Enhancing the Level of Learning Process with Interactive Multimedia Systems

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ABSTRACT: *To modify and reorient the teaching and learning systems, the of new information and communication technologies contribute to improving the quality. Nowadays the multimedia tend to help the creation of teaching materials that guide student learning. The use of interactive media facilitates the understanding of the contents through various forms of information. The intention is to bring more support and enhance the level of the students. The main aim of this study is the application of an educational multimedia system integrated with the Kinect device. The study was initiated by using the cascade model consisting of sequential development. The evaluation permitted to assess the functionality of the software, and the integration of the kinect device. The intention was to develop an interactive, dynamic and fun environment with full mastery of student participation, and teacher acceptance. We found that the use of any audio visual interactive medium favors learning through sensory organs such as sight and hearing.*

Keywords: System, Multimedia, Interactive System, Kinect, Learning, Teaching, Basic Education

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1. Introduction

At present, education has become one of the cornerstones of economic, social, scientific and technological development. It is recognized as one of the most precious and powerful social goods to achieve individual and collective well-being [1]. Education is a process in which the human being develops and cultivates attitudes, knowledge, habits and, behaviors. The objective is to socialize and integrate into the academy the positive use of virtual spaces for social interaction and information on communication technologies. For the educational system, one of the most important challenges is to adapt quickly to technological changes. The common goal is to integrate ICT in order to create new forms, concepts and effective methods that contribute to improving the teaching and learning process.

Academia has had great transformations as human knowledge and scientific and technological development advancements. Information and communication technologies (ICT) have been integrated into all levels of education. Its implementation offers unlimited possibilities to improve the teaching-learning process [2].

The educational use that students give to ICTs is directly related to the teacher's approach, their needs, and the educational level. In this context, ICTs are classified into three categories: ICT that supports the transmission of messages from the sender to the recipient, ICT that supports active learning through experimentation with the objects of study and ICT that facilitates interaction to learn [3].

Multimedia-interactive systems are found in the ICT category that facilitates interaction to learn. Interactive tools are didactic resources that promote the acquisition of knowledge in a more dynamic and participative way for students.

Kinect technology applied in education promotes kinesthetic learning. This learning consists of understanding and acquiring knowledge through experimentation and movements. That is, learning through experimentation and practice, games, models, even physical representations of what is studied, such as a globe or a human skeleton [4]. In this sense, Kinect technology develops core concepts for academic growth. The Xbox 360 Kinect device can be applied in the classroom in activities related to mathematics, such as algebra, measurements, decimals, coins, probability, graphics, anatomy, chemistry, physical education, arts, among others [5].

The educational applications that integrate the Kinect device represent a classroom model. This allows exploring and implementing innovative teaching and learning strategies in a learning environment monitored and supervised by the teacher.

The work integrates multimedia technology and the Kinect device to generate new learning experiences. The digitalization of academic content is used to later add multimedia effects and create interactive environments. The objective is to foster creativity, the ability to observe, classify, interact, discover and complement new information with prior knowledge [6]. The document is organized as follows: the second section offers a conceptualization on educational multimedia; The third section describes the design, development and functionality testing of the multimedia system and the Kinect device; finally in the last section the conclusions are presented.

2. Educational Multimedia

Multimedia consists of using various types of media to transmit, manage or present information. These media can be text, graphics, images, audio and video, among others. In the field of computing, multimedia is the combination of specific software and hardware to store and present interactive content [7].

The use of multimedia is very extensive since it is present in almost all forms of human communication. Different industries benefit from multimedia, for example: for entertainment through the use of special effects in movies and animation of cartoon characters; medicine through the use of augmented reality and virtual reality to simulate human body organs; education with applications according to the material and educational level; and among many other fields. Multimedia is an interactive medium that offers the possibility of presenting information in different ways, stimulating different senses through the creation of motivating, pleasant and interactive environments for the human being [8].

In this context, ICT applied in education has led to new teaching tools and paradigms. Educational multimedia are educational materials or resources that combine different types of information and media. These are monitored through the computer to improve the teaching and learning process [9].

The goal is not only to acquire knowledge but also to understand the way of learning by getting the most of the benefits of ICT in order to transform the mental structures regarding the use of technology in the educational community. Figure 1 shows the structure of the cognitive theory of multimedia learning. The theory centers on the foundations of multimedia education and bases the application of an interactive multimedia system as a teaching resource [10].

Multimedia learning refers to the construction of students' mental models, through the use of printed or spoken words and static or dynamic images. The cognitive theory of multimedia learning argues that individuals possess two systems for processing information: visual and verbal. The auditory input corresponds to the verbal system, and text input or animation corresponds to

the visual system [10, 11]. Therefore, this theory proposes that multimedia content should be designed and presented considering the following aspects:

• Use an appropriate combination of graphics and words to offer a good presentation.

• Present the content in small fragments. This allows the student to process and understand small amounts of information before moving on to the next exercise.

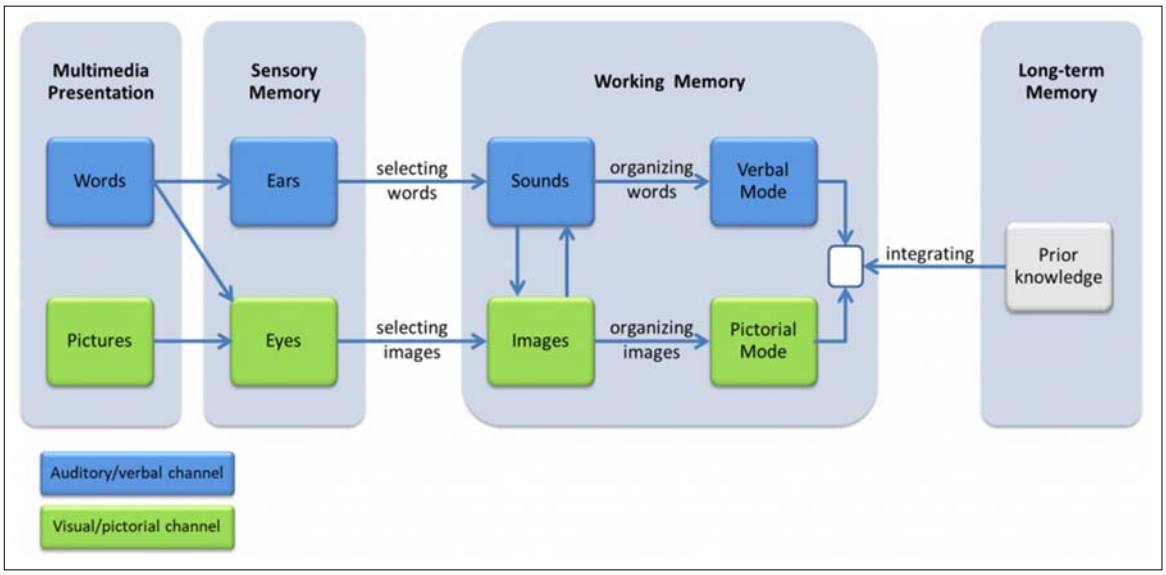

Figure 1. Cognitive theory of multimedia learning [10]

• Use hearing aids when a topic is presented or explained. That is to avoid presentations with large amounts of text. The objective is to facilitate the processing of information using different sensory channels of understanding.

• Describe the graphics through explanatory texts.

• Questions and practice exercises on each topic should appear in the same section.

• Information that is not relevant to the content should not be incorporated into the presentation. This includes decorative graphics and random background music.

Based on these assumptions and the information obtained from interviews with teachers, the content presented in the multimedia system was designed using visual and verbal media such as images, videos, audios and texts. The design was evaluated by teachers and students to ensure the playful quality of the tool to generate a more attractive and easily understood environment. The integration of the Kinect device allows students to control and interact with the content of the multimedia system without having to establish physical contact with the computer. This is possible, thanks to the integration of a natural user interface that recognizes gestures, voice commands, objects and images. This level of interaction facilitates the psychomotor development of children. The purpose is to improve the body's expression of the child as well as developing kinesthetic, spatial and communicative intelligence through the movements of the body.

3. Multimedia system based on Kinect

The project was developed by applying the cascade model, whose methodological approach rigorously orders the stages of the process for software development, so that the beginning of each stage must wait for the end of the previous stage. Next, the development phases and their results are described [12].

3.1 Phase 1:

Requirements Analysis. The following describes the requirements, scope and limitations of the multimedia system.

Objective. To develop and implement a multimedia desktop system that presents the academic content of the Mathematics and Language subjects of the first grade of primary school established by the Ministry of Education of Ecuador.

Hardware component. The multimedia system requires the use of the Kinect device for Xbox360. The device is the interface of interaction between the system and the users. The goal is for students to learn with body activity through the use of their hands. The Kinect device is a tool created for games, it contains SDK (Kit Software Development) libraries that help create interaction.

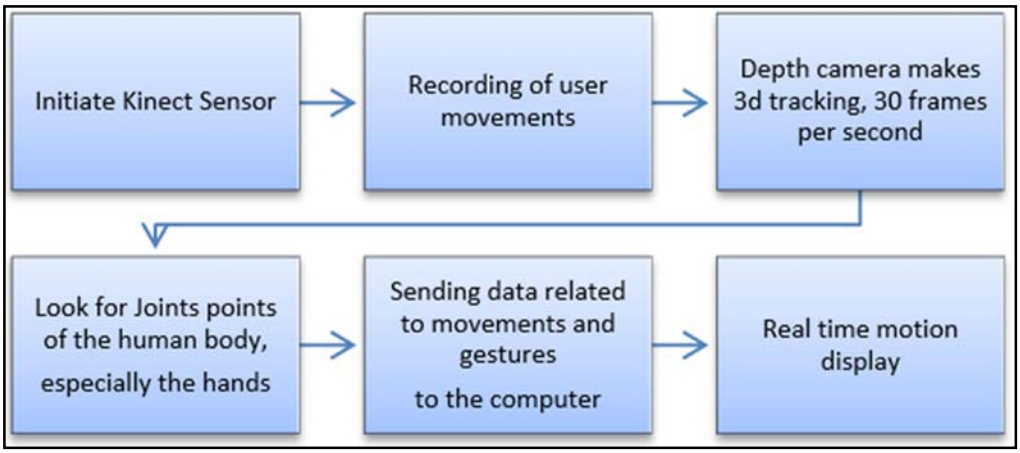

Figure 2. Structure of the interaction of the Kinect device

It works by capturing the human skeleton and then shows the information in the X, Y, Z plane of its movements [13].

Component. The setting for the development is Visual Studio 2012. The drawings will be made in the Microsoft Expression Blend program to generate dynamic animations.

System modules. The system will consist of two modules. Each module contains tasks and activities to develop and practice.

Mathematics: Add and subtract, decomposing numbers, color geometric figures, select correct quantities in additions.

Language: Sentence structure, complete words, recognize syllables.

3.2 Phase 2: System Design

Following, it is shown the decomposition of the system organized using diagrams that represent its processes and functions.

System scheme. Next, the scheme of operation of the main processes of the system is presented. Figure 2. Represents the process to capture information about the movement of the person in front of the Kinect device and then process it and present it on the screen. Figure 3 Shows the functional process of the system started with the Kinect device.

System design. Figure 4 shows the communication between the user, the Kinect device and the computer. The user generates the movement, the sensor receives the movement through the camera and the computer validates the received data to finally show the results on the screen.

Kinect device operation. Figure 5 shows the operating design of the Kinect device integrated with libraries (SDK) that make it easy to develop applications with Kinect.

Interface Design. The following images show the design of the system interfaces.

3.3 Phase 3: Testing and Implementation of the System.

Different test scenarios were designed to verify the functionality of the system for each specified component. Table 1 describes the component interaction scenario.

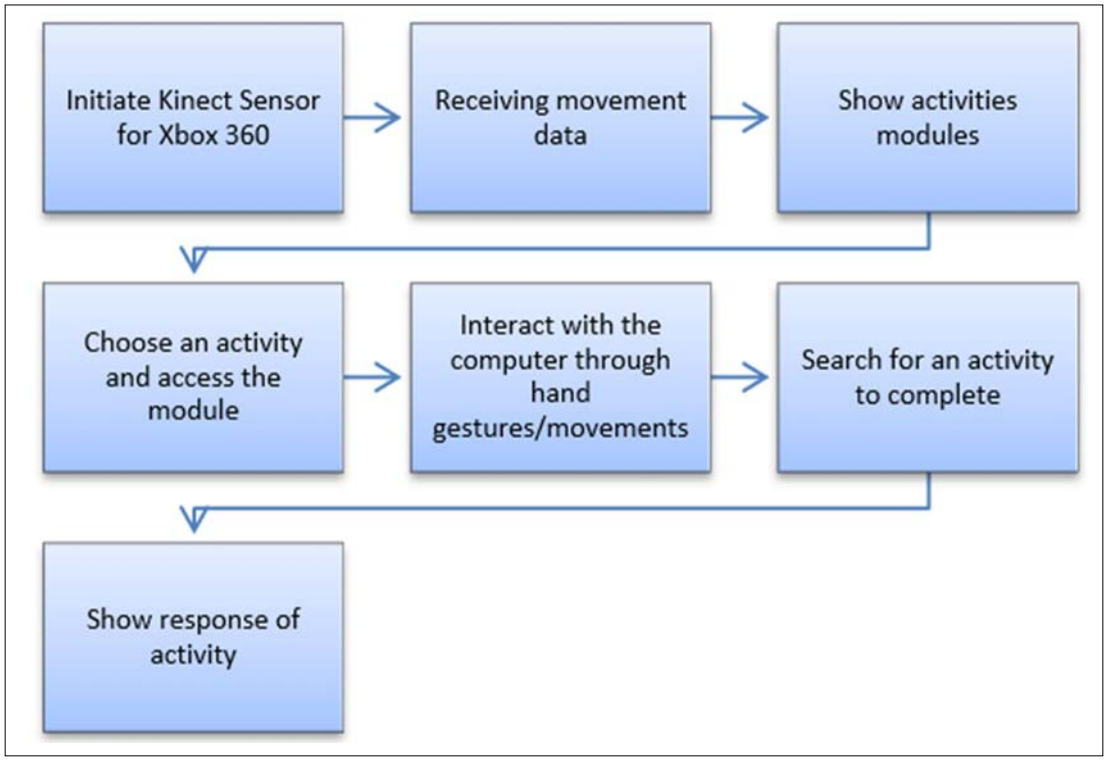

Figure 3. Structure of the System with the Kinect device

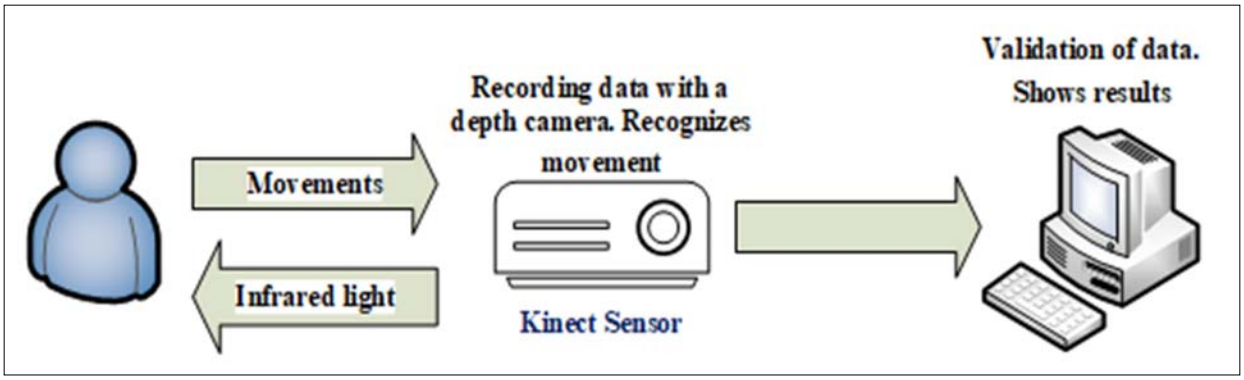

Figure 4. Structure of the communication of the system

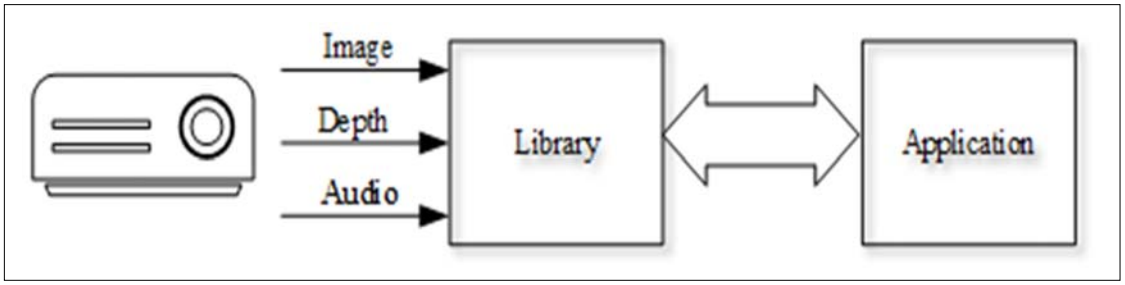

Figure 5. Operation of the Kinect device

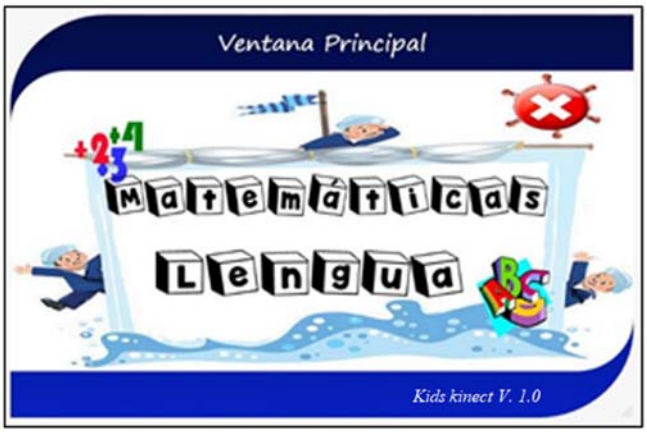

Figure 6. Main window

Figure 7. Presentation of addition exercises

Figure 8. Presentation of math decomposition exercises

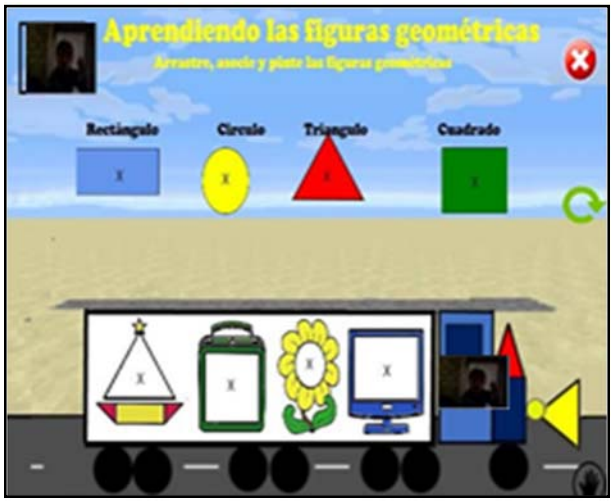

Figure 9. Learning of geometric shapes

Figure 10. Structure of sentences

Figure 11. Learning phonics

Test: Component Interaction	
Objective	Perform communication between the Kinect device and the multimedia system
Description	Verify the operations performed
Complexity level	High
Case 1: Iniziating reading of kinect sensor+	
	Reading of expected movements
Input data	Camera recognizes movements
Data Capture	Shows user movements on the screen
Validate data	If there are more than 2 users wait until you delete 1.
Case 2: Iniziating addition exercises	
Input data	Selection of addition exercises
Click on START button	The system presents random addition exercises.
People involved:	Teacher and student
Test results	
Faults obtained	None
Case 1 processed and 2_ X_ Correct execution	
correct ones	____ Incorrect execution
	____ Execution with error detection

Table 1. Functionality tests - Component interaction

Figure 12. Validation of logical-mathematical exercises

The functional results of each component were 90% successful. The system manages to capture the movements of the human body through the camera of the Kinect device. The tests were carried out in a real scenario with first-year basic students as shown in Fig. 12. The different activities and practices presented in the system were validated with 90% effectiveness.

4. Results

A survey was conducted to assess the usability level of the system. These questions were applied to a total of 34 students in the first year of primary school. Fig.13. represents the percentage of acceptance and interest in using the multimedia system. 87% of the students strongly agreed to use the multimedia system; they also consider it is easy to use and understand.

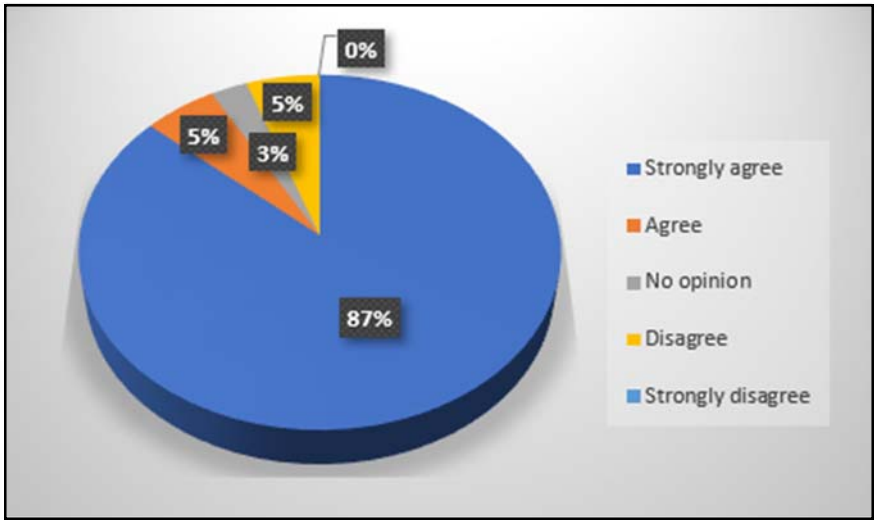

Figure 13. Acceptance and interest in using the multimedia system

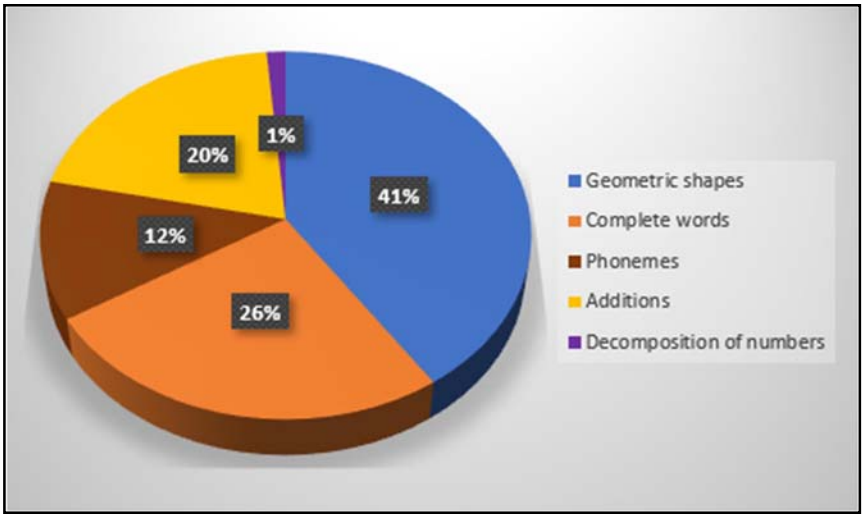

Figure 14. Acceptance of activities of the multimedia system

Figure 14 represents the activity with the highest acceptance by the students. 41% of students prefer to perform the activities presented in the math module, option geometric figures. 26% prefer to use the language module, the option to complete words. The activity of least acceptance is the decomposition of numbers with 1%.

Figure 15 represents the ease of system interaction. 76% of the participants mentioned that the interaction through the movements of their hands and body is easy to execute and also innovative. However, 15% of the participants disagreed about the ease of interaction. This is due to the slow interaction when the depth sensor captures the movement of both hands at the same time.

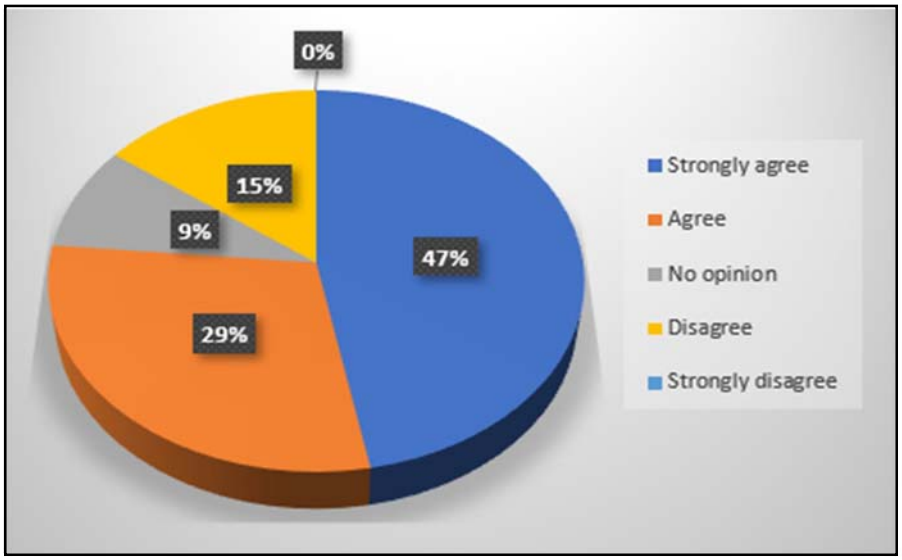

Figure 15. Ease of interaction with the multimedia system

5. Conclusions

The theoretical references promote the use of technological resources of Educational Multimedia in teaching. It is necessary to complement traditional learning styles with technological and innovative resources for students.

The application of multimedia with Kinect technology in the educational field facilitated the teaching and learning process. The use of various types of information creates a pleasant, fun, attractive and motivating environment for the student. It facilitates the understanding of the contents employing sensory organs such as sight and hearing, including the development of kinesthetic intelligence.

The multimedia system is an ambitious project that seeks to become an innovative technological tool in the area of primary education. The Kinect device's depth camera recognition allows users to interact through their body movements creating a different learning experience.

The educational community agreed that the multimedia system used as a teaching resource improves the academic performance of students in the classroom. This interactive system that does not use cables provides greater security in participation and allows students to stay focused. The acquisition of knowledge is through the display of information and interpretative elements that help to better understand the object of study; It also fosters a socio-technological culture in the institution.

6. Recommendations

For future work related to Kinect technology for educational purposes, or to replicate this research, it is recommended to extend the topics and areas of study according to the academic programs and levels. Also, the academic performance of students, as well as the development or improvement of their skills, and specific competencies related to multiple intelligences must be observed in depth.

To improve the operation of the Kinect device, it is necessary to place it in a fixed position so that the depth chamber correctly senses the person in front of it; otherwise, the device will sense a wrong position without detecting the person. The approximate distance between the person and the Kinect device should be between 1.20m and 2m distance. The distance between the ground and the Kinect must be between 0.70cm and 1.20m high to work without problems; otherwise the depth sensors will not recognize the person, and the interaction with the device will be interrupted.

Finally, the Kinect device must be away from heavy-duty machinery to prevent damage due to problems of loading or unloading

voltage. Prevent lights or sunlight from shining directly onto the sensor; Besides make sure that no foreign object blocks the lens of the sensor. These recommendations guarantee the optimal operation of the device.

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