being increasingly implemented in Early Childhood Education. There are many Early Childhood Education centres, and teachers in particular, supplying their classrooms with some nice devices which grant their students fun, motivation, and learning moments at a small expense, as it is now easier to find cheaper and more versatile models. However, when facing this situation, we must alert the educational community about some dangers and contradictions that this unplanned or natural implementation of robotics implies. Educational robotics reaches beyond the use of robots, as teachers can and must organise other types of activities which usually do not need material resources and do not imply additional expenses. We can work coding, logical thinking, anticipation and initiative, with such a simple activity as one in which a student simulates being a robot which obeys orders from another student (Recio, 2019). It is true that robots have certain appeal and visibility which makes them more motivational, but if we make a uncoherent and unplanned use of them, it may result in something merely superficial, something just amusing, like a game. (Pei & Nie, 2018). It may even cause counter-productive attitudes as, once the movement dynamic of a floor robot is understood, it may tire the students and create negative attitudes towards its possible future use (Reich-Stiebert, Eyssel & Hohnemann, 2019). Also, some teachers could even have negative attitudes, fears, and prejudices towards the use of robotics in the classroom (Lammer, Vincze, Kandlhofer, & Steinbauer, 2017).

In order to avoid all this, we firmly believe in the need of quality training in robotics and computational thinking, which will allow Early Childhood teachers to plan, sequence, and

manage the teaching-learning process with activities, resources, and strategies which will allow them to obtain and develop the best which these subjects can offer them (Agatolio, Pivetti, Di Battista, Menegatti & Moro, 2017; Alimisis, 2019). This training must start at the Degree of Education at University, as good initial training guarantees a better understanding of the concept and its later efficient implementation (Román-Graván, Hervás-Gómez y Guisado-Lizar, 2017). This must be followed by continuous training, which reaches all Early Childhood teaching staff and is updated and reviewed over the years in order to ensure it is adapted to the latest technological and methodological advances. We also support the fact that a good choice of robot should be made, as not all robots are adequate for all ages or for the characteristics and needs of all type of students. We should first analyse what types of robots there are and which one are the most appropriate for early childhood education. In this sense, we must value the efforts made by several authors in some possible classifications or in creating a taxonomy of educational robots (Catlin, Kandlhofer, Holmquist, Csizmadia, Angel-Fernandez & Cabibihan, 2018; Catlin, Kandlhofer, Holmquist, Csizmadia, Angel-Fernandez & Cabibihan, 2019; Komis & Misirli, 2016; Mubin, Stevens, Shahid, Al Mahmud & Dong, 2013; Pei & Nie, 2018). There are many factors which are motivating that the so-called floor robots, mobile robots or turtle robots, according to the classification made by Catlin et al. (2018), are the ones used in Early Childhood Education classrooms. Among these factors are the following: their low cost, compared to other types of robots (for social or construction purposes for example), being fashionable, their easy distribution and sale, being easy to use, their attractive design, and so no. It must also be outlined that, in the last few years, the number of models of this type of robots has increased, existing currently an enormous amount of possibilities which the official brands are trying to sell with all types of messages, which are sometimes deceitful and cause confusion.

When arriving at such a situation, it should be the teachers themselves or even the educational centres who, inside the wide range of possibilities which are offered nowadays regarding floor robotics, may analyse those robots which best adapt the needs of the centre, the classroom, and the students' learning process.

Therefore, the goal of this research is to validate an instrument which will allow the classification and analysis of the floor robots existing on the market and which are aimed at Early Childhood Education. A classification and analysis of the functionality of floor robots will allow teachers to learn about their use, know their pedagogical possibilities, and adapt their students' learning process to their needs in a planned and coherent way.

2. Methodology

Since the goal of our research is to validate an instrument which will allow the classification and analysis of the different models of floor robots existing on the market and aimed at Early Childhood Education, we needed to start from an idea or premise which would let us begin the whole process. Taking some ideas from the technical specifications of some of the robots available in our closest surroundings, as well as some other ideas of the existing classifications (mainly the one from Catlin et al., 2018), we made a first analysis sheet and named it FAREI19, which can be checked in Annex 1. Such analysis sheet was validated by a team of experts.

We selected 120 names of experts in robotics in Early Childhood Education throughout Spain. Such expects were considered from three different fields: on the one hand, Early

Childhood teaching staff with wide experience in the use of educational robotics, who will de identified as MEI; on the other hand, university teaching staff of the Degree in Early Childhood Education, who teach educational robotics to the future teachers of that stage, and who will identify as UNI; and finally, a group of people from the private field belonging to companies or organisations working on sales, consulting, and/or training in educational robotics, who will be identified as COM. From the 120 invitations, 73 were answered, only 50 of them were considered valid, and the 23 remaining either considered the instrument valid without contributing with any change or consideration or did not understand what they were being asked and just completed the sheet with the features of a specific robot.

In order to identify each response, they wer3e coded through the three letters abovementioned, and which correspond to each group (MEI, UNI, and COM), and the entry number of the valid response (from 1 to 50). The 50 responses corresponded to those from a total of 25 Early Childhood Education teachers, 18 to University teaching staff, and 7 sales or training technicians from private companies. In order to obtain such number of responses, all the participants were sent emails with a letter of presentation and the documents necessary to validate, together with their corresponding instructions. They were given a deadline of four months to send their responses, which was the necessary time to receive such amount of valid responses.

3. Analysis and results

The obtained responses were transferred to an Excel sheet and coded relating to each of the items from the FAREI19 sheet plus one which was used for extra contributions, either of uncompleted items from the sheet or of general considerations regarding its style and/or structure.

In order to present and analyse them, the obtained results were displayed in different tables, according to the different sections from the original sheet: Table 1: items about the robot's features and description; Table 2: items about the robot's actions and functions; Table 3: items about the robot's educational interest; table 4: pros, cons, and final assessment; and Table 5: date, signature, and remarks.

Table 1
Items about the robot's features and description

Item	Considerations
Model	Name and model (MEI06) (MEI07)
Brand	Manufacturer's link or address (UNI31) Brand or publisher (MEI11)
Price	Approximate price (UNI16)
Purpose	To be specified according to the teacher (UNI16) It would be included in the other items: educational component and ludic component (UNI17) (UNI22) Rename by Possibilities (MEI24)
Description	To be specified according to the teacher (UNI16)

Image	What would its contribution be? (UNI16)
Minimum age	Must be included at the beginning of the sheet (UNI01) And maximum, if there is (UNI16), or age range, or recommended age (UNI31) (MEI03) (MEI06) (MEI11) (MEI24) (MEI35) (MEI41) (COM43) Age is subjective (COM09) (COM38) (COM46)
Instructions for use	Teachers may find it difficult to complete this information (UNI16) Do not include the manufacturer's instructions but those who test the material (MEI03) Online o printed (MEI18)
Instructions' language(s)	
Free resources available: Y/N	For many people the term "free" might be confusing (UNI16) It they are, Yes, being able to say which one (UNI29) and if there is an online community where to share them (UNI30) (UNI36) (MEI15) (MEI25) (MEI40)
Complements available: Y/N	I would rename them as "Accessories available" (UNI29), whether they are bought separately or come with the robot itself (UNI31) (UNI36) (MEI25) (MEI33) (MEI39) (MEI40), and whether if they are cheap or not (MEI18) Possibility of extension (COM08)
Customer service: Y/N	It there is, specify what type (by mail, telephone, etc) (UNI16) (COM08) If they only deal with technical problems or also pedagogic ones (UNI31) If there are or not spare parts for the robot, and guarantee period (MEI15)
Other considerations	Specify the goal and a brief presentation of the robot at the beginning of each sheet (UNI16) Specify it has small parts (UNI17) (MEI40) Specify with which material has the robot been manufactured in case of allergies (UNI17)

Table 2
Items about the robot's actions and functions Ítems sobre las acciones y funciones del robot

Item	Considerations
Programmable: Y/N	Robot's programming type (code, blocks, scratch, others) (UNI12) (UNI31), where from (manually, with cards, computers, mobile phones or tablets) (UNI29) (UNI30) (UNI31) (MEI03) (MEI06) (MEI07) (MEI15) (MEI25) (MEI33) (MEI39) (MEI41) (COM08) (COM38) (COM43), and if it is simple or not (MEI05) (MEI40)
Maximum number of orders:	It would be included in the robot's features (UNI36) Unnecessary (MEI21) (MEI24) Interesting (MEI25) (MEI44)
Remote control: Y/N	Specify if it works with a remote control or panel, or with a tablet or mobile phone (UNI01) (UNI04) (MEI06) (MEI15) (MEI40) (MEI44) (MEI47) and if it is simple or not (MEI05) How can the device be connected to the robot? (USB cable, Wi-Fi, Bluetooth, etc.) (UNI30)
Combinations/Possibilities: Reduced/Limited/Infinite	Mixing combinations and possibilities is confusing (UNI16) Unnecessary (MEI24) Add Enough to the rank – Reduced/Limited/Infinite/Enough (MEI11)
Movement: Y/N	Is it through panels? If it is, what are the panels' measurements? 15x15? 20x20? (UNI01) (MEI44) (MEI48) Does it allow movement? I would include it in the robot's features (UNI36) Are its movements precise or does it twist, and is the robot stable or not when placing it on the floor? (MEI05) (MEI40) If it is a floor robot, movement is implicit (MEI25)
Lights: Y/N	Included in the robot's features (UNI17) (UNI36) Substitute them by: optical signals: lights Y/N, text display Y/N, graphic display Y/N (UNI27) Being able to say something more than Y/N (MEI25)
Sound: Y/N	Better ask for Audio (UNI16), sounds, reproduce music (UNI27), and if it can be switched off or not (MEI05) (MEI41) Incorporate it to the robot's features (UNI17) (UNI36)

	Being able to say something more than Y/N (MEI25)
Attractive aesthetics: Y/N	Better incorporate it to the features section or the description (UNI17) (UNI36) Very subjective item, better value if the aesthetics is appropriate to the age of use (UNI22) (UNI31) (MEI03) For children, aesthetics is essential, but emotiveness is interesting for the robot to be accepted (UNI27)
Consistency/Durability: Y/N	I would only include durability (UNI16), as consistency is subjective (UNI31) (MEI03) and would indicate the reason of the failure (MEI15) I would call it "Robustness" (UNI29) (MEI40) (MEI41) Incorporate it to the robot's features (UNI17) Include a rank and not Y/S (UNI29) (UNI45) (MEI07)
Difficulty to assemble by the students: Y/N	Include rank from 0 to 5, where 0 means that it does not need to be assembled and 5 means it does need to and it is complex (UNI01) (UNI12) (UNI29) (UNI45) (MEI03) (MEI07) or a low/medium/high degree (UNI04) Some robots do not need to be assembled (MEI11) (MEI25) (MEI37), so I would ask if it requires assembling (COM02) (COM08) (COM43)
Difficulty to handle by the students: Y/N	Include rank from 0 to 5, where 0 means that it is not difficult to handle and 5 means it is (UNI01) (UNI12) (UNI29) (UNI45) (MEI03) (MEI07) or or a low/medium/high degree (UNI04), or indicate which are the difficulties (UNI22) If it has different levels of difficulty when used at different ages (MEI05) (MEI15) (MEI40)
Teacher's need to be involved: Y/N	This item might be unnecessary, depending on the teacher's methodology (UNI01) (UNI16) (MEI44) I would detail the involvement moment: training/execution/the whole process (MEI07) The teacher's involvement is always necessary (COM09)
Battery/Recharge:	Battery (lithium batteries) (UNI04) (UNI16) (MEI07) (MEI21) (MEI24) (MEI40) (MEI41) (MEI49) Incorporate it to the robot's features (UNI17) (UNI36)

Duration of battery/recharge: h.	Autonomy (runtime) (UNI04)
Other considerations:	Wi-Fi (UNI04) Does it have sensors or does it have the possibility of incorporating them in order to measure for example temperature or speed? (UNI04) (MEI40) I would add an item to those of assembly and handling difficulty, with a scale and not Y/N, which would be called “Intuitive use” (UNI29) (UNI36) (MEI07) How is a failure managed? What happens when commands and/or actions are incorrectly introduced? (UNI34) I would add if it is easy or difficult for the teacher to learn how to use it (MEI05) (MEI37) Can it be opened and altered? (MEI05)

Table 3
Items about the robot’s educational interes

Item	**Considerations**
Educational component: Y/N	This section should be more developed in didactic descriptors: objectives, methodology, competences, sideways trend, programming, spatial orientation, movement sequence, cooperative work, areas or competences it develops, etc (UNI13) (UNI22) (UNI23) (UNI34) (UNI36) (UNI45) (MEI07) (MEI14) (MEI18) (MEI20) (MEI25) or a degree with 3, 4 or 5 options (UNI29) Educational potentiality (UNI29)
Ludic component: YS/N	I do not know to what extent it is correct to indicate that whatever is ludic is not educational. I would remove this item (UNI16) (MEI03) Develop this item and not as Y/N (UNI22) (UNI29) (UNI45) (MEI14) Ludic potentiality (UNI29)
It promotes computational thinking: Y/N	Instead of computational thinking, in early childhood education we must talk about sequential or algorithmic thinking (UNI10) This item has more to give. Ask about the skills it develops: problem solving, teamwork, creativity, etc. (UNI16) (UNI17) (UNI22) (UNI36) (UNI45) (MEI07) (MEI14) (MEI25) (MEI40) Potentiality for the development of computational thinking (UNI29) Use a scale and not Y/N (UNI30)

Other considerations:	To be added if it includes a didactic proposal. Sometimes it is associated to them because of being robots commercialized by publishing companies (UNI01) (MEI11) (MEI15) (MEI50) If it includes a teaching guide, then we are not talking about a robot but a toy (COM09) Possibilities of use with students with practical difficulties, learning difficulties or ESD (MEI03) (MEI40) (COM42)

Table 4

Pros, cons, and final assessment

Item	**Considerations**
Pros:	I would rename it as Main advantages and would give it less importance/space in the sheet (UNI22) (MEI18) (MEI40)
Cons:	I would remove this item so that the teacher can focus on what is positive (UNI17) I would rename it as Main disadvantages, difficulties or problems, and would giveit less importance/space in the sheet (UNI22) (MEI18) (MEI40)
Final assessment (1-10):	Better use a Likert scale, from 1 to 5 (UNI22)
Quality/price ration:	Use a low/medium/high degree (UNI04) (UNI12) (UNI16) (UNI45) (MEI24) (MEI25) Include it to the robot's features (UNI36) It is not indicative, but durability is (COM09)
Other considerations:	

Table 5

Date, signature, and remarks

Item	**Considerations**
Analysis made by:	
Date:	
Remarks:	

Other considerations:	The sheet has much information which can be included directly by the manufacturer. I would only leave the information that the teacher may add in a more subjective way (UNI16) We should include the needs of space to work with the robot and the required organization/interaction with the robot: individual, in pairs, in a small group, in a large group, etc. (UNI22) (UNI31) (MEI06) (MEI15) (COM02) Classroom experiences with such robot, either described or on a video on the Internet (MEI18) (MEI40) Purchasing link (UNI31) (MEI41) Types of activities which can be created with the robot and their duration (UNI31) (MEI15) Transport and storage (MEI40) (COM02) Comprise all Y/N items in a more visual table, with all the items in columns, and a column to tick Yes and another one to tick No (UNI34)

4. Discussion

On the basis of the results, and generally speaking, we can confirm that the initial sheet to be validated (FAREI19), has been greatly accepted by experts. As we previously said, we have obtained very positive commentaries and assessment about the instrument, not only from the 50 considered responses but also from the 73 obtained.

Even then, it is necessary to introduce a set of changes and details, which have been suggested by experts, as can be seen in the results analysis.

Before going into detail, we must generally highlight that, as it was expected, early childhood education teachers have been more worried about and interested in the sheet's aspects related to its aesthetics, ludic component, operation and difficulty to be handled both by teaching staff and students. University teaching staff has been more concerned about those items related to the robot's pedagogic-formative character and if its use supports or not the development of certain competences, among which we must outline computational thinking. Finally, the commercial sector has been more concerned about those items related to technical and economic issues: customer service, possibility of extension or additional complements, quality-price ratio, and so on. All of that is quite predictable regarding each sector.

With relation to the suggestions and commentaries provided, it is necessary to introduce certain changes in the sheet, which will now explain in detail:

- Renaming certain items: Model by Name/Model, Brand by Brand/Publisher, Minimum age by Recommended age, Free resources available by Resources available, Complements available by Accessories available, Battery/recharge duration by Autonomy, Attractive aesthetics by Aesthetics, Consistency/Durability by Robustness, Pros by Main advantages, and Cons by Main disadvantages.

- Eliminating the dichotomy Y/N and allow more information to be included in the items: Resources available, Accessories available, Customer service, Programmable, Remote control, Movement, Lights, Sound, Aesthetics, and Robustness.

- Eliminating the dichotomy Y/N and substitute it with a 0 to 5 Likert Scale, which offers a graded assessment and provides more information than a simple Yes or No. This is the case of the following items: Difficult to assemble by students, Difficulty to handle by students, and Final Assessment.

- Inserting items which had not been considered and are relevant, such as for example: Manufacturing material, and Does it have small parts? It is important to know the material the robot is made in case the students have any time of allergy. It is not advisable for robots to have small parts which early childhood students could put in their mouths.

- Eliminating items which are unnecessary or already included in other items, after having opened the possibility of including more information in them. This is the case of Combinations/Possibilities and Teacher's need to be involved: Y/N

- Changing the section/location in the sheet of certain items which better correspond to new sections. This is the case of the following items: Movement, Lights, Sound, Battery/Recharge, and Duration of battery/recharge, which correspond to the robot's features and not so much to its actions/functions.

- Joining all the items section about the robot's educational interest in a single item named Skills and competencies developed.

- Adjusting the quality/price ratio in a low/medium/high degree.

With all this, the resulting validated sheet named FAREI can be checked in Annex 2.

Additionally, although none of the experts has mentioned it and it was not considered in the first version of the sheet, we have decided it would be convenient to complement the FAREI sheet with some guidance notes about how to complete it, which can be checked in Annex 3.

5. Conclusions

A good use of educational robotics implies planning and arguing the meaning and functionality we desire to give to it. In this research we have stated that all this can be accomplished with quality training together with a justified and reasoned choice of resources, materials, and strategies to be developed with the students. This last section is the one that consists in our main goal, to provide the educational community with an instrument which will allow them to appropriately choose a floor robot that best meets the early childhood students' needs. As it has been previously mentioned in this article, the floor robot must not be the only resource to be used when working with educational robotics in Early Childhood Education, although it is a good complementary resource which is more and more used in the classrooms at that stage. With this instrument, teachers will be able to analyse, classify, and compare the different models of floor robots they choose, and they will therefore be able to contrast the educational potentialities they have.

By designing and validating this instrument, FAREI, and mainly thanks to the opinions and commentaries of 50 experts in educational robotics in Early Childhood Education, we have been able to find a valuable tool since, by completing it, not only teachers will find the

arguments which will allow them to choose one model or another, but they will also learn about the particularities of educational robotics and discover all the learning possibilities such resources offer in order to develop their students' skills and competences. These skills and competences go beyond digital competence, as they will be able to focus on teamwork, problem solving, sideways trend, creativity, socialisation, initiative, and so on (Santos y Osório, 2019).

We understand that this instrument is valid for every specific context or reality, and that it must no be used generally or globally, as each educational community, each classroom, and each student in particular has unique and different characteristics to others. However, its decontextualized use may also provide information and learning which, from a global perspective, brings us closer to educational robotics, and in particular to floor robotics in Early Childhood Education. Therefore, being able to take this instrument out of context, with its necessary variations and changes, and into another type or resources and other educational stages, is among our future lines of research, as new challenges to consider in order to supply the educational community with instruments and tools which will facilitate their own learning how to learn throughout the analysis and reasoning of the resources' arguments.

This is precisely the best quality of this research but also its main limitation, as its goal is extremely focused on a specific type of resource and at a particular educational stage.

We offer the educational community our FAREI sheet as an excellent resource, which has been validated by 50 experts in educational robotics, and which allows the analysis and knowledge of the educational potentialities of the different floor robots which can be considered as another resource in Early Childhood Education. The FAREI sheet will not only allow to make an accurate and planned choice, but it will also open doors to a deeper and more competent knowledge in the way students learn and develop skills and competences.

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Como citar:

Álvarez-Herrero, J.F. (2021). Design and validation of an instrument for the taxonomy of floor robots in Early Childhood Education [Diseño y validación de un instrumento para la taxonomía de los robots de suelo en Educación Infantil]. *Pixel-Bit. Revista de Medios y Educación*, 60 59-76. https://doi.org/10.12795/pixelbit.78475

ANNEX 1

FAREI19 sheet model (Analysis Sheet of Robotics in Early Childhood Education, not validated)

Model:		
Brand:	Price:	
Purpose:		
Description:	Image:	
Minimum age:		
Instructions for use:	Instructions' language(s):	
Free resources available: Y/N	Complements available: Y/N	Customer service: Y/N
Programmable: Y/N	Maximum number of orders:	Remote control: Y/N
Combinations/Possibilities: Reduced / Limited / Infinite		
Movement: Y/N	Lights: S/N	Sound: Y/N
Attractive aesthetics: Y/N	Consistency/Durability: Y/N	
Difficulty to assemble by students: Y/N	Difficulty to handle by students: Y/N	
Teacher's need to be involved: Y/N		
Battery/Recharge:	Duration of battery/recharge: h.	
Educational component: Y/N		
Ludic component: Y/N		
It promotes computational thinking: Y/N		
Pros:		
Cons:		
Final assessment (1-10):	Quality/price ratio:	
Analysis made by:	Date:	
Remarks:		

ANNEX 2

FAREI19 sheet model (Analysis Sheet of Robotics in Early Childhood Education, after validation)

Name/Model:		
Brand/Publisher:	Price:	
Purpose:		
Description:	Image:	
Recommended age:		
Instructions for use:	Instructions' language(s):	
Resources available:	Accessories available:	Customer service:
Movement:	Optical signals:	Audio:
Aesthetics:	Robustness:	
Batteries/Battery/Recharge:	Autonomy: h.	
Manufacturing material:	Does it have small parts?:	
Programming type:	Maximum number of orders:	Where is it programmed from?
Difficulty to assemble by students: 0-1-2-3-4-5		
Difficulty to handle by students: 0-1-2-3-4-5		
Skills and competences which it develops:		
Main advantages:		
Main disadvantages:		
Final assessment: 0-1-2-3-4-5	Quality/price ratio: low / medium / high	
Analysis made by:	Date:	
Remarks:		

ANNEX 3

Guidance notes for completion of the FAREI sheet (with instructions about how to complete it)

Name/Model: Include the robot's name and model
Brand/Publisher: Brand, company or publisher which sells the robot
Price: Include the approximate price, if possible, also the shop, company or url
Purpose: In the teacher's words, which is the robot's use or purpose
Description: In the teacher's words, describe the robot
Image: Include one or several images of the robot, together with its components
Recommended age: Establish an approximate age range for its use
Instructions for use: In the teacher's words, how the robot is handled/used
Instructions' language(s): In which language(s) the manufacturer's instructions are
Resources available: Is it accompanied by a facilitator's guide with educational possibilities? Is there a community on the Internet which shares activities, experiences, and so on? Can resources be created for its use?
Accessories available: What accessories does it have or can be bought which are compatible with the robot? Is it possible to extend them in order to use it at a higher age range?
Customer service: If there is customer service, include the contact telephone number, email or address. Do they only help with technical problems or also with pedagogic ones? Does the robot have spare parts? Does the robot have a warranty?
Movement: Is it through panels? If it is, what are the panels' measurements? 15x15? 20x20? Are the movements precise of does it have errors which need to be constantly corrected?
Optical signals: Lights, text display, graphic display?
Audio: Sounds, music, repeated sound, etc? Can they be switched off?
Aesthetics: Is it adjusted to the recommended age? Does the robot's aesthetic create emotiveness?
Robustness: Does it stand falls, involuntary blows, etc? What average shelf-life does it have?
Batteries/Battery/Recharge: What type of batteries does it have? Are they easily changed/recharged?
Autonomy: **h.** With new or recently charged batteries, how much runtime is it guaranteed?
Manufacturing material: What materials have been used to make the robot? Is there any warning related to possible allergies?
Does it have any small parts?: Does it have any small parts which make it inappropriate for that age?
Type of programming: Through codes, blocks or panels, scratch or other? Is it simple or not?
Maximum number of orders: if it is specified or if it has been studied, what maximum number of orders does it accept?
Where is it programmed from?: from a control or panel, from a tablet, a mobile phone, a computer, etc?, and how is that device connected to the robot: via Wi-Fi, Bluetooth, USB cable, etc?
Difficulty to assemble by students: 0-1-2-3-4-5 If it does not need to be assembled, it is 0. If it is complicated to assemble, it is 5.
Difficulty to handle by students: 0-1-2-3-4-5 If it is very easy or very predictable to handle, or there is no need to handle it at all, it is 0. If it is very complicated to handle or no intuitive at all and requires the teacher's involvement, it is 5.

Skills and competences which it develops: what competences does it develop? Programming, spatial orientation, computational thinking, movement sequence, collaborative work, problem solving, creativity, socialisation, etc.
Main advantages: the robot's strengths
Main disadvantages: the robot's weaknesses
Final assessment: 0-1-2-3-4-5 The total score I would give the robot
Quality/Price ratio: low / medium / high Regarding the relation between its performance and its price, which is the ratio, being high the best one.
Analysis made by: Name of the teacher who is making the analysis
Date: Date on which the analysis has been made
Remarks: Other aspects which have not been considered in the previous items, such as**:** Can it be connected via Wi-Fi or Bluetooth? Is it apt for students with any type of disability or learning difficulties? Is it possible to adapt the robot to different age ranges? Are there any needs regarding space and organisation/interaction to work with the robot: panels, floors, boards or table covers; and is it for individual, pairs, small groups, large groups, etc. Type of activities which can be created with the robot, their duration, etc. The robot's transport and storage Etc.