Electronic toy for improvement of the process of literacy under language Braille in boys of the Area of no Seers of the Technical North of University

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Summary—the following project has like purpose improve the process of literacy under language braille in boys no seers of 3 to 7 years that allow to include them in the education by means of the use of an electronic toy braille. This project will have four modalities of operation: free Learning, Test of vowels, Test of alphabet, Test of numbers, each one designed chord to the solution posed.

The design this made by means of the tool of free hardware Arduino and other necessary components and adapted to the needs of the user.

Of the same way the implementation of this electronic toy turns into a project priority for the Area of no Seers of the Technical North of University, since at present this center does not have a specific tool for the education – learning braille.

Index of Terms— Braille, free Hardware, Education, Learning.

I. INTRODUCTION

In the Ecuador a good percentage of the total population suffers of some type of disability. Conscious that the education like entity sociality is the key tool to attain deep transformative processes and durable in the culture exists the need of positively in the training of people with visual disability, as well as the fact that important sectors of the society are suing fulfillment of his rights, like the equity between the genders, the elimination of social prejudices to the people that are "different". Ploughs to promote, strengthen his methods of education, speed up, develop of form ludic his learning, the access, the equivalence of circumstances and the right of a totally independent life, went the base for its proposal and begin to use it. The electronic toy for improvement of the process of literacy braille will be designed and implemented for boys no seers and boys with low degree of visual disability of 3 to 7 years of age. The feasibility of this didactic material considers optimum, since it will not cause damages to the boys on the contrary would improve his tactile skills, auditory and mental from early age, by means of a learning ludic and no only using methods and tools of pre – braille in macro types or simulators, programs and materials of different texture that simulates the six points that use like sign generator in the code braille.

II. REFERENTIAL FRAME

A. Current situation

Nowadays it finds people with disabilities that require of a better education, generally this type of enters want to learn to cost by himself same, is thus that in the actuality exist methods, tools and institutions that specialize to offer them a better education and allow them exert an important role in front of the society, with the end that his professional future improve as well as also his quality of life. With this the majority of people understand that with a disability can advance generously and with equality in front of a normal person, without disability any.

B. Disability

Defined by the DND eat: "A permanent deficiency of the distinct organs, devices or systems that does that a present person difficulty to make the activities of the daily life as for example: dress, eat, avoid risks, clean and personal hygiene, listen, see".

C. Types of visual disability.

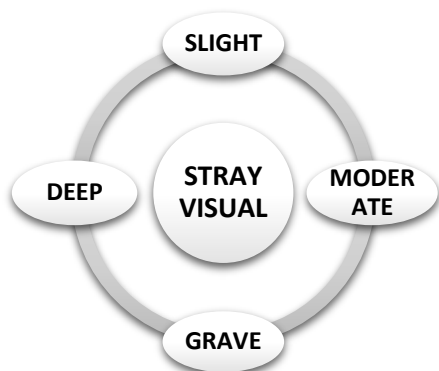The WHO classifies the different degrees of losses visual them in four categories, which show in the Figure 1.

Figure 1. Types of visual disability.

D. Methods of education braille

1) Alborada: That allows to learn to read, shows the letters in a logical order, considers a quite easy method to use and motivator for students adults, since it allows them from the start read words and sentences, this cartilage contains signs of punctuation, letters of the capital and tiny alphabet, numbers and vocals.

2) Bliseo: Ands a technician of instruction for adults already taught to read and write, in this method begins teaching the sign generator used in the code braille, afterwards enter the first letters in 3 different groups.

- Group 1: letters from (to until j)
- Group 2: letters from (k until the t), in this group or takes in account the ñ
- Group 3: letters from (or until the z)

3) Pérgamo: It is a method of literacy for people adults with blindness, the learning begins with the six points that presents the code braille, has an order of presentation of capital letters, tiny, afterwards will indicate the letters that are not very appointed eat: x, q, ch, k, w, ü; for afterwards follow with the letters pl, cl, bl, tr, between others; finally it learns the numerical signs and the signs of punctuation: point, comma,

two points, semicolon, question, admiration, comillas, bracket.

4) Point ready: Ands a method presented in Spanish and Catalan, is formed by two series.

- **First series:** it Constitutes a program of pre-reading and pre-writing; for the pre-reading, offers a chain of exercises with which will be able to execute a recognition of the sizes of geometrical forms such as: triangles, square, rectangles, circles, follow-up of horizontal and vertical lines, space locations with lines and square, series of diverse groups of points. Finally in this series speaks on the learning of the system braille, sign generator and his positions to start with to explore the first letters: to, b, l, and, or; as well as also it boards the pre-writing, and exhibit several methodological considerations that they will have to apply the professors.

- **Second series:** The education of the code braille, in which it presents all the letters of the alphabet, exercises of tactile recognition and identification to combine the previously learnt letters and begin with the reading of syllabus, words and sentences, the order of education presents with the education of sign common generator, vocals, tiny alphabet, sign generator capital letters, sign generator numbers of 0-9, signs of punctuation, all this contains drawings in high relief as well as it also contains the illustration of the method and of how the teachers have to use it.

5) Thyme: It is a method in which it initiates with the reading braille and the tactile exploration, oriented to children, exhibit short and simple sentences that the child can conceive formed of linguistic combinations that a boy can perceive with ease. For this subject use   didactic materials with high relief of in accordance with the ages, initially enter the vowels, gone on down a sequence of the letters in the following order: to, or, or, and, l, p, á, b, c, d, m, sign of capital letter, point, i, n v, or, s g, t, f, r í, ll, j, z, ñ, é, h, and, ch, ú, q, rr, r, gu. They employ first the letters with more ease in front of the touch, gone on down the

letters with more hamper phonetics avoiding the composition with symmetrical letters, finally employ double space to facilitate the reading.

E. Tools of education braille

1) Manual writing: it executes with a punch (resembled a small lezna), with which drills the paper, is planted on a support called guideline affirmed by a refill, exist in several sizes and forms, whose generic designation is the one of regleta, in the Figure 2 observes this type of material.
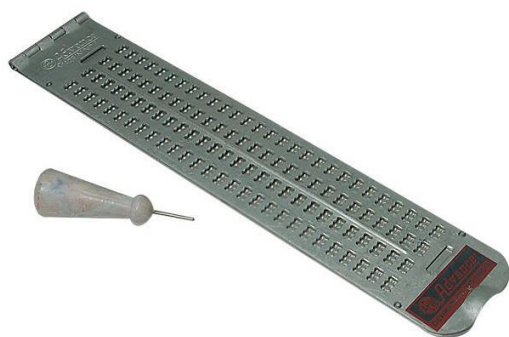

Figure 2. Strip and Punch.

2) For mechanical writing: they use tools that base in the perforation of paper by means of crowbars that the instrument possesses, this machine is known with the name of "perkins". As it shows in the Figure 3.

Figure 3. Machine Perkins.

3) Braille Spoken: It is a portable tool that allows the processing and storage of the information through a keyboard of seven keys, allows to reproduce synthesis of voice and also of way

impresa in high relief or code braille, admits to connect to a Pc. This tool shows in the Figure 4.

Figure 4. Braille Spoken.

4) Line braille: it allows to reproduce information that finds in the computer by means of the line braille in shape of points or better known like braille ephemeral. Can appreciate the form of this tool in the Figure 5.

Figure 5. Braille Line.

5) Thermoform: Machines of termo formed see Figure 6, allows to duplicate tactile images in seconds, this type of machineries, by his physical characteristics is recommended for short texts or feet of illustrations in relief, since, as they show the beneficiaries, presents several problems of tactile perception for extensive use.

Figure 6. Machine Termo Formed.

6) Material form on support of paper: The material form in braille is done by rotary and special machineries that print the letters in high relief on paper finer and thickness that the one who usually uses to print or draw.

7) Materials Macros: there are institutions that use didactic materials or macros that do reference to the code braille, this type of material help to boys to develop of better way the skill of touch. To continuation in the Figure 7, presents the material that usually use these centers to start with the education and literacy of the system braille.

Figure 7. Materials Macros.

III. I DESIGN ELECTRONIC TOY

To make the design of this project made a diagram of initial blocks to comprise that it is what wants to make with the use of the toy braille to arrive to a final result. In the Figure 8, shows said diagram.
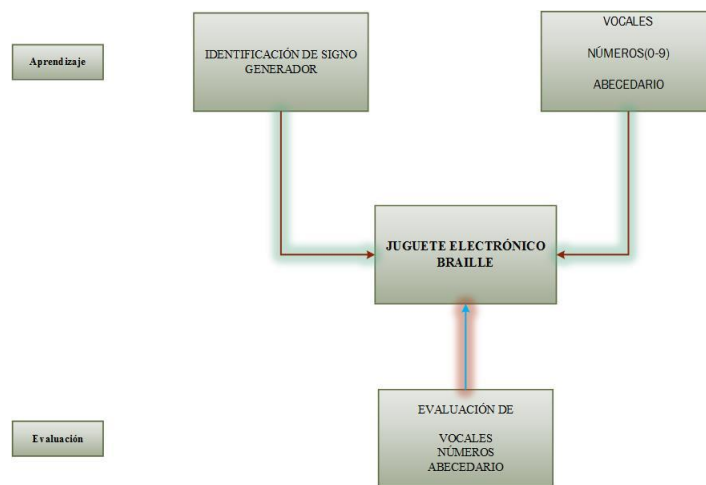
Figure 8. Diagram of initial blocks.

A. Hardware of the project.

For the design of this project made the selection of hardware eat:

1) Platform based in free Hardware

It considered adapted use the platform Arduino Mega 2560, that in spite of having little space by heart and a small processor has a big quantity of pines, is the platform adapted to develop projects of Hardware of small, average and high range, has an IDE amicable with the user, easy to handle and install, in addition to that has a big variety of resources of learning. In the Table 1 shows the technical characteristics of this platform.

Table 1.
Technical specifications Arduino Mega 2560

CARACTERISTICAS TECHNICAL	
Microcontrollers	ATmega1280
Microprocessor	2560
Tension of operation	5V
Voltage of entrance (recommended)	7-12V

Voltage of entrance (limits)	6-20V
Digital pines I / Or	54 (Of which 15 provide exit PWM)
Pines Of analog entrance	16
Current DC by And / S Pin	40 mA
Current DC of 3.3V Pin	50 mA
Memory flash	128 KB (4 KB used by the agent of start.)
SRAM	8 KB
EEPROM	4 KB
Speed of clock	16 MHz
Largo	108mm
Width	53mm
Weight	55g

2) Module of audio

The module of audio selected for the design of this application is the module DFPlayer mini, a small module that allows to insert a card SD of until 32 GB of capacity, what with an exit of direct audio to speakers, bears a system of archives Fat 16 and Fat 32. In the Table 2 shows the specification of pines of this device.

It bears archives with format WMV, WAV and Mp3, bears devices of audio of until 3Watts of power.

Table 2.
Specification of pines module DFPlayer mini

PIN	SYS	DESCRIPTION	FUNCTION
1	VCC	Voltage of feeding	Feeding of entrance
2	RX	Reception	Reception of data
3	TX	Transmission	Transmission of data
4	DAC_R	Channel of left audio	Exit of audio PWM to the speaker.
5	DAC_L	Channel of right audio	Exit of audio PWM to the speaker.
6	SPK2	Speaker +	Exit of audio +
7	GND	Ground	Put to earth
8	SPK1	Speaker-	Exit of audio -
9	IO1	Trigger Port 1	Trigger Divide 1
10	GND	Ground	Put to earth
11	IO2	Trigger Port 2	Trigger Divide 2
12	ADKEY1	Ad Port 1	Declining volume/previous track
13	ADKEY2	Ad Port 2	Volume increases/following track
14	USB+	USB+ DP	Port USB
15	USB-	USB- DM	Port USB
16	BUSY	Playing Status	Signal Busy

3) Buttons

For this application has selected buttons with pressure or retention since these work with 2 states and is what needs for the operation of this electronic prototype.

At present in the market exists a variety of button with these specifications, thus, uses the button that shows in the Figure 9.

Figure 9. Pulsador With retention.

B. Design of the Hardware of the project

1) Design of the board of punctuations

Sand uses 10 buttons of which 6 of them form the Sign Generator 2, the 4 remaining buttons uses them to him like Sign Generator 1 for numbers and capital letters as it can observe in the Figure 10.
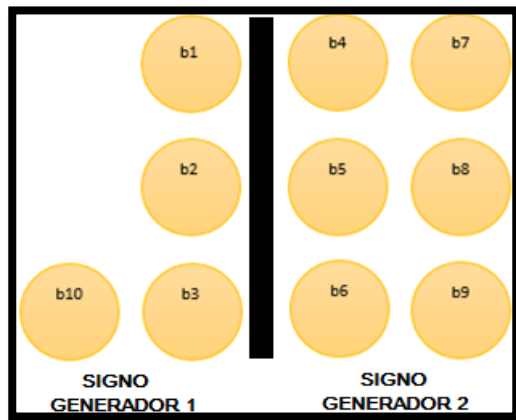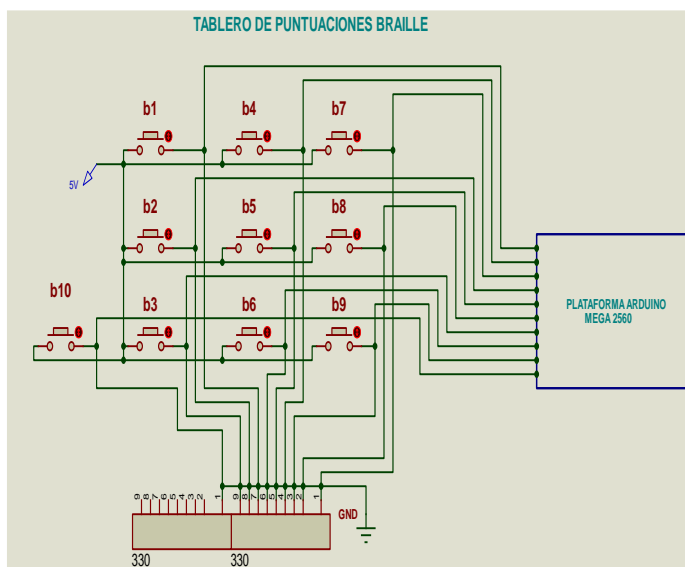
Figure 10. Board of punctuations braille.

Figure 11. Diagram of connection board of punctuations.

Each pulsador represents a digital signal, whose logical levels represent like "0" logical or "1" logical.

2) Design of the board of control

Figure 12. Board of control.

These buttons distribute of the following way:

- ### *Button for Way Learning*

To the press this button issues an audio that says way learning, method in which the user can learn vowels, numbers, capital alphabet, tiny, vocals, and signs of punctuation using different combinations braille. For example if press the button 1 and the button 2 of the Figure 35, issues an audio that represented that button has press next press the button ENTER and immediately will issue an audio which will indicate that letter has made , in case that the combinations of the buttons are not correct will not issue any audio.

- ### *Button for test of vowels*

To the press this button issues a signal of audio that says vowels, Next press the button ENTER which will issue another signal of audio that asks the vowel that has to combine, the user has to make the combinations of the buttons and press the button ENTER again which will issue an audio that will say if it is correct or no the combination made. This

practical method allows to the user make the combinations of vowels of orderly form from to until.

- ### *Button for alphabet*

To the press this button issues an audio that says alphabet, next the user has to press the button ENTER so that it issue another audio in which it asks that letter has to combine by means of the 6 points braille, already made the necessary combinations press again the button ENTER to verify if the combination is correct or no. This method is for the tiny alphabet the process is random.

- ### *Button for numbers*

To the press this button will issue an audio that says numbers, the user immediately has to press the button ENTER that will issue another audio which will ask the number to combine by means of the 6 points braille already made the necessary combinations press the button ENTER that verifies if the combinations are correct or no.

- ### *Button ENTER*

For any one of the modalities of operation of the toy uses the button ENTER, this button allows to verify the combinations that make for any letter, character or number.

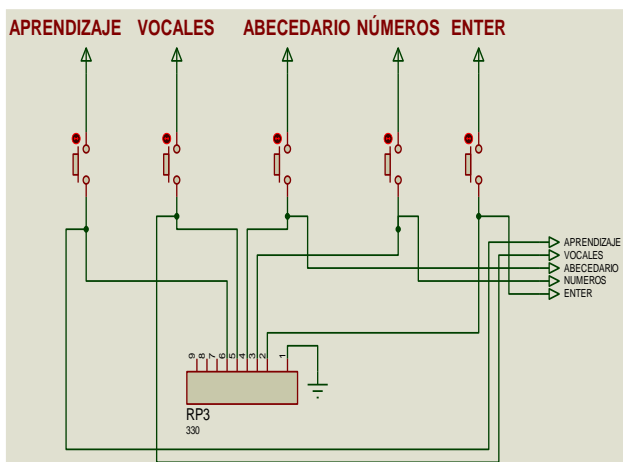In the Figure 13 shows the connection of the board of control.

Figure 13. Diagram of connection board of control.

C. *Design of the software of the project.*

For the development of this application made a combination of bits to make the different combinations that represent the letters of the alphabet, numbers, vowels, signs of punctuation, among others. To continuation in the Tables 3, 4, 5, 6 and 7, shows the combinations made for tiny letters, capital, vowels, numbers and signs of punctuation respectively.

Table 3.
Combination of bits tiny alphabet.

Letter	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10
a	0	0	0	1	0	0	0	0	0	0
b	0	0	0	1	1	0	0	0	0	0
c	0	0	0	1	0	0	1	0	0	0
d	0	0	0	1	0	0	1	1	0	0
e	0	0	0	1	0	0	0	1	0	0
f	0	0	0	1	1	0	1	0	0	0
g	0	0	0	1	1	0	1	1	0	0
h	0	0	0	1	1	0	0	1	0	0
i	0	0	0	0	1	0	1	0	0	0
j	0	0	0	0	1	0	1	1	0	0
k	0	0	0	1	0	1	0	0	0	0
l	0	0	0	1	1	1	0	0	0	0
m	0	0	0	1	0	1	1	0	0	0
n	0	0	0	1	0	1	1	1	0	0
ñ	0	0	0	1	1	0	1	1	1	0
o	0	0	0	1	0	1	0	1	0	0
p	0	0	0	1	1	1	1	0	0	0
q	0	0	0	1	1	1	1	1	0	0
r	0	0	0	1	1	1	0	1	0	0
s	0	0	0	0	1	1	1	0	0	0
t	0	0	0	0	1	1	1	1	0	0
u	0	0	0	1	0	1	0	0	1	0
v	0	0	0	1	1	1	0	0	1	0
w	0	0	0	0	1	0	1	1	1	0
x	0	0	0	1	0	1	1	0	1	0
y	0	0	0	1	0	1	1	1	1	0
z	0	0	0	1	0	1	0	1	1	0

Table 4.
Combination of bits alphabet majuscule.

Letter	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10
A	1	0	1	1	0	0	0	0	0	0
B	1	0	1	1	1	0	0	0	0	0
C	1	0	1	1	0	0	1	0	0	0
D	1	0	1	1	0	0	1	1	0	0
E	1	0	1	1	0	0	0	1	0	0

	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10
F	1	0	1	1	1	0	1	0	0	0
G	1	0	1	1	1	0	1	1	0	0
H	1	0	1	1	1	0	0	1	0	0
I	1	0	1	0	1	0	1	0	0	0
J	1	0	1	0	1	0	1	1	0	0
K	1	0	1	0	1	0	1	0	0	0
L	1	0	1	1	1	1	0	0	0	0
M	1	0	1	1	0	1	1	0	0	0
N	1	0	1	1	0	1	1	1	0	0
Ñ	1	0	1	1	1	0	1	1	1	0
O	1	0	1	1	0	1	0	1	0	0
P	1	0	1	1	1	1	1	0	0	0
Q	1	0	1	1	1	1	1	1	0	0
R	1	0	1	1	1	1	0	1	0	0
S	1	0	1	0	1	1	1	0	0	0
T	1	0	1	0	1	1	1	1	0	0
U	1	0	1	1	0	1	0	0	1	0
V	1	0	1	1	1	1	0	0	1	0
W	1	0	1	0	1	0	1	1	1	0
X	1	0	1	1	0	1	1	0	1	0
Y	1	0	1	1	0	1	1	1	1	0
Z	1	0	1	1	0	1	0	1	1	0

Table 5.
Combination of bits for vowels

Vowel	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10
a	0	0	0	1	0	0	0	0	0	0
e	0	0	0	1	0	0	0	1	0	0
i	0	0	0	0	1	0	1	0	0	0
o	0	0	0	1	0	1	0	1	0	0
u	0	0	0	1	0	1	0	0	1	0
á	0	0	0	1	1	1	0	1	1	0
é	0	0	0	0	1	1	1	0	1	0
í	0	0	0	0	0	1	1	0	0	0
ó	0	0	0	0	0	1	1	0	1	0
ú	0	0	0	0	1	1	1	1	1	0

Table 6.
Combination of bits for numbers

Number	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10
1	1	1	1	1	0	0	0	0	0	1
2	1	1	1	1	1	0	0	0	0	1
3	1	1	1	1	0	0	1	0	0	1
4	1	1	1	1	0	1	1	0	0	1
5	1	1	1	1	0	0	0	1	0	1
6	1	1	1	1	1	0	1	0	0	1
7	1	1	1	1	1	0	1	1	0	1
8	1	1	1	1	1	0	0	1	0	1
9	1	1	1	0	1	0	1	0	0	1
0	1	1	1	0	1	0	1	1	0	1

Table 7.
Combination of bits for signs of punctuation.

Sign	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10
.	0	0	0	0	0	1	0	0	0	0
,	0	0	0	0	1	0	0	0	0	0
;	0	0	0	0	1	1	0	0	0	0
:	0	0	0	0	1	0	0	1	0	0
-	0	0	0	0	0	1	0	0	1	0
	0	0	0	0	1	0	0	0	1	0
?	0	0	0	0	1	0	0	0	1	0
	0	0	0	0	1	1	0	1	0	0
!	0	0	0	0	1	1	0	1	0	0
"	0	0	0	0	1	1	0	0	1	0
"	0	0	0	0	1	1	0	0	1	0
(	0	0	0	1	1	0	0	0	1	0
)	0	0	0	0	0	1	1	1	0	0

IV. IMPLEMENTATION

A. *Proofs of operation.*

The realization of the proofs has like purpose check the level of answer and acceptance that the Toy Braille can generate in the children. The proofs consisted in making an evaluation observativa to the users to describe the development of willing activities.

In the Figure 14, shows the proofs that made with boys of the Area of no seers of the north Technical University.

Figure 14. Proofs of operation.

For this has experienced an education with 20 boys 10 of them applying the usual method of education braille, that is to say with systems macros that simulate the sign generator braille and the 10 remaining applying the didactic toy, with the end to do a statistical analysis of feasibility of use when creating this electronic application.

It is precise to mention that not only can make an education – learning to boys with visual disability on the contrary also can it to him do with boys without disability. It is thus that the evaluation was applied to boys with visual disability and boys without disability.

The evaluation that made to the users is practical by means of the use of the toy braille and material macros that represent the Sign Generator Braille main, however the evaluator made an evaluation observativa to the children with the end to describe his exert, this by means of a list of collate, for next make a statistical analysis of feasibility of use of the application, that will allow to show that the toy braille is adapted for the education of boys with visual disability.

B. *Workshop of education – learning*

To check the functionality of this prototype made the workshop of education – learning to a girl with pertaining visual disability to the Area of no Seers of the north Technical University, this process has come it to him making during 4 consecutive months, with the end that the child learn the basic system braille in which it includes the following parameters of learning such as: sign main generator, of the sign generator for numbers, sign generator for capital letters, combinations for vowels, numbers, tiny alphabet and capital alphabet. To this evaluation adds a practical proof in which the student by means of score own shows has been his learning with the help of this workshop.

The level of learning that the user purchase will be evaluated practically by means of the use of the toy braille and described by means of a scale of

qualifications that the Ministry of Education presents. As it shows in the Table 8.

Table 8.
Scale qualifications

Qualitative scale	Quantitative scale
It surpasses the learnings required	10
It dominates the learnings required.	9
It reaches the learnings required.	7 – 8
It is next to reach the learnings required	5 – 6
It does not reach the learnings required	≤ 4

Of agreement to the results obtained in the evaluation of the learning of the child with visual disability concludes that the user obtained a score of 126/130 that is equivalent to a qualification of 9, 69/10. This qualification will allow to have the result of learning obtained by the student through the toy braille, due to the fact that the punctuation finds in the 9.69 concludes that the student Dominates the learnings required.

With these results can notice that the learning that the student obtained was well in addition to that it made it in less time that with the usual method. Initially it said that with the usual method the users no seers delayed of 8 months to 1 year in learning the alphabet braille, with this didactic method has checked that if it can reduce the time of learning in 50%.

V. CONCLUSIONS

With the investigation made determined that they exist several tools and methods for the education learning braille, which have like base the use of the sign generator braille, see Figure 35.

It made the design of a planning of learning based in the planning's that the Ministry of Education presents annually, to be able to make a workshop of education – learning in which it applies several important appearances that allow that the education carry of suitable way to boys with visual disability,

of equal way made a design of evaluation represented by a list of collate.

The toy didactic braille was implemented in the area of no seers of the north Technical University, exactly with 20 boys with the end to test the feasibility of use of the toy by means of a statistical analysis. Initially it observed something of difficulty to identify and manipulate the toy, however was acceptable and easy to use, of the same way the evaluation made to each one of them carried successfully, which concludes in that this didactic material is very feasible to use it.

The workshop of education made in base to the planning presented, this with the purpose to describe the learning that the students with visual limitation can purchase through the workshop in which they will learn to manipulate the didactic toy giving like this a beginning to his basic education braille and to his time show that the toy is feasible and optimizes considerably the time of learning in 50%.

The final result that obtained is successful due to the fact that the user that he received the workshop of education learning braille by means of the didactic toy, has obtained a qualification of 9, 5/10 which concludes that the/the student finds inside the Command of the learning required.

VI. RECOMMENDATIONS

Has to know the technical specifications of the elements that use in this type of applications with the end to keep them protected and like this obtain a material of quality and with a good operation, is recommended to use the leaves of data of the manufacturers.

For the design and creation of this type of toys is important to carry a logic of programming that was intelligible for the users as well as the design has to be comprehensible of agreement to what required learn, since it is elaborated for boys with visual limitation.

Take advantage of this tool to the maximum due to the fact that it finds designed with electronic tools of technology advanced that offer accessibility in the process of educational training.

It is important to include to people with different disabilities, not only with visual limitation in the daily activities, this project of thesis is created with the purpose to include to no seers in the current society and not to keep them forgotten by his disability.

It is recommended to work with this type of boys no more than two daily hours, since because of his disability upset quickly and tend to bore, which does that his work was not optimum.

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