Interactive Whiteboards in Andean Communities: A Training Model

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***Abstract*– Interactive whiteboards are an educational tool widely adopted as part of the integration of Information and Communication Technologies (ICT) and cost reduction. This technology becomes more effective when teachers know and apply interactive teaching methods that can improve the results of the teaching-learning process. This research presents a training model for primary and high school teachers in Yanaquihua, Condesuyos, Arequipa. The proposed training model generated good results: teachers improved their interactive content-making skills by 29 percent. Also, 50 percent of the interactive content created by teachers is considered satisfactory quality. Only 11 percent of teachers needed to dedicate more effort to achieve the objectives. This document reports the importance, the limitations, and the results of applying the proposed training model to improve the performance and effectiveness of technologies in the classroom.**

***Keywords*-- Interactive whiteboard; training model; Andean communities; teachers' training; interactive content.**

I. Introduction

The integration of ICTs into the daily activities of people and companies is an unquestionable fact [1]. Nevertheless, its use for educational purposes is still developing, mainly in emerging countries and rural areas [2]. The educational processes not only require the implementation of technological equipment; but they require specific changes for the adaptation of this equipment to more traditional educational practices [3], and that the teacher not only knows technically about these technologies but also assumes an active role [4], being a mediator for the teaching-learning process and participating in the generation of knowledge-based on available technological equipment [2].

Throughout its evolution, education has adopted specific methodologies, pedagogical activities, and tools [3]. One of these fundamental tools is the one that allows the presentation of knowledge: the classic blackboard. At the beginning of the 20th century, it was the most used tool, but this way of presenting content evolved with the use of the overhead projector (1950), acrylic board (1980), multimedia projector, and is now evolving with the *Interactive Whiteboard* (IWB) [5].

IWBs are not as modern as one might suppose. IWB is an electronic device with a physical or projected screen of large dimensions that allow interactivity and from which a computer is operated [6]. This technology was conceived in the early nineties by Smart Technologies company and used by English schools [7]. As of today, IWBs have not succeeded in replacing traditional blackboards due to socio-economic reasons (scarce resources) or to technical-cultural issues (students and teachers with little motivation and training in the use of these technologies) [8].

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II. Background

A. Technological tools and education

IWBs and their contribution to education, as technological tools, show encouraging results reflected in the improvement of students' motivation and their level of understanding of lessons. IWBs have as well allowed increasing the levels of student attention and interaction in the classroom. Therefore, as part of state policies, various governments have developed ICT integration programs for education and have introduced the use of IWBs to their educational institutions with the clear objective of improving academic performance [9]. The United Kingdom, the United States of America, Australia, Mexico, Turkey, and Spain as the governments that have made a more significant investment to implement this type of technology in all the levels of regular basic education (primary and secondary school) [10].

In Latin America, several efforts to make the use of ICT affordable to educational institutions in diverse social contexts. Thus, the government of Peru, through the National Program of Educational Infrastructure (PRONIED) of the Ministry of Education (MINEDU) in 2016, invested nearly two million soles in furnishing with interactive devices for the new interactive classrooms of 35 emblematic schools of 19 regions of the country [11]. In addition, national and international institutions such as the Inter-American Development Bank (IADB) are financing these initiatives to reduce social, economic, cultural, and territorial inequalities that could influence, in turn, the access and the ability to use these technologies [12].

However, these programs and investments become more effective when these technological tools are acquired, installed, and trained teachers with technological pedagogical approaches. Thus, inserting these actions gradually into educational curricula with clear and measurable objectives to generate benefits that can be verified [13].

On the other hand, it is not enough for teachers to know how to use this technology. They also need to know and apply

strategies that motivate and capture students' attention so that participation in classroom activities occurs in the most natural way possible and integration with the technology [10]. Therefore, the inclusion of technologies such as IWBs in learning sessions involves modifying traditional teaching strategies, including the adaptation of the academic syllabus and the preparation of classroom material, to take advantage of the functional characteristics offered by these technological devices.

From an educational point of view, IWBs have many benefits [3], [14]:

- Such as their capacity to adapt to different teaching-learning strategies.
- The ease of handling allows access to a large number of educational resources on the web.
- Allow the use of existing material created by other teachers, educational administrations, and editorials.
- The reuse of content allows the continuous improvement of the available material and the promotion of active learning among teachers.

On the other side, the use of IWBs presents certain disadvantages by relying on external conditions such as the internet connection, its unavailability, a slow connection, or usage policies for uploading and downloading contents could impede their use. Furthermore, the problems of technical nature, caused by the lack of maintenance of the technological equipment, could as well undermine the capacity of the technology [9], [15], [16].

The human factor is a fundamental point in the adoption of IWBs, and limitation since, at first, the teacher has a significant increase in the workload for the preparation of the class material, since he or she must adapt or build material for the use of the IWB [17], [18], [14]. Furthermore, the teacher's effort to develop the educational material is directly affected by his knowledge and the skills acquired during training. Thus, an inadequate training process produces frustration and demands more significant effort from the teacher since he still does not master the operation and the technical resources of the IWB.

B. Interactive whiteboards in the classroom

Experiences performed with IWBs in the teaching-learning process at primary and secondary levels suggest that students have a higher degree of acceptance of the implementation and use of IWBs in the classroom, with the youngest being the ones who show a better attitude and disposition [3], [17], [19].

Generally, IWBs make the classes more dynamic, exciting and help students better understand the topics' content. In addition, when IWBs combined with a proactive attitude of the teacher is more motivating for the students, increased the student's participation [10], [20], [21], [22], [23].

Concerning the didactic potentialities offered by IWBs, it is worth highlighting the facility that the tool provides to the teacher to explain, summarize, and review the topics discussed [5], [10]. IWBs allow for better visualization (zoom) and understanding of teacher's drawings and schemes [10], [17], [14], as well as the reproduction of audiovisual material [1], [9], [17], [19]. They develop the students' visual memory [17] and their technological and digital skills [1], [18]; they also facilitate collaborative activities [14].

IWBs allow incorporating kinesthetic activities at the pre-school level through manipulating objects projected on the screen, such as dragging, dropping, rotating, and resizing these interactive elements. In addition, it increases the student's interactions with his peers and the teacher [21], which contributes to the obtention of the necessary social skills for his personal development.

There are also isolated studies that suggest that some students do not consider that this resource can improve the quality of educational processes [5] or that teachers do not believe that there is a significant improvement in students' academic performance [1], [17], [14], [22]. IWBs success in improving students' performance depends highly on the educational institution, the teacher, the academic discipline, the frequency of IWBs use, the complexity of the lesson, and the dynamic of the explanation. This multiplicity of factors could make that the beneficial results are not so evident [9], [10], [18], [22], [24]. Nevertheless, there is a direct correlation between the level of the teacher's technical training for IWBs and its frequency of use [14]; and the frequency of use and the use of the IWBs' interactive functions on the students' side [24].

Some studies over teacher's training for using this resource identified that the teachers' skills are generally not optimal. In the sample used for the study, not everyone had an appropriate level of knowledge to use the IWBs [5], [17]. Thus, IWBs are in many cases underused, used only for the projection of slides and multimedia material [10], [17], [16] [22] or for writing, as if it were a conventional whiteboard [17], [22].

In that sense, to experience positive results and increase the rates of achievement in the classroom, it is necessary that the teachers' training is adequate and continuous [1], [19], [16], [18], [20], [22], which allows teachers to develop their technical and pedagogical skills progressively. Training should not be carried out only at the equipment implementation stage, nor should it include only theoretical and technical content [19]. More than understanding the operation of the IWB and recognizing the tools it contains, teachers need to learn how to design interactive activities to incorporate them into their educational strategies [16].

On the other hand, it is imperative that the person responsible for the technical support of IWBs in the institution (school) advises, supports, and provides feedback to teachers, and helps during the integration of ICTs in educational institutions [1], [19]. By establishing a positive, helpful attitude from IT support, teachers will feel a degree of satisfaction with the new technologies, and the barriers that the imposition of new technologies could generate on teaching activities will be reduced [20].

Since the teachers' training is of utmost importance to achieve the effective integration of IWBs in classrooms, designing a training model that combines technical and pedagogical skills allows teachers to produce interactive digital

content compatible with their didactic strategies efficiently. The training model should consider the economic, financial, cultural, and time availability aspects of the educational institution and students.

III. Methodology

A. Case study

The study considers the socio-cultural context present in Andean communities in Peru. Recently, the Peruvian State has started implementing government programs such as the National Program of Educational Infrastructure (PRONIED) and the National Broadband Development Plan, seeking to improve the technological and communications infrastructure in regular educational centers (schools). The study happens in the district of Yanaquihua, in the province of Condesuyos of the department of Arequipa. Yanaquihua is an Andean community located more than 3000 meters above sea level, with a population density of 3.72 inhabitants per square kilometer. The main economic activity is related to gold mining activities, which generate significant tax revenues for the municipality.

Therefore, the municipality of Yanaquihua has developed programs to improve the technology and communications services in the district. The first stage of this program in 2014 furnished the district's schools with various technologies, including IWBs. The equipment acquisition included an eight-hour theoretical-practical training for teachers who worked at those educational institutions at that time.

In 2018, the second stage started with an inventory and diagnosis of the equipment installed in the first stage of the improvement program. In summary, this analysis showed that none of the installed IWBs were operational. Some of the leading causes are inoperative equipment due to technical failures and lack of maintenance, teachers not technically trained to use the IWBs, and the pedagogical plans not integrating IWBs. In this sense, the program's second stage included acquiring new IWBs and developing a training plan to train teachers effectively. The requirement to training plan includes not only technical but also pedagogical aspects.

B. Design

This proposal constitutes an applied research study, which uses a pre-experimental model to identify how the proposed training model influences teachers' technical and pedagogical skills in the use of IWBs. The study sample constituted all the primary and high school teachers of six educational centers in Yanaquihua. Table 1 shows information regarding the neighborhood where each educational institution localized, the level of education provided, and the number of IWBs installed, summarizing the education improvement program's first and second stages.

TABLE 1.
DISTRIBUTION OF IWBS AMONG SCHOOLS

Town	Name of the school	Level of education	# IWB
Yanaquihua	40438	Primary	3
	Jorge Basadre	High	6
Charco	40448	Primary	2
Ispacas	San Juan Bautista de la Salle	Primary	4
	Andrés Avelino Cáceres	High	5
La Barrera	José Olaya	Primary	2
		High	5
		Total	**27**

All teachers from the educational institutions listed in Table 1 were invited to participate in the training. However, only 38 (86%) of 44 teachers enrolled in the training, whose characteristics as shown in Table 2. The main criterion for not accepting the invitation was the teachers' availability for teaching and family activities.

TABLE 2.
DISTRIBUTION OF IWBS AMONG SCHOOLS

		f	%
Gender	Male	23	61
	Female	15	39
Level	Primary	16	42
	Secondary	22	58
Age	Less than 30 years old	2	5
	30 – 39 years old	8	21
	40 -49 years old	19	50
	More than 49 years old	9	24

The period required for the training is during the academic semester. For this reason, the duration and dates must reconcile the teachers' teaching activities and the location and distance of each of the educational centers.

C. Measurement instruments

During the initial stage of the training, was applied a survey using a questionnaire as an instrument. The questionnaire had a heading with the instructions, and three sections: the first one contained questions about the personal information of the participants; the second, questions about their teaching activity, and the third, contained questions related to their level of knowledge regarding the use of IWBs.

During the training process, was used the observation technique with a checklist as an instrument. The checklist defines some skills that teachers must achieve during the training. This observation is part of the follow-up scheduled for each teacher as training support and mentoring activities.

At the end of the training, they were using two different techniques for collect data and validation. In the first place, a survey was used with a questionnaire to measure teachers' perceptions regarding the impact of IWBs in their teaching activities. Then, the observation technique permit evaluates the quality of the digital educational content produced during the training, as presented by [25], where ten criteria are evaluated: objectives and didactic coherence; quality of contents; capacity to generate reflection, criticism, and innovation; interactivity and adaptability of the learning object; motivation; format and design; usability; accessibility; reusability; interoperability.

IV. Proposed Training Model

A. *Profile*

The training model in the case study described was called "Face-to-face training on interactive technologies using smart digital boards" and lasted five weeks with a total academic workload of 65 chronological hours. In order not to interrupt teachers' activities, carried the training sessions on Saturdays (8 hours) and Sundays (5 hours), and the monitoring or support was scheduled based on their availability on weekdays (Monday through Friday), forming groups for practical reinforcement activities for 1 to 2-hour sessions.

B. *Team*

The trainers were university professors specialized in ICT and IWBs, who mastered learning and pedagogical techniques using educational technologies. These trainers imparted the masterclasses and led the workshops of the training program. In addition, they were responsible for creating the material and planning the activities of each session.

University students, of the last cycles of careers related to technology and education, integrating the training team. Their training role was to support the trainers during the development of the weekend sessions, solving the doubts and technical problems that arose during the sessions on weekends. Also, their primary responsibility was to monitor and support the teachers during the week (Monday to Friday). They assisted the teachers in solving practical problems that interfered with the correct functioning of the equipment, and they advised teachers on interactive digital content creation issues according to the subjects they taught.

C. *Training program modules*

- **Unit 1 - The Interactive Digital Whiteboard:** In the first class was described introductory topics on IWB technology, uses and applications of the IWB, associated accessories, and conditions for using the IWB in the classroom. In this first approach of the teachers to IWBs, sometimes was allocated to explore, experiment, and discover the tools of the OpenBoard software. The assistants took part in this activity: they were located next to the IWB to solve any doubts that may arise during the teachers' interventions. Moreover, teaching common procedures for troubleshooting software and hardware with simple actions such as turning off and restarting the device. At the end of the session, the teachers showed much interest and understood that manipulating an IWB is not more complicated than a computer or projector.
- **Unit 2 – Software Basic Operation and Installation:** The second masterclass was described topics related to primary care, configuration, installation, and use of the OpenBoard and other utility software in the teachers' personals computers. Teachers must have continuous access to IWB related software tools to practices and familiarize themselves with the features offered by these technologies. All software used is open license.
- **Unit 3 - The Interactive Digital Whiteboard in the Classroom:** This masterclass described topics related to pedagogy, such as the introduction of ICT in education, the potential of the IWB in the teaching-learning processes, and didactic proposals with the use of the IWB. At the end of the theoretical review, was executed practical actions about the operation of OpenBoard tools and the location of the IWB in the classroom to improve student visualization. Then, each one of the teachers put into practice what they had learned through exercises that the trainer proposed during his intervention. Finally, it evaluated that the teachers comply with certain activities of information visualization and interaction with the content presented.
- **Unit 4 - OpenBoard for creating interactive activities:** The review of tools and methods to build and organize interactive content produced a didactic strategy that allows teachers to develop their interactive content. For this purpose, we propose to use existing interactive content on the OpenBoard platform that can be quickly adapted to improve teaching lessons. The adaptations include translating language content, building similar examples, and reproducing dynamics using images and information corresponding to the topics of teacher lessons. The essential interaction process employs animations and a pre-established sequence of actions.
- **Unit 5 - MS PowerPoint for the creation of interactive activities:** The learning process of teachers about interactive content naturally leads to adapting the content and creating new content. For this purpose, the MS PowerPoint tool proves to be the tool with the most suitable learning curve. The features offered by MS PowerPoint include the use of hyperlinks to link to different content. Gamification strategies permit the design of interactive and engaging activities for students with hyperlinks.

D. *Dynamic*

The dynamic proposed in this training model focuses on incorporating a follow-up system that allows the consolidation of the knowledge and skills acquired during the masterclass weekend sessions. This follow-up includes monitoring, problem-solving, and advice, where each occurrence generates a detailed report with relevant information about the reason for the occurrence, i.e., whether it is a technical, conceptual, or experience problem., as shown in Fig 1 - Follow-up phase.

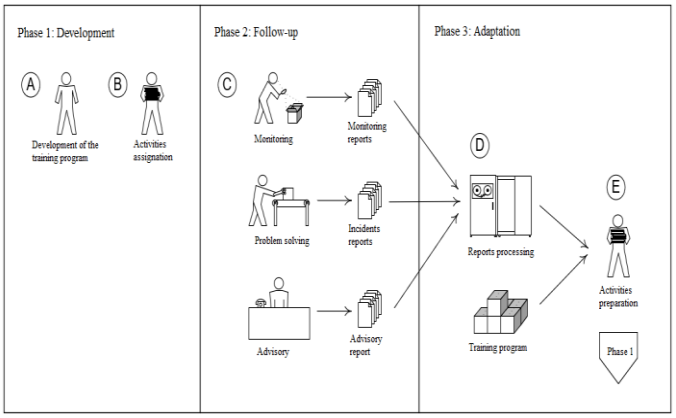

Fig. 1. Working process

The reports are essential to provide feedback to the training program and plan reinforcement activities according to the deficiencies found, as presented in Fig 1. - Adaptation, that will be included in the development of the activities of the next training day as shown in Fig 1 - Development.

V. Results

The data obtained in the initial information gathering questionnaire (Fig 2) reflect the teachers' knowledge before the training. As it can be seen, 97% of teachers did not know Linux / Ubuntu (operating system installed in the IWBs) or OpenBoard. Concerning digital whiteboards, only 21% had used some digital board at some point in their teaching career, compared to 79% of teachers who had never used this type of resource.

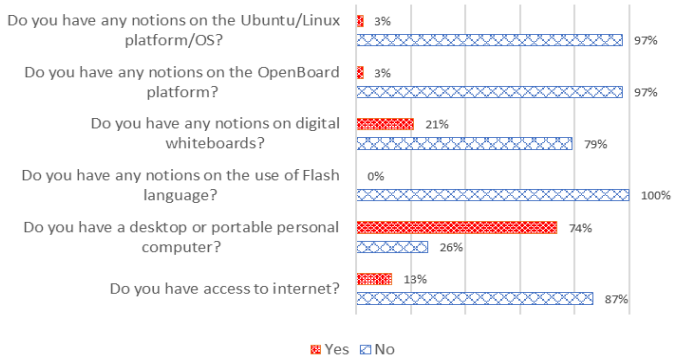

Fig. 2. Information gathering questionnaire.

According to the questionnaire, 74% of teachers had access to a personal computer. However, only 13% had access to an internet connection. This situation is evident since the Yanaquihua district is located in a rural area where speed and internet access are limited, and even mobile phone networks present some issues. Concerning the use of IWBs in the classroom during the training sessions (Fig 3), teachers under 30 are the ones who took more advantage of the functions of the IWBs.

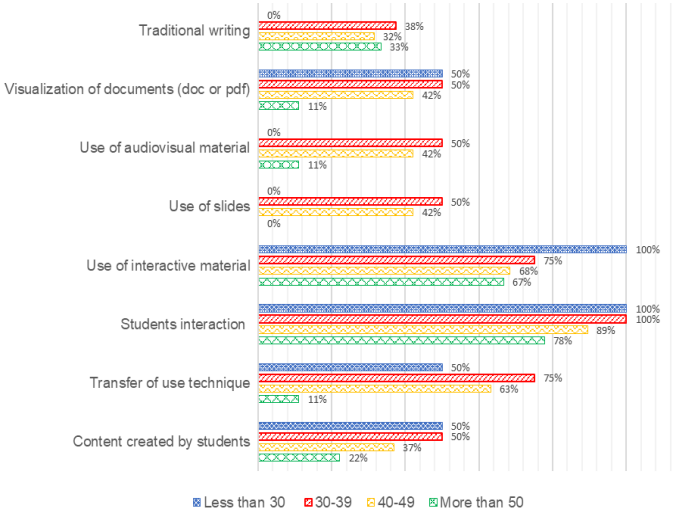

Fig. 3. Use of IWBs in the classroom by age group.

On the other hand, among teachers over 50, only 11% use documents and audiovisual material as support for their lessons. In addition, they do not prioritize the transfer of techniques nor promote content creation by the students.

The data obtained over the follow-up phase and interviews show that teachers perceive that IWBs positively impact student training and improve the educational process (Fig 4).

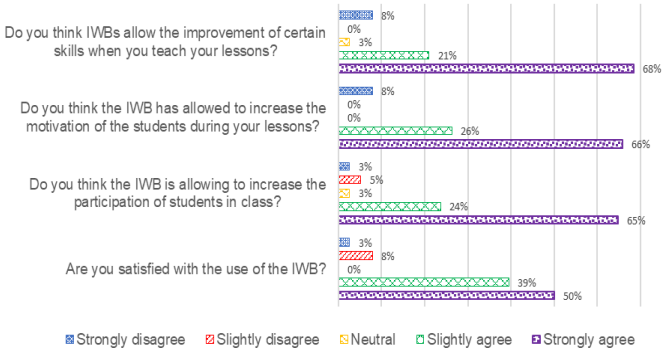

Fig. 4. Perception of the impact of IWBs on education

The last activity proposed during the training was creating interactive content applying the technical and pedagogical skills learned in the training model. Evaluate the performance achieved by teachers considers the rubric designed by Fernández-Pampillón, Domínguez, & Armas (2013).

Each teacher had to build an interactive content that should be used in their lessons with the students. Regarding the effectiveness of the material constructed, 29% of the teachers' tasks were excellent, and 50% were considered of good quality. Only 11% of the teachers required a more significant effort to achieve the planned objectives. In addition, 10% did not carry out the activity mainly due to time constraints (Fig. 5).

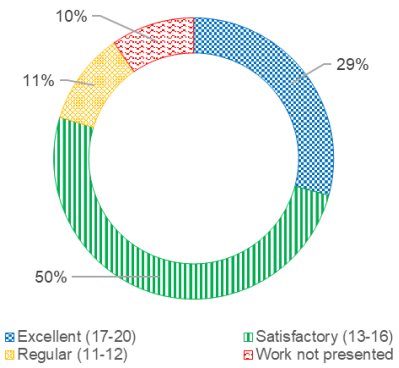

Fig. 5. Evaluation of interactive digital content development

The results show that teachers felt comfortable in carrying out these activities with IWBs (Fig. 6). However, no research was conducted on the students' opinions regarding using the IWB and the interactive content.

Fig. 6. Use interactive content and IWBs in the classroom.

VI. Conclusion

Adequate training, not only technical but also pedagogical, in IWBs is fundamental for investments in education to generate the returns expected by the educational authority and the student community. In this way, the equipment acquired does not become things that take up space without much use. However, the main conclusion is that the acceptance and adoption of IWBs depend directly on the knowledge and skills acquired by teachers during training processes. If this knowledge and skills allow the development of interactive content without significant efforts and frustration, this content becomes a means that facilitates the imparting of lessons and the transmission of knowledge.

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