

Development of an Educational Software Focused on the Learning of the Communication Subject for Elementary Students of the I.E. Las Verdes 36001, Huancavelica-Peru

Samuel Illapa Bellido Contreras, Brandon James Huamán Mallcco, Carla Milagros Fonseca Villar, and Nabil Moggiano

Abstract—Educational software involves every program that is intended to be used as a didactic resource in teaching and learning processes. This project puts into practice, the gamification of learning as a pedagogical method, improving the teaching process and cognitive development, through the use of software. Level Up Kids software was developed through the traditional/cascade methodology, focusing on each stage of the process for its development, divided in: Analysis, Planning, Design, Content, Development and Testing. As a result, there was an 31.81% decrease of failed students, out of a total of 132 students, taking as evaluation criteria, the grades obtained during the 3rd and 4th bimester of the year 2021, using the software in this last period. Considering the Level Up Kids software as a complementary tool for education.

Index Terms—Educative software, gamification, e-learning, ludic method, teamwork.

I. INTRODUCTION

Currently, in the face of the growing presence of Information and Communication Technologies, and their use as educational means and resources, the problems of sectorization and inequality of learning, as well as the bad study habits of students at the primary level, became evident.

The implementation of the ludic concept, hand in hand with the advancement of computer science and networks, facilitated the insertion of ludic methodologies in the educational area, such as support materials, which led to a need for verification and evaluation of these methods, in relation to the pedagogical quality they offered, being influenced, to variables of type, characteristics, disposition, availability and usability [1].

In this way, with the evidence obtained, and the variables collected, it was contemplated to create a creative and entertaining software that helps to have equitable learning for all students at the primary level for improving cognitive development in students.

The software has as an objective, to put in practice, the learning gamification as a pedagogic method, as well as, to promote the teamwork, through positive qualities and feelings.

Next the methodology used in the development of the software is mentioned, followed by the model of its

components, characteristics, and indicators. In the results section, the interpretation of the data obtained, before and after the use of the software, is presented. Finally, the conclusions obtained from the project are presented.

II. THEORETICAL FRAMEWORK

A. Educational Software

Educational software refers to a program or application that provides tools to teachers and/or students in order to facilitate and complement the teaching and learning process, with some particular features such as: ease of use, interactivity and monitoring of learning speed in students, through the management of educational material, schedules, academic notes, learning monitoring and even at the level of communication between teachers and students [2].

B. Gamification

It is a learning technique that refers to the inclusion of games to the educational environment, with the purpose of achieving better results, to better capture some knowledge, improve some skill, among other objectives. Gamifying is applying strategies (thoughts and methods) of games in non-playable contexts, in order that people adopt certain behaviors. Gamification is a technique, a method and a strategy at the same time. It starts from the knowledge of the elements that make games attractive and identifies, within a given activity, task, or message, in a non-game environment, those aspects that can be converted into games or play dynamics. All this to achieve a special link with users, encourage a change in behavior or convey a message or content. That is, to create a meaningful and motivating experience [3].

C. Traditional Method

In traditional methodologies the project is conceived as one of big dimensions and defined structure; the process is sequential, in one direction and without reverse; the process is rigid and doesn't change; the requirements are agreed at once and for the entire project, demanding long periods of prior planning and little communication with the client once it has been completed [4].

D. Ludic Method

The ludic activity is an empowering element of the various spheres that make up the personality of children in early childhood and is at the same time a condition for access to life and the world around them, because it generates various

Manuscript received May 12, 2022; revised June 13, 2022.

The authors are with Faculty of Engineering, Universidad Continental, Peru (e-mail: 75092993@continental.edu.pe, 70345941@continental.edu.pe, 70041413@continental.edu.pe, nmoggiano@continental.edu.pe).

feelings such as: affection, friendship, partnership, tenderness, which generally contribute to the education of feelings and positive qualities of personality from early ages, and is that through the game seeks to internalize attitudes, make personal decisions and give answers to others [5].

E. Teamwork

Teamwork is a task that is carried out by a group of members, in order to unite the knowledge, opinions, skills, abilities, ideas and efforts of each member, maximizing them and reducing the time of execution of tasks, to achieve a common goal. The greater the understanding and cohesion among all team members, the better the results that will be obtained at the end of each task [6].

F. Didactic Program

It refers to educational software used to support the teaching and learning process of students, because through these programs they can learn about a specific topic or subject with the help of visual and tactical activities, there are even didactic programs for students of all ages which have different didactic strategies [7].

III. METHODOLOGY

A. Data Collection Instruments

Records of the selected students' grades were used to obtain background information on the selected students' grades and to compare the data with the grades obtained after the implementation and use of the software. In Table I, the number of students selected for the object of study is specified.

TABLE I: NUMBER OF STUDENTS SELECTED FOR THE OBJECT OF STUDY

Grade Level	I.E. Las Verdes 36001
1 st	21
2 nd	23
3 rd	24
4 th	20
5 th	23
6 th	22
Total	133

B. Analysis Phase

In this stage, the objectives, scope and composition of the sequence to be carried out for the elaboration of the project were established. It was determined as a purpose to promote, in primary level students, the use of web pages as a learning alternative. As a general objective, to improve the cognitive development in students. And as specific objectives, gamma learning and encourage teamwork [8].

C. Planning Phase

It consists of the development of a strategic plan establishing the tools, instruments and means of outreach to be used before, during and after the development of the platform, which is shown in detail in Fig. 1.

At this stage, the basic structure of the website was defined by means of prototypes. In addition, the topics that will feed

the database were raised, according to the current curriculum of students belonging to the educational institutions already mentioned [9].

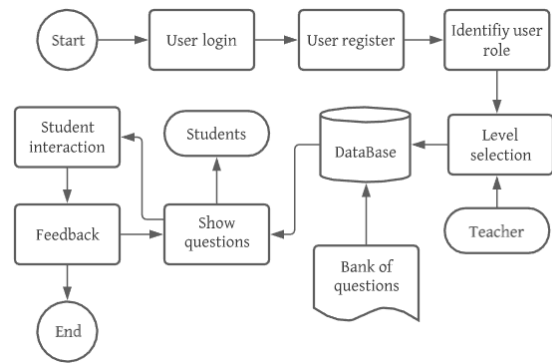


Fig. 1. System design flowchart.

D. Design Phase

The structure and interface of the web page has been designed, illustrated in Fig. 2; mainly considering:

- 1) The ludic method, which includes the improvement of the teaching process using different mechanics and elements based on games [10]. It's also known as game-based learning, encompasses the improvement of the teaching process through enjoyable activities in which educational content and topics can be included with the use of different strategies, mechanics, and game-based elements [3].
- 2) Usability refers to the ease with which users can interact spontaneously and without complications when performing a certain action in the software [4]. It consists of characteristics such as ease, simplicity, and intuitive use of the software [11].
- 3) Ergonomics, which encompasses the non-overloading of information in the user's interaction with the software [12]. In this case we have used this concept to adapt the software to human capabilities, so that users, in this case students, are not overloaded by the interaction with the educational software, but that it supports them in their learning process, making use of a design focused on the user experience [5].
- 4) Color psychology, concept in which it is detailed that colors are also a way to communicate and provide a different meaning to each element that is displayed in the software where it is convenient that each color goes according to what is sought to convey to users [13].
- 5) Efficiency is one of the important characteristics because it helps us to provide an appropriate performance in relation to the number of resources used, to avoid excessive consumption of resources in the devices in which the software is installed [1].



Fig. 2. Website user interface, designed in the Balsamiq Mockup software.

E. Content Phase

According to the results of the 2019 Student Census Evaluation (ECE), organized by the Ministry of Education (MINEDU) through the Office for the Measurement of the Quality of Learning (UMC), only 34.5% of elementary school students nationwide are at a "Satisfactory" achievement level in reading and writing, detecting a low learning achievement of 65.4% of the rest of the students [14]. For this reason, a bank of questions was prepared in relation to the subject of Communication, which were developed and verified in accordance with the National Basic Education Curriculum provided by MINEDU, focusing on the subject's competencies, shown in detail in Table II.

TABLE II: COMPETENCIES IN THE SUBJECT OF COMMUNICATION, ACCORDING TO NATIONAL BASIC EDUCATION CURRICULUM OF MINEDU [15]

Competencies in the Subject of Communication
Communicates orally in his/her native language
Reads different types of written texts in his/her mother language
Writes different types of texts in his/her mother language

The objective of the development of this educational software is to help students to reinforce the development of communicative competencies, so that in some way they also strengthen their skills and abilities in the other subjects mentioned in the National Curriculum of Basic Education, with a playful method that allows them to complement and measure their learning in a fun way, thanks to the fact that there is no fear of making mistakes, nor the pressure to get a better grade, but rather the motivation to earn points and move up a level in their learning. As mentioned in the table above, a student must be able to speak, listen, read and write adequately according to the context in which he/she finds him/herself, whether in school, social or cultural life.

F. Development Phase

We opted for the use of technologies provided by Microsoft, such as the development environment of Visual Studio 2019 and SQL Server 2014 as the database environment [16], which are illustrated in Fig. 3. As well as the hosting service of Microsoft Azure, through a gradual design and according to the specifications, using the programming languages of Asp.net core, JS and C#, also the tagging language - HTML and the style language - CSS [17].



Fig. 3. Website game options interface, designed in visual studio 2019 software.

G. Test Phase

Today's students are not like those of a few years ago, since today's children are already related to the use of some technological devices from a young age [18], that is why, at this stage, we chose to perform tests of synchronization, functionality, and usability of the website, which are detailed below:

- **Synchronization:** Ensuring that all changes made to the software are reflected consistently and accurately in all linked systems [19].
- **Functionality:** Verifying the integration of the software components in the web page, to ensure compliance with the expected functionalities, according to the quality criteria [19].
- **Usability:** To ensure a higher level of user satisfaction with respect to adaptability, simplicity, aesthetics, ease of use and navigation in the software [19].

Initially, by means of a local version, to later make use of the hosting service of Microsoft Azure and apply it in the lessons of the I.E. Las Verdes 36001, with the students selected for the object of study. Fig. 4 shows a student interacting with the Educational Software.

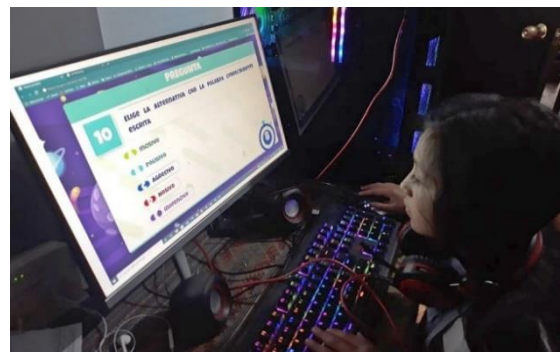


Fig. 4. Second grade elementary student using the software, courtesy of I.E. Las Verdes 36001.

At the same time, project metrics were obtained using tools such as SciTools Understand, which are shown in Fig. 5, specifying the structure and number of methods, controllers and functions used in the development of the Level Up Kids software, obtaining an optimal result.



Fig. 5. Metrics summary — Understand.

During this process, connection, design, and logic errors were found, which thanks to the tests carried out with the students, were detected, and solved in time, optimizing the web page and guaranteeing a good user experience for the students, which helped us to achieve the objectives initially

determined, such as improving the teaching process and the cognitive development of the students with the help of the educational software.

IV. RESULTS AND DISCUSSION

In Peru's educational system, the qualification score varies on a scale from C to AD, in which the minimum passing grade is B [20]. This information serves as a reference to be able to analyze the results obtained during the 3rd and 4th academic bimester.

The grades obtained in the evaluation process in the subject of communication before and after the application of the educational software showed a significant improvement in the grades of the students of I.E. Las Verdes 36001, in all of the six-level school evaluated, which are shown in Table III.

TABLE III: DESCRIPTIVE STATISTICS OF THE COMMUNICATION SUBJECT

	N	Grade	N	%
Pre_sw_1st	21	AD	2	10%
		A	8	38%
		B	9	43%
		C	2	10%
Post_sw_1st	21	AD	5	24%
		A	11	52%
		B	5	24%
		C	0	0%
Pre_sw_2nd	23	AD	1	4%
		A	10	43%
		B	8	35%
		C	4	17%
Post_sw_2nd	23	AD	4	17%
		A	12	52%
		B	7	30%
		C	0	0%
Pre_sw_3rd	24	AD	2	8%
		A	9	38%
		B	11	46%
		C	2	8%
Post_sw_3rd	24	AD	8	33%
		A	14	58%
		B	2	8%
		C	0	0%
Pre_sw_4th	20	AD	3	15%
		A	7	35%
		B	7	35%
		C	3	15%
Post_sw_4th	20	AD	6	30%
		A	13	65%
		B	1	5%
		C	0	0%
Pre_sw_5th	22	AD	3	14%
		A	12	55%
		B	6	27%
		C	1	5%
Post_sw_5th	22	AD	8	36%
		A	11	50%
		B	3	14%
		C	0	0%
Pre_sw_6th	22	AD	4	18%
		A	11	50%
		B	7	32%

		C	0	0%
		AD	7	32%
Post_sw_6th	22	A	15	68%
		B	0	0%
		C	0	0%

In the bar graph of Fig. 6, you can see the comparison between the average of the qualifications in the subject of Communication, before (3rd bimester) and after (4th bimester) of software implementation. In which we can highlight that the grades of the students of the 6 levels of primary education increased, after the implementation of educational software. Formatting toolbar.

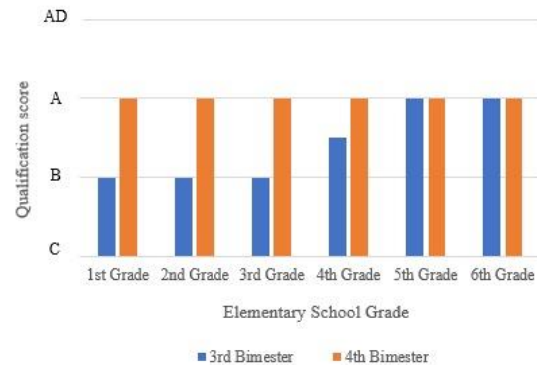


Fig. 6. Third and fourth bimester grade point average bar chart.

In Fig. 7, you can see the total number of students passed and failed during the 3rd and 4th bimester of the school year. The comparison between these 2 bimesters has been made, to represent the results before and after software implementation, where it is clearly visualized that the number of approved students increased by 42 in the last period, which represents 31.81% of a total of 132 students.

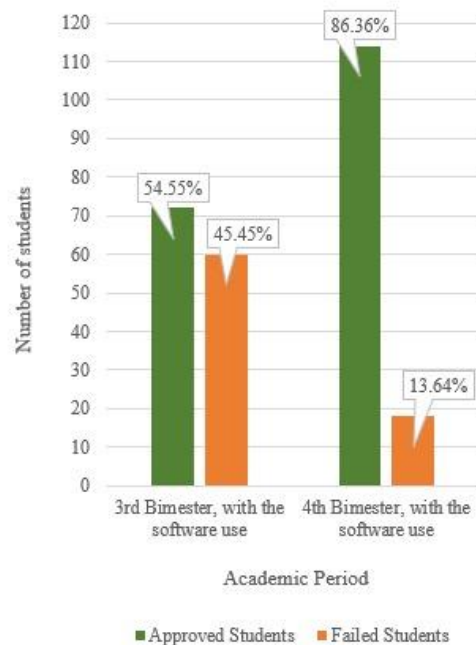


Fig. 7. Bar Chart of pass and fail students by bimester.

V. CONCLUSIONS

In the design phase, the structure and interface of the

website was outlined, including the ludic method that encompasses the improvement of the teaching process using different mechanics and game-based elements.

In the content phase, a bank of questions was prepared in relation to the subject of Communication, which were developed and verified in accordance with the National Basic Education Curriculum provided by MINEDU.

In the testing phase, the aspects of synchronization, functionality and usability of the educational software were verified, as well as the usability and ergonomics, increasing the degree of motivation in the learning process and the cognitive development in the students.

Finally, it can be considered the Level Up Kids software as a complementary tool for the improvement of the learning of the subject of Communication in the students of the I.E. Las Verdes 36001 in the elementary school level, due to the decrease in the percentage of failed students in 31.81% of a total of 132 students.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Samuel Illapa Bellido-Contreras and Brandon James Huamán-Mallco designed and developed the software; Carla Milagros Fonseca-Villar implemented and conducted the tests at the educational institution; Nabilt Moggiano advised, supervised and coordinated the writing of the paper; all authors had approved the final version.

ACKNOWLEDGMENT

The authors would like to thank to the Universidad Continental and I.E. Las Verdes 36001 for providing the environment and necessary resources to develop and execute the research.

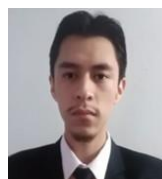
REFERENCES

- [1] F. R. Caballero, "Herramienta para la Selección de Software Educativo Aplicable al Área de Tecnología en Educación Básica," *SciELO*, vol. 11, January, 2017.
- [2] Z. Cataldi *et al.*, "Revisión de Marcos Teóricos Educativos para el Diseño y uso de Programas Didácticos," in *Proc. the V International Congress of Computer Engineering*, 1999, pp. 172-184.
- [3] F. Gallegos *et al.* Gamificación una propuesta docente diseñando experiencias positivas de aprendizaje. [Online]. Available: [https://rua.ua.es/dspace/bitstream/10045/39195/1/Gamificacio%CC%81n%20\(definico%CC%81n\).pdf](https://rua.ua.es/dspace/bitstream/10045/39195/1/Gamificacio%CC%81n%20(definico%CC%81n).pdf)
- [4] B. M. Montero *et al.*, "Metodologías Ágiles Frente a las Tradicionales en el Proceso de Desarrollo de Software," *Espirales Revista Multidisciplinaria de Investigación*, 2018, vol. 2, no. 17.
- [5] L. Vasilcovich *et al.*, "Empleo del Método Lúdico en la Formación de Sentimientos y Cualidades del Niño Preescolar," *EduSol*, 2016, vol. 16, no. 54, pp. 42-53.
- [6] P. Cardona and H. Wilkinson, "Trabajo en equipo," *IESE Business School*, 2006, vol. 3, pp. 1-8.
- [7] E. N. Rojas, "Programa didáctico para mejorar el pensamiento crítico en los estudiantes de la especialidad de Lengua y Literatura del segundo ciclo de la Escuela Profesional de Educación FACHSE-UNPRG," Master's thesis, Facultad Ciencias de la Educación con mención en Docencia y Gestión Universitaria, Universidad Pedro Ruiz Gallo de Lambayeque, Lambayeque, Perú 2019.
- [8] J. Gil-Quintana and E. P. Jurado, "La Realidad de la Gamificación en Educación Primaria," *Perfiles Educativos*, vol. 42, no. 168, pp. 107-123, April-June, 2020.
- [9] Ministerio de Educación - Gobierno del Perú, Oficina de Medición de Calidad de los Aprendizajes. (2019). Evaluación PISA 2018. [Online].

Available:
<http://umc.minedu.gob.pe/wpcontent/uploads/2019/12/PISA-2018-Resultados.pdf>.

- [10] L. S. Vasilcovich *et al.*, "Empleo del método lúdico en la formación de sentimientos y cualidades del niño preescolar," *EduSol*, vol. 16, October, 2015.
- [11] P. Buckley and E. Doyle, *Gamification and Student Motivation*, vol. 24, no. 1162-1175, August, 2016.
- [12] M. S. H. Schultenburg, "A Ergonomia E A Hedonomia Como Conceitos Nodesevolvimento De Uma Interface Web," *Ergodesign & HCI*, vol. 3, 2015.
- [13] J. F. C. Garcia, "Psicología del color aplicada a los cursos virtuales para mejorar el nivel de aprendizaje en los estudiantes," *Grafica*, vol. 5, no. 9, pp. 51-56, 2017.
- [14] U. M. Peru, "Evaluación de logros de aprendizaje," 2019. [Online].
- [15] Ministerio de Educación - Gobierno del Perú (April 25, 2020). Currículo Nacional de Educación Básica. [Online]. Available: <https://cdn.www.gob.pe/uploads/document/file/1364676/RVM%20N%20193-2020-MINEDU.pdf>
- [16] S. Mukherjee, "SQL server development best practices," *International Journal of Innovative Research in Computer and Communication Engineering*, vol. 10, 2019.
- [17] HTML, Specifications. (2020). [Online]. Available: <https://www.immagine.com/eLibrary/ARCHIVES/SUPRSEDED/W3C/W980424S.pdf>
- [18] A. G. Ospina, "Las TIC en la Enseñanza de los Métodos Numéricos," *Sophia*, 2015.
- [19] D. E. Perez and A. A. Paumier, "Testing como Práctica para Evaluar la Eficiencia en Aplicaciones Web," *Revista Latinoamericana de Ingeniería de Software*, vol. 2, no. 5, pp. 307-309, 2014.
- [20] Minedu. (2020). Resolución Ministerial N° 193-2020. [Online]. Available: [cdn.www.gob.pe/uploads/document/file/1364676/RVM N 193-2020-MINEDU.pdf](https://cdn.www.gob.pe/uploads/document/file/1364676/RVM%20N%20193-2020-MINEDU.pdf)

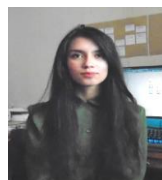
Copyright © 2022 by the authors. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited ([CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)).



Samuel Illapa Bellido Contreras is a student of systems engineering and computer science at the Universidad Continental of Huancayo, Peru. He is a bachelor with a diploma in software engineering, a member of ACM Continental. With experience in web page development and teaching at the initial and primary level.



Brandon James Huamán Mallco is a student at the Faculty of Engineering, in the computer and systems engineering career at the Universidad Continental of Peru. With backgrounds in web development, his research interests are related to software development, cryptocurrencies, blockchain technology, and artificial intelligence.



Carla Milagros Fonseca Villar is from the city of Huancayo, Peru, is a system engineering student at the Universidad Continental, and has a degree in computing and informatics from the Instituto Continental, specializing in software development, computer networks, and cybersecurity. Her research interests are related to technological advances in the use of artificial intelligence, machine learning and natural language processing for the benefit of education and the environment.



Nabilt Moggiano is a director of research at the Faculty of Engineering, Universidad Continental. She holds a master of disaster management from the National Graduate Institute for Policy Studies (GRIPS, Japan). She is the full member of the organization for women in Science for the Developing World (OWSD-UNESCO). She is a researcher in the National Registry of Science, Technology and Technological Innovation (RENACYT) in Peru.