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A Study of Elementary School Students’ Geometric Reasoning using Digital Origami Simulation Tool

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ABSTRACT

The purpose of this study is to explore the effects of applying Digital Origami Simulation System to promote sixth-grade students’ learning of geometric reasoning ability. The participants were 90 students who studied the sixth grade in central Taiwan. This research adopts quasi-experimental design. The participants are divided into two groups: experimental group and control group. The experimental group takes Digital Origami Simulation Tool to support learning, and the control group takes traditional teaching. The instruments included Assessment of Line Symmetrical Graphics and Graphics Reasoning Ability. Data collection required participants to perform a pretest, a post-tests and learning records. The results of the study are presented below. Experimental group students have greater performance on the ability to geometric reasoning than the control group ones. Overall, the effect of Digital Origami Simulation Tool in geometric reasoning helps the students improve their performances.

KEYWORDS

Geometric reasoning, Line symmetrical graphics, Origami, Digital origami simulation tool, Paper folding

1 INTRODUCTION

Art education, the purpose of arts education is not to train students to become artists but to inspire their different thinking mechanism. We know that scientists and artists have a very important job which is to discover new matters and stimulate more creativity. The Director-General Federico Mayro Zaragoza of the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1997 agreed with this idea. The researcher advocates that origami should incorporate such functions and applicability. The reason is that origami is not only a form of art. It possesses the learning function of hand-brain-eye coordination and can help students immerse in the process and unleash their potentials to discipline the body and mind. As the Paper Art Association of Hong Kong Chairman David Chan have ever said [1], “Origami can help train a person’s overall coordination skills, including hand, eye, and brain.” Therefore, the origami is a multi-learning tool. Because it can develops of students’ scientific cultivation, exploration, and deduction skills. [2]. Origami is originated from Japanese words. “Ori” means folding and “kami” means paper. Earliest historical records proven that Origami originally came from Japan. While the English name “origami” is adopted globally, another way of calling it is “paper folding,” although most people prefer the former. Origami requires no other tools aside from a square-shaped paper. A seemingly monotonous piece of paper can immediately become a 3D model through the simple folding it with both hands. The origami process can be referred to as a presentation of creativity. It is an art education and it also has been gaining respect from mathematics educators and spatial perception has become a core objective of schools’ mathematics education [3]. Under the new educational concepts, students are frequently encouraged to use daily essentials to explore geometric relationships and vocabularies, as well as understand line symmetry and other related mathematical concepts through origami [4]. In addition, NCTM (National Council of Teachers of Mathematics) established its 10-phase standard and the 3rd standard is geometry and spatial
perception. Pellegrino & Hunt [5] stressed that spatial ability presents the reasoning skills of visual patterns. When we apply spatial application skills to address our everyday problems, we are also applying our reasoning skills.

We can observe that children’s origami operation and use processing, techniques and strategies of origami denotes the application and transfer of a series of spatial pattern concepts. A planar piece of paper can be folded multiple times. The geometric concepts and spatial concepts used in the process can benefit students in terms of mathematical and scientific developments [6, 7]. During the paper-folding process, the shape and structure change between 2D and 3D. Students continuously manipulate the shape and structure and have already developed a correct image in their minds. Then, students fold the paper according to basic paper-folding techniques and compare their imagined image with the assigned origami shape and structure. Therefore, the emphasis of this study is to observe whether or not students’ observation or judgment of spatial figure reasoning skills changes before and after the origami activity.

Developing digital computer systems can compensate for the inadequacies of traditional classroom teaching and the two forms of teaching can complement each other. Moreover, another objective of the developing the “Digital Origami Simulation Tool” is to transcend the limitation of real papers. In traditional Origami process, unwanted creases are bound to appear after folding the paper repeatedly. These creases or wrinkles can be possibly removed by reverse folding though the effect is only limited. The same situation occurs using our system, but the good thing is you can just press the undo button, and the wrinkles will be completely gone. That is the benefit of using digital system. Also, the kind of paper being used in Origami can also affect the result of the process and the appearance of the paper. For example, if a person used a thick paper and it was folded repeatedly, it will result in errors and will also affect the folding accuracy. On the other hand, the paper will easily have cracks after repeated folding if the paper used is too thin. A digital system does not have these limitations [8].

This study developed two systems – “Line Symmetrical Graphics” and “Graphics Reasoning.” We call the two systems “Digital Origami Simulation Tool.” The purpose of this study is to develop a Digital Origami Simulation Tool. And we use the system to do 6 teaching sessions that determine whether or not Grade 6 students’ line symmetrical graphics of geometry and reasoning skills can be improved.

2 SURVEY OF RELATED RESEARCHES

Origami is intricately related to geometry and spatial concepts. The basic steps of origami are simple [9] and similar to Euclid’s geometry system as all proofs start with a few basic axioms [10]. In the mathematics textbooks of Taiwan’s Grade 4 and 5 students, students are taught how to produce right angles and discover isosceles triangle and right triangle properties through origami. In middle school textbooks, students are taught how to realize line symmetry and angle bisector through origami. In addition to ruler and compass construction, another good way to learn geometry is through origami [11, 12]. Geometry is a tool to learn mathematics and science. Through our experience with spatial situation, we can transform our knowledge of spatial geometry into creative thinking [13].

Origami involves creating different shape and structure through repeated folding of a piece of planar paper. The series of spatial structure changes is in fact the best observation target for the learner. It also represents a simple and interesting teaching activity for the development of scientific exploration and reasoning skills. Wehman and McLaughlin [14] classified visual-motor characterization into separation and continuous. The former indicates hand-eye coordination, which has a distinct starting point and end point. Continuous characterization indicates the continuous change and adjustment of a series of visual motion. Origami possesses the above two visual-motor characteristics. The continuous change of the paper shape and structure, and the planning of spatial relationships are very beneficial toward the training of creativity.
People with poor spatial visualization ability are often unable to create 3D shape and structure from 2D graphics because their spatial visualization creates confusion and thus their answers are affected. Some scholars believe that spatial ability refers to the ability to perform mental rotation of 2D or 3D graphics using mental imagery after acquiring the related 2D and 3D information, as well as the ability to grasp the cognitive process and surrounding relationships of mental rotation [15, 16, 17]. The spatial concepts of children are shaped as they grow up. Spatial concepts are built on the foundations of location, distance, and displaced spatial concept awareness. The ability to distinguish between up/down is developed before the ability to distinguish between left/right. Distance, for example, far or near [18]. Also, direction is determined by using the self as a central representation before replacing the self with other people or objects.

“Spatial rotation and movement ability” refers to the ability to distinguish and memorize 2D and 3D spatial graphics. “Spatial visual imagery ability” is the utilization of reasoning to imagine or visualize the graphic characteristics or relations. “Spatial orientation ability” is the ability to determine the direction and relative position of objects, and “Spatial orientation application ability” denotes the ability to address spatial orientation issues in our everyday lives [19]. These abilities are highly correlated to our everyday lives, e.g., reading maps, road signs, the size of objects, and spatial location. Hoffer [19] noted that if students have difficulties with these abilities, they could write upside down or be confused with the characters “d” and “b”. Therefore, training students’ spatial perception is the key to developing their problem-solving skills in the future, especially visual spatial problems.

The Digital Origami Simulation Tool developed different from general animated paper-folding systems, famous websites such as the origami-club (http://www.origami-club.com) can only display one form of paper folding. Since the functions available include only play, forward, rewind, pause and adjusting play speed, the system cannot directly demonstrate the operating behavior of paper-folding. There is also the Origami Paper Airplane Folds in 3D [20], which runs on the tablet PC. While this is a 3D origami system that allows for free paper rotation and scale, the paper-folding screenshots are pre-recorded.

3 METHODOLOGY

3.1 Research Design and Participants

This study adopts a quasi-experiment approach in which the experiment group was taught the Line Symmetrical Graphics, Graphics Reasoning and the control group was administrated traditional teaching activity. A week prior to the teaching of the experimental group, both groups received a pre-test of the “Assessment of Line Symmetrical Graphics and Graphics Reasoning Ability.” In the experiment phase, the experiment group received 6 digital simulation system teaching sessions. Each session is 40 minutes. Two days after the experiment, a post-test was assessed to both the experiment group and the control group. Samples of this research were taken from 4 classes of Grade 6 students in central Taiwan, of which the experiment group consisted of 44 students and the control group consisted of 46 students.

3.2 Development of Instrumentations

This instrumentation consists of three items, Line Symmetrical Graphics, Graphics Reasoning and Assessment of Line Symmetrical Graphics and Graphics Reasoning Ability. A more details will be described below.

3.2.1 Line Symmetrical Graphics

This research created the “Line Symmetrical Graphics” as a modified and extended system from Open Media Laboratory of Chukyo University at Japan (http://www.om.sist.chukyo-u.ac.jp/research/origami/). The major purpose of the Line Symmetrical Graphics is to help students learn about line symmetry principles through a digital origami system, as well as learning by doing and leaning by self-observation through actual operation and exploration. In particular, students only have to follow the basic principles of “identify a straight line in a graphic, double fold along the straight line and so you can achieve entire overlap, and then this geometric graphic is a
symmetrical graphic.” “Learning by doing” is the most important element in a digital system. Figure 1 illustrates the operation of line symmetry.

![Figure 1. Line Symmetrical graphics – screenshot of digital origami system operations](image)

Therefore, this system forces students to prove through actual operation and observation whether or not line symmetrical graphics exists.

### 3.2.2 Graphics Reasoning

Graphics Reasoning was developed with the “Unity” game engine. This major purpose of the system is to train students: relative graphic position, spatial reasoning skill and moving/rotation skill. A picture with a transparent background is placed at the right hand side of the screen. The dashed lines in the middle represent folded lines. After the picture on the right is folded to the left so that the right and left overlap, students are asked what type of graphic would emerge (e.g. Figure 3). The purpose here is to train students’ graphic reasoning skill and test students’ graphic symmetry and relative position, as well as reasoning skill after the rotation.

![Figure 3. An example of the graphic reasoning](image)

There are two versions of Graphics Reasoning: game version and timed version. The game version is designed for students’ use in exercises, and the timed version is for their use in the actual testing. A total of 80 questions are provided in the game version to help students exercise and summarize their thoughts. Students can freely use the hint function, but the score will be lower every time they use it. To encourage students’ thoughtful response in the exercise process, students are awarded a puzzle depending on their score. The purpose of the puzzle is to stimulate students’ learning motivation.

![Figure 2. Survey questions](image)
The interface of the game version can be classified into “Scoring area,” “Puzzle area,” “Questions area,” “Options area,” and “Functions area” (see Figure 4). The “Scoring area” shows that when the score reaches 100, the student is awarded a puzzle. Collecting all 9 pieces of the puzzle completes a portrait. “Questions area” and “Options area” indicate the text description of the questions and answering options, respectively. “Functions area” provides students with hints so that when students are stuck, they can use the “paper folding” and “rotation” functions to help with their response. When students hit the “paper folding” function, the screen will show an animation of the right-to-left folding; when students hit the “rotation” function, the picture will be rotated clock-wise.

The interface of the timed version is classified into “Timing area,” “Hints area,” “Questions area,” “Options area,” and “Functions area” (refer to Figure 5). The “Questions area,” “Options area,” and “Functions area” are similar to the game version, while “Timing area” records the amount of time students spend on each question and “Hints area” provides the hint function. In the 25 questions of the test, students can only perform paper folding and rotation 4 times. It is therefore essential for students to consider carefully before using the hint function.

3.3.3 Assessment of Line Symmetrical Graphics and Graphics Reasoning Ability

After collecting and discussing the related literature of spatial ability, we designed 9 questions to evaluate students’ symmetrical graphics and graphic reasoning ability, as well as what questions are appropriate for elementary students. The researchers invited a panel of experts and senior teachers of elementary school mathematics, and asked them to modify the questions and create expert validity. After completing the draft of the pilot test, a test with an allotted time of 35 minutes was administered to 23 students form Grade 6. After statistical analysis, the Cronbach’s α of the 23 samples was .804. Therefore, the inventory used in this study has good reliability.

4 EXPERIMENTAL RESULT AND DISCUSSION

The researchers then analyzed the pre-test Assessment of Line Symmetrical Graphics and Graphics Reasoning Ability scores of students in the experimental group and control group. The experiment group averaged 63.2 (perfect score is 100), with a SD of 23.0, while the control group averaged 64.8, with a SD of 18.5. We also tested for the homogeneity of variance in both group, in which F was insignificant at 1.548 (p=0.075). The
The researchers then conducted independent t-test to determine whether the average score of the two groups differ in the pre-test. Results showed that the t-value was also insignificant at -0.361 (p=0.360). Therefore, analytic results showed that students’ pre-test scores in the two groups did not demonstrate significance. In other words, the Assessment of Line Symmetrical Graphics and Graphics Reasoning Ability of students in the two groups are identical prior to the experiment (Table 1).

Table 1. Comparison of the experimental and the control group in pre-test

<table>
<thead>
<tr>
<th>Group</th>
<th>Means</th>
<th>SD</th>
<th>F</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>63.2</td>
<td>23.0</td>
<td>1.548</td>
<td>-0.361</td>
</tr>
<tr>
<td>(n=44)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>64.8</td>
<td>18.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n=46)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*: p<0.05; **: p<0.01; ***: p<0.001

The researchers then examined students in the experimental group and control group after the former received 6 teaching sessions. A t-test analysis showed that the experimental group averaged 80.6, with a SD of 16.8, while the control group average 65.9, with a SD of 22.4. The post-test of the two groups showed significant difference as t=3.48 (p=0.0004). The statistical results are illustrated in Table 2.

Table 2. T-test of the post-test score for experimental group and control group

<table>
<thead>
<tr>
<th>Group</th>
<th>Means</th>
<th>SD</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>80.6</td>
<td>16.8</td>
<td>3.48***</td>
</tr>
<tr>
<td>(n=44)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>65.9</td>
<td>22.4</td>
<td></td>
</tr>
<tr>
<td>(n=46)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*: p<0.05; **: p<0.01; ***: p<0.00

Research results showed that after the Digital Origami Simulation Tool treatment, students in the experimental group have significantly higher scores than students in the control group. We should therefore promote this Digital Origami Simulation Tool to allow users to learn and observe by doing, and learn the concepts and applications of line symmetrical and graphic reasoning.

In addition, the researchers conducted an in-depth analysis of students’ response in the Line Symmetrical Graphics and Graphics Reasoning. In the Table 3, of the Line Symmetrical Graphics‘ 14 questions, the 44 experimental group students had an average correct response rate of 86.16%, and 14 students had perfect scores. Of the Graphics Reasoning’s 25 questions, students’ average correct response rate was 79.47%, and no student had a perfect score. The above shows that students find operating Line Symmetrical Graphics very easy. Also, after confirmatory operation, students are better able to verify whether a response is correct.

Table 3. Summary of results of experimental group

<table>
<thead>
<tr>
<th>Item</th>
<th>No.</th>
<th>Average correct response rate</th>
<th>Perfect scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetrical Graphics System</td>
<td>14</td>
<td>86.16%</td>
<td>14</td>
</tr>
<tr>
<td>(n=44)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphics Reasoning System</td>
<td>25</td>
<td>79.47%</td>
<td>0</td>
</tr>
<tr>
<td>(n=44)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition, since the timed version of Graphics Reasoning provides the hint function, we further examined the behavior of students’ response. In the Table 4, the 44 students in the experiment group spent an average of 182.8 seconds to complete the 25 questions and used the hint function an average of 1.4 times. In particular, 22 (50%) of the students did not use the hint function.

Table 4. Summary of results of Graphics Reasoning timed version

<table>
<thead>
<tr>
<th>Average answering time</th>
<th>Average use hit</th>
<th>Without use hit</th>
</tr>
</thead>
<tbody>
<tr>
<td>182.8</td>
<td>1.4</td>
<td>22 (50%)</td>
</tr>
</tbody>
</table>

A correlation analysis of the accuracy, time spent, and use of the hint function shows no significant relationships among the three variables. The analytic results are shown in Table 5.

Table 5. Correlation analysis of accuracy, time spent, and use of hint function

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Time spent</th>
<th>Use of hint function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Accuracy</td>
<td>-0.18</td>
<td>-</td>
</tr>
<tr>
<td>Time spent</td>
<td>0.04</td>
<td>-0.12</td>
</tr>
</tbody>
</table>

*: p<0.05; **: p<0.01; ***: p<0.001
The improvement of the experiment group students in the post-test mainly comes from the learning results of the Digital Origami Simulation Tool. Although the system provides students with a limited number of hints, students’ performance is not significantly correlated with the use of hint function. Therefore, if the hint function is taken out of the system, students’ error rate would still be the lowest. Therefore, practical operation of the Digital Origami Simulation Tool can boost students’ symmetrical and graphic reasoning abilities.

5 CONCLUSIONS

After 6 teaching sessions, the post-test performance of experimental group students reaches statistical significance. In other words, experimental group students shows significant improvement than the control group in terms of line symmetry, relative graphic position, spatial reasoning ability, and moving/rotation ability. Therefore, simulation learning can effectively help students establish the concepts of line symmetrical and graphic reasoning, learn from doing and observe, and learn by imperceptible influence. In addition, 50% of the students did not use the hint function but their error rate is still the lowest. This means that after taking the exercise, students can independently give responses without the support of the hint function. Although this experiment proves that the digital origami simulation system can effectively enhance students’ line symmetrical and graphic reasoning abilities. The effect on other influential factors is unknown, e.g., simulation learning strategy, presentation of animated teaching materials, and hint function etc. We suggest that future studies achieve more in-depth research results by different methods like interviews and observations.

ACKNOWLEDGMENT

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6 REFERENCES


A Study of Visualization for Hidden Relation between Published Documents and Message from Twitter by means of Sentimental Analysis Approach

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ABSTRACT

Recent years have found that information processing for social media can bring several kinds of effective results to us in the domains of industries, education, social science, economics, and so on. Such approaches, sometimes called sentiment analysis and/or opinion mining, are potentially applicable from trend analysis for industrial products and useful business services to embossment of human thinking, behaviour and/or emotion. This time our study focuses on Twitter used by students of some Japanese universities, acquires their tweeting data (messages on Twitter), analyzes sentimental values from the according data, and performs visualizing demonstration.

It also investigates existence of some relations between calculated sentimental values and location attributes of students’ universities. At the same time, it tries to discuss whether the above procedure and analysis can visualize conventionally hidden relationship between contents of tweeting messages and characteristics of universities categorization. One of the aims of this study is to help young persons to choose their suitable universities based on relationship visualized in the suitable manners and to provide some useful examples for extraction of sentimental values from categorized groups.

KEYWORDS

Sentiment Analysis, Twitter, Visualization of Hidden Relation, Data Mining.

1 INTRODUCTION

Data mining is one of the useful information processing techniques to extract characteristics or attributes from a huge amount of data from several phenomena. Some special-purpose filtering can extract useful pattern and information from the given data in a relatively short period. With suitable tuning of the filtering parameters, we will be able to obtain necessary relations and characteristics through data mining processes.

As you know, nowadays, we can watch very much various kinds of messages from Social Media, such as Facebook, Twitter, Blogs and so on. We can investigate several meanings embedded in the messages from Social Media through data mining approach. Information processing technique can show us interesting meanings of messages in Social Media by means of a suitable translation scheme from words in the above messages into numerical expression such as probability of occurrence.

This study has been challenging to realize some kind of data mining as an example of visualization of sentimental words extracted from messages of Twitter and relation between sentimental value and the relevant human group. We have defined translation scheme from words in message into sentimental values. And we apply this scheme into data mining, calculation of sentimental values for tweeting messages acquired from Twitter, and demonstration of relation between sentimental values and categorized human group.

The paper will describe an approach to extract sentimental messages from Twitter and its application to investigate characteristics of categorized human groups. And it will mention our trial visualization of potentially hidden relation between sentimental tweeting message and the relevant human groups. It introduces related works about analysis of message from Social media, calculation of sentimental values and visualization of relation between message and categorization in the next section. It illustrates our system configuration and structure of information processing for data mining in the third section. It
explains our results of analytical data with our defined translation scheme from message to sentimental values in the fourth section. It reports how to visualize relation between sentimental Tweeting and categorized human groups, and discusses whether proposed approach can provide suitable results to visualize useful relations in the fifth section. And finally it summarizes our conclusion in the last section.

2 RELATED WORK

This section introduces some suitable related works to design and implement our data mining approach for message from Social Media.

Yang Yu and Xiao Wang [1] of Rochester Institute of Technology USA, collected real-time tweets from U.S. soccer fans during five 2014 FIFA World Cup games using Twitter search API and used sentiment analysis to examine U.S. soccer fans' emotional responses in their tweets, particularly, the emotional changes after goals. They found that during the matches that the U.S. team played, fear and anger were the most common negative emotions and in general, increased when the opponent team scored and decreased when the U.S. team scored. Anticipation and joy were also generally consistent with the goal results and the associated circumstances during the games. Their project revealed that sports fans use Twitter for emotional purposes and that the big data approach to analyze sports fans' sentiment showed results generally consistent with the predictions of the disposition theory when the fanship was clear and showed good predictive validity.

Apoorv Agarwal and his team [2] of Columbia University USA, presented results for sentiment analysis on Twitter. They used previously proposed state-of-the-art unigram model as their baseline and reported an overall gain of over 4% for two classification tasks: a binary, positive versus negative and a 3-way positive versus negative versus neutral. They presented a comprehensive set of experiments for both these tasks on manually annotated data that is a random sample of stream of tweets. They tentatively concluded that sentiment analysis for Twitter data was not that different from sentiment analysis for other genres.

Mike Thelwall et. al. [3] from University of Wolverhampton UK, described “An analysis of Twitter may give insights into why particular events resonate with the population.” Their article reported a study of a month of English Twitter posts, assessing whether popular events are typically associated with increases in sentiment strength. Using the top 30 events, determined by a measure of relative increase in (general) term usage, the results gave strong evidence that popular events were normally associated with increases in negative sentiment strength and some evidence that peaks of interest in events had stronger positive sentiment than the time before the peak. It seemed that many positive events were capable of generating increased negative sentiment in reaction to them.

Kumamoto and Tanaka [4][5] in Japan, focused on the impressions people got from news articles, and propose a method for determining impressions of these news articles. Their proposed method consisted of two main parts: one part involved building an `impression dictionary' that described the relationships among words and impressions. Another of the method involved determining impressions of input news articles using such an impression dictionary. The impressions of a news article were represented as scale values in user-specified impression scales, like `sad - glad' and `angry - pleased'. Each scale value was a real number between 0 and 1, and was calculated from the words (common nouns, action nouns, verbs, adjectives, and katakana characters) extracted from an input news article using the above impression dictionary.

With reference of these previous works, we have started to build our system for acquisition of tweeting data, sentiment analysis and visualization of usually hidden relation.

3 SYSTEM CONFIGURATION

This session illustrates a scheme of our system for data processing flow and an important idea how to select sample accounts as well as acquire tweeting messages from Twitter.
3.1 Data Processing Flow of our System

Our system is configured with three major parts, namely acquisition of data from Web (Social Media), information processing scheme (data mining for acquired message from Web), and generation of documents by our system. Figure 1 shows schematic block diagram for our system.

![Figure 1. Schematic Diagram for System Configuration](image)

The leftmost part of our system is to connect Web-based Social Media (Twitter as our case) and to acquire amount of data to be analyzed. “twpro API” symbolizes selection facility to decide target group among the whole world. “Twitter API” plays a role of periodic data acquisition for the target group selected with “twpro API”. In our case, data to be acquired is tweeting message from Twitter. The number of account selected is 748. And acquired data from Twitter are approximately 2,280,000 numbers of tweeting messages.

The middle part is to present a series of manipulations for information processing from data into generated results which include some temporary files. These manipulations will be carried out from top to bottom sequentially. They are sometimes performed automatically. This part is the main body of our system and can accomplish some kind of sentiment analysis and generate our interesting results.

The rightmost part is to explain temporarily and/or permanently generated document files from the middle part. Some of them are output destination for one manipulation as well as input source for another one. All of them are to be analyzed in our study and these results possibly create useful evidences for trial visualization of relationship.

3.2 Acquisition of Tweeting Message

At first, we have decided the necessary accounts obtained from Twitter, which is the target of Social media for our sentiment analysis. We utilized an API in order to obtain accounting information and selected target accounts through which we obtain Tweeting message from Twitter. Figure 2 shows an example of retrieval results by using “twpro API” in Figure 1.

![Figure 2. Retrieval Results by means of “twpro API”](image)
account for users of Twitter by “twpro API”. We can, therefore, accomplish effective sentiment analysis for tweeting messages of selected account of Twitter.

4 SENTIMENT ANALYSIS

The first half of the section describes designing dedicated translation mechanism for our approach from extracted message to suitable words for sentiment analysis. The second one provides calculating sentimental values for selected tweeting message by means of utilization of translation mechanism.

4.1 Creation of Sentimental Dictionary

After acquisition of the target data to be analyzed from Twitter, suitable manipulation is necessary to do filtering words from sentences in acquired message in order to perform the first step of sentiment analysis. Such filtering manipulation can be carried out in the following ways:

1. getting one line (= taking a sentence from a message)
2. retrieving predefined character-string (= search parameter) in that line with pattern matching mechanism
3. accumulating times of detection for searched patterns from line to line
4. making a correlation between the total results during accumulation and the target message (= one tweeting)
5. aggregating each message into categorized group according to amount of total results

<table>
<thead>
<tr>
<th>Table 1. Category and Search Patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>category</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>$W_N$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>$W_P$</td>
</tr>
<tr>
<td></td>
</tr>
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<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

It is very important to predefine search patterns based on their sentimental meaning and to categorize tweeting messages according to occurrences of search patterns and their sentimental meanings. Table 1 shows category of sentimental meanings and their examples of search patterns. $W_N$ specifies set of words which do clearly Negative Sentiment, conventionally, and $W_P$ also specifies set of words which express clearly Positive Sentiment, conversely. We must define $S_N$ and $S_P$ according to frequency of appearance in a tweet message about $W_N$ and $W_P$. We assume that $w_N \in W_N$ and $w_P \in W_P$. $S_N$ is a set of tweeting messages which include $w_N$ and/or $w_P$ if and only if the number of $w_N$ is greater than the number of $w_P$, and $S_P$ is another set of tweeting messages which include $w_N$ and/or $w_P$ if and only if the number of $w_N$ is less than the number of $w_P$. $n(S_P)$ is number of $S_P$, while $n(S_N)$ is number of $S_N$. Figure 3 shows Venn diagram for Relation between $S_N$ and $S_P$.

![Figure 3. Venn diagram for Relation between $S_N$ and $S_P$](image)

Now, we can calculate conditional probabilities: $Pr_N(w)$ and $Pr_P(w)$ for a give word, respectively, as follows;

$$Pr_N(w) = \frac{n(S_N, w)}{n(S_N)} \quad (1)$$

$$Pr_P(w) = \frac{n(S_P, w)}{n(S_P)} \quad (2)$$

$n(S_N, w)$ is the number for “frequency of appearance” about the word: $w$ in the above set: $S_N$, 12
and $n(S_P, w)$ is also the number for “frequency of appearance” about the word: $w$ in the above set: $S_P$. With conditional probabilities (1)(2), we specify the relevant sentimental value: $sv(w)$ as the expression (3) using special additional weights: $weight_N$ and $weight_P$, where $weight_N = \log_{10}(n(S_N))$ and $weight_P = \log_{10}(n(S_P))$. These weights are simply defined to grow as $n(S_N)$ and $n(S_P)$ increase.

$$sv(w) = \frac{2 \times \Pr_p(w) \times weight_p}{\Pr_N(w) \times weight_N + \Pr_P(w) \times weight_P} - 1 \quad (3)$$

So we can define the sentimental values for given words. In the next subsection, we will show an example of sentimental value dictionary in Table 2.

### 4.2 Calculation of Sentimental Value

Calculation of sentimental values for extracted tweeting message using dictionary is one of the most important manipulations in our system to perform some kind of sentiment analysis approach. Based on arguments in the previous section, we have defined dictionary for sentimental values to make a correlation between selected words and their sentimental values. Table 2 shows an example part of our sentimental value dictionary. It presents Japanese words at the leftmost, their sentimental values at the middle, and their meanings in English at the rightmost.

<table>
<thead>
<tr>
<th>word</th>
<th>value</th>
<th>mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>mondai</td>
<td>-0.2</td>
<td>problem</td>
</tr>
<tr>
<td>syakkin</td>
<td>-0.29</td>
<td>debt</td>
</tr>
<tr>
<td>heiwa</td>
<td>-0.06</td>
<td>peace</td>
</tr>
<tr>
<td>hazimari</td>
<td>0.214</td>
<td>begins</td>
</tr>
<tr>
<td>hohoemi</td>
<td>1</td>
<td>smile</td>
</tr>
</tbody>
</table>

Our dictionary of sentimental value now has approximately 9,500 words of items in it. With references of such a dictionary, calculation of sentimental value for one sentence will be carried out, for example, in the following ways, which is shown in Figure 4. This Figure tries to present schematic illustration of mechanism to calculate sentimental value in the sentence-by-sentence manner using English expression instead of real Japanese message.

- At the upper case, Meaning of the first sentence is “I have a problem with my debt,” which really includes Japanese word {“mondai”, “syakkin”}. Each word can be converted into sentimental value {-0.2, -0.29}. And a total result of sentimental value for the relevant tweeting sentence is -0.49. The result is negative.
- At the lower case, the second is “Peace begin with a smile,” which really includes Japanese word {“heiwa”, “hazimari”, “hohoemi”}. Each word can be converted into sentimental value {-0.06, 0.214, 1}. And a total result of sentimental value for the relevant tweeting message is 1.154. The result is positive.

Just like the same ways shown in Figure 4, our system can calculate sentimental values for each tweeting message with our sentimental value dictionary. And moreover we can categorize users of accounts based on the criterion into some groups. After that, we calculate the average sentimental value for each categorized group for the sake of visualization of the relation between sentimental values and characteristics of patterns of thinking and behaving in the same categorized group.
5 DISCUSSION

This section presents discussion about results for sentiment analysis and demonstration for trial visualization, namely discuss whether to visualize hidden relation between sentimental value and characteristics of categorized group or not.

5.1 Demonstration to show Hidden Relation

We have focused on tweeting message from young persons, who are the students of 26 numbers of Japanese national universities with medical faculty. Table 3 shows categorized sentimental values for the 26 universities using normalized summation of sentimental values (calculated with expression (4)) for selected 20 students.

\[ SV(u) = \frac{\sum_{i=1}^{n} S(u_i)}{n} \]  

(4)

Table 3. Categorized sentimental values for each university

<table>
<thead>
<tr>
<th>University ID</th>
<th>Categorized Sentimental Values SV(u)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>0.109</td>
</tr>
<tr>
<td>02</td>
<td>0.218</td>
</tr>
<tr>
<td>03</td>
<td>0.229</td>
</tr>
<tr>
<td>04</td>
<td>0.268</td>
</tr>
<tr>
<td>05</td>
<td>0.284</td>
</tr>
<tr>
<td>06</td>
<td>0.306</td>
</tr>
<tr>
<td>07</td>
<td>0.311</td>
</tr>
<tr>
<td>08</td>
<td>0.313</td>
</tr>
<tr>
<td>09</td>
<td>0.321</td>
</tr>
<tr>
<td>10</td>
<td>0.325</td>
</tr>
<tr>
<td>11</td>
<td>0.328</td>
</tr>
<tr>
<td>12</td>
<td>0.338</td>
</tr>
<tr>
<td>13</td>
<td>0.352</td>
</tr>
<tr>
<td>14</td>
<td>0.357</td>
</tr>
<tr>
<td>15</td>
<td>0.362</td>
</tr>
<tr>
<td>16</td>
<td>0.364</td>
</tr>
<tr>
<td>17</td>
<td>0.374</td>
</tr>
<tr>
<td>18</td>
<td>0.398</td>
</tr>
<tr>
<td>19</td>
<td>0.418</td>
</tr>
<tr>
<td>20</td>
<td>0.428</td>
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<tr>
<td>21</td>
<td>0.431</td>
</tr>
<tr>
<td>22</td>
<td>0.439</td>
</tr>
<tr>
<td>23</td>
<td>0.447</td>
</tr>
<tr>
<td>24</td>
<td>0.462</td>
</tr>
<tr>
<td>25</td>
<td>0.495</td>
</tr>
<tr>
<td>26</td>
<td>0.672</td>
</tr>
</tbody>
</table>

SV(u) is categorized sentimental value, defined for each university: u and calculated by expression (4). S(u_i) is an average of sentimental values per one tweet on one day: i by the students of their belonging university: u. In (4), an interval of its summation can be specified from “Sampling Start Date: s” to “Sampling End Date: e”. And n is total number of tweets per one day.

So we can provide an example of base for “Rank Correlation” of the relevant 26 numbers of our universities by means of sentimental values from Twitter. Table 3 also shows the above example using our expression (4) in the mode of ascending order. With such an order of each university based on categorized sentimental values, we can probably some capability to visualize normally unrecognized, i.e. so-called ‘hidden’, relationship between trends/phenomena/behaviour of tweeting messages and the relevant categorized universities by means of the intermediation of sentimental values.

We can obtain a published data book for Japanese Universities, named “Daigaku no Jitsuryoku” [6] (in Japanese, its meaning of the book title is capability and current status of university). We have challenged to perform visualization of a hidden relationship between Japanese universities and their possessing students’ tweeting messages with reference of the above published data book. People of university, students and teachers, are very interesting in one of special information about ranking of university, for example, an order for “dropout ratio of students” at each university. So we have decided to demonstrate visualization of relation between categorized sentimental values for each university and dropout ratio of students at the corresponding university.

Figure 6 shows a scatter graph of the relation between Categorized Sentimental Value for each University and the corresponding Dropout Ratio of Students at University as a results of the above demonstration. From Figure 6, we can probably recognize some uncertain (we cannot describe suitably) relation between dropout ratio and sentimental value, because Spearman's rank correlation coefficient (\( \rho \)) is statistically calculated as \( \rho = 0.33 \) in this case. It seems that young people, students of university, who present their
tweeting message with higher sentiment values, belong to university which has higher scores of dropout ratio. So this result can probably demonstrate some relation between categorized sentimental value and characteristics of patterns of thinking and behaving in the correspondingly categorized group.

Of course, we have been investigating some feasible reasons for such a relation, but we cannot find globally useful and reasonable interpretation until now. So we do not definitely report that this is a meaningful example for “visualization of hidden relation” by means of sentiment analysis using message from Twitter.

### 5.2 Trial Visualization of Other Relations

In order to confirm that our approach is available for visualization of generally hidden and normally non-recognized relations, we have applied the same approach to investigate possible relations or dependencies among our categorized sentimental values, period of time to generate tweeting, numbers of students / teachers of universities, and location factors of universities. We can recognize accurate period of time to generate the relevant tweeting messages from Twitter. We can easily obtain correct information about the numbers of students/teachers from published data of statistics. Location factors of universities can be obtained from geometric data (also published).

Coefficients of correlation between sentimental values and period of time to generate tweeting are calculated and summarized as follows: $r = 0.06$ for anytime, and $r = -0.08$ for daytime (from 9:00 o’clock to 18:00 o’clock). We must determine that sentimental values can be independent from period of time to generate the relevant tweeting messages from Twitter. Secondarily, we have applied the same approach to determine whether or not there exist some possible relations between sentimental values and the number of students or the number of teachers. Figure 6 shows a scatter graph of relation between our categorized sentimental values for university and the numbers of students in the corresponding university. And Figure 7 shows a graph of the relevant relation between the categorized sentimental values for university and the numbers of teachers in the corresponding university.
calculated and summarized as follows:  
\[ r = -0.34 \] for student number, and  
\[ r = -0.46 \] for teacher number. We can assume that our categorized sentimental value is negatively-correlated with the numbers of students / teachers of the corresponding universities. The numbers of students and teachers can indicate or express scaling factor of the relevant university. So the above results might visualize some hidden relation between sentimental value and scaling factor of university, namely there are probably existing some dependency of sentimental value and scaling factor of university.

And finally we have applied our approach to determine whether or not there exist some possible relations between categorized sentimental values and population of the corresponding prefecture. Figure 8 shows a scatter graph of relation between our categorized sentimental values for university and the corresponding prefectural population.

![Figure 8](image.png)

**Figure 8.** Scatter Graph of Relation between Categorized sentimental value for university and prefectural population

Coefficient of correlation between sentimental values and population of the corresponding prefecture is calculated as  
\[ r = -0.18 \], and it is considered to be slightly negative relation between them. But we cannot definitely assume that there exists some relation between categorized sentimental value and population of the corresponding prefecture.

6 CONCLUSION

This paper described an approach to collect accounts of Twitter, acquire tweeting messages, create useful sentimental dictionary, calculate sentimental values, and aggregate sentimental values for categorized groups. And it also demonstrates some applications to visualization of some relations, which are normally not recognized and potentially hidden in our conventional environments. So it can show our trial application of sentiment analysis to visualization of hidden relation between categorized sentimental value and characteristics of patterns of thinking and behaving in the same categorized group.

Our aim of this research is to visualize some normally unrecognized relation, namely hidden relation in other words, using approach by big data analysis. This study can bring us amount of information, useful experience and suitable techniques for sentiment analysis for visualization. Simultaneously, it has provided a very important problems for us to resolve in the future.

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http://kyoiku.yomiuri.co.jp/torikumi/jitsuryoku/yomitoku/contents/1-4.php
Influential Agents in the Online Education Diffusion at a Mexican University: What the Social Network Analysis Tell Us

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ABSTRACT

Through a Social Network Analysis applied to a survey at a Mexican University the diffusion of online education dynamics in a 13 year period was determined. For the analysis, the 13 years was divided into four periods. Teachers answered the survey by identifying by name the people or University initiatives, including people outside the University, which influenced his decision to venture into online education. The most influential agents for each period were determined by their In-Degree value. For the analysis, the inter and intra periods influence of agents was considered. Three agents who held great influence in the diffusion in the most part of the period where identified, one of which kept the higher In-Degree value among teachers, and slightly lower than the node of University initiatives that promote online education. Is considered that the level of online learning diffusion in this University have been very limited without the influence of two influential agents in the overall process.

KEYWORDS

Social Network Analysis, Innovation Diffusion, Online Learning, Change agents

1 INTRODUCTION

The vertiginous development of Information and Communication Technologies (ICT) in recent decades has substantially transformed society as a whole. As a consequence of this development, authors such as Dolence and Norris [1] speak about the transition of industry period to the information period. Likewise, organizations like World Bank [2] and the OECD [3] contemplate a new economy based on the knowledge which Higher Education Institutions (HEI) demand. It is a change of paradigms in the teaching-learning processes promoted in México by the Secretariat of Public Education (SEP) [4] and the National Association of Universities and Institutes of Higher Education (ANUIES) [5].

For HEI, the pressure of the external context to incorporate ICT in their educational and administrative processes has focused to turn substantial resources in infrastructure that are not always implemented for the best [6]. On the other hand; teachers have technologies which they can use in their teaching, but without a full understanding of how to use them effectively from an educational perspective.

In this context of technological growth, the Internet is a disruptive technology that has changed rapidly HEI daily lives, and it is precisely this ubiquity of Internet, what allows enrichment of teaching practices by facilitating transition to focus the educational process into learning. Although web tools, initially find their common use in distance education as a way of replacing limitations of interaction in traditional remote models, its utilization is not restricted to this educational modality [7]. In general we can say that in México, as in the whole world, the incorporation of Internet in HEI without a long tradition in distance education favored its incorporation and experimentation into the traditional modality as a complementary support [8] that evolved from the online course topics, and alternating the study of online content with one-to-one sessions [9], [10] to make available complete courses on line ready to be taught via Internet.

Universidad Autónoma de Baja California (UABC) first researches related to online education started in 1996 with an acceptance, formalization and institutional support somewhat irregular over time [6]. Therefore, the aim of the
work is focused on knowing the process of online educational diffusion in UABC in 1996-2009 period.

2 METHOD

The UABC teachers involved in online education were the subject of interest, and 4523 invitations were sent through institutional email obtained from UABC employs database. The purpose was for them to answer a survey, provided that the first questions were not intended for administrative staff and teachers whom were not involved in online education.

LimeSurvey system was used for design and application of the online survey. This system allows exporting results in formats that make easier a subsequent manipulation into a spreadsheet.

The survey asked teachers to write down the year of involvement into the online teaching modality and the name of the person(s) responsible of their involvement in online education. The information was anonymous and registered in codes of two-letters and a number. The first letter from campus of origin and the second letter from the maximum level of education followed by a number. The data obtained from involvement process into online education was coded and manipulated for its analysis as social networks in Gephi program.

3. RESULTS

We obtained 324 valid surveys of the 4523 invitations that participate, because were the only ones fulfilling inclusion criteria into accurate analysis and teaching practices; and for dissemination process analysis we obtained 201 valid surveys. The survey was online for eight weeks and approximately every 15 days a reminder was sent to those who had not participated. Table 1.

3.1. Online Education Diffusion Process

To analyze the responses of 201 teachers whom indicated the year that were involved in online education and mention to the person(s) that motivate them to get involved in this teaching modality, four periods were defined starting in 1996 until the end of the survey on December 2009. Periods go from 1996 to 1998, another from 1999 to 2002, also from 2003 to 2007, and 2008 to 2009. The periods correspond to four different administrative periods in UABC, where the first and last ones include partial periods.

<table>
<thead>
<tr>
<th>Campus</th>
<th>Teachers by campus</th>
<th>Teachers involved in Online Education who answered the survey</th>
<th>Percentage who answered the survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensenada</td>
<td>1238</td>
<td>124</td>
<td>10</td>
</tr>
<tr>
<td>Mexicali</td>
<td>2136</td>
<td>109</td>
<td>5</td>
</tr>
<tr>
<td>Tijuana</td>
<td>2050</td>
<td>85</td>
<td>4</td>
</tr>
<tr>
<td>Tecate and San Quintín</td>
<td>28</td>
<td>6</td>
<td>21</td>
</tr>
</tbody>
</table>

There are two essential data for the analysis: one is that a teacher has indicated the startup period and the other is that at least he has mentioned someone else, or that she or he has been mentioned by another teacher. The preceding creates two data groups; a first group that at least mention one teacher who responded to the survey indicating its initial period, and a second group that also mentions to other teachers of UABC or external teachers but the initial period is unknown, this includes mentions to institutional programs or employees involved in these programs.

By the nature of the question (to mention the person(s) that led you to get involved in online education) the generated networks are directed and the most important is the In-Degree.

This analysis is presented for periods that describe primarily the characteristics of the network in which only UABC teachers are involved with defined period and then, to describe the network including external agents, institutional programs and teachers of UABC whom have not their period of involvement in the online education. In this analysis scheme will be incorporated the different periods as correspond.

1996-1998 period

From the amount of teachers whom responded to the survey and say they have initiated in this period, there are 13 elements that make up a
network with only 6 nodes connected by the influence of modality involvement as shown in Figure 1. In this group are identified in blue 10 teachers of Ensenada campus (E), 8 doctorate degree (D) and 2 persons with master's degree (M). 2 teachers in the Mexicali campus were recorded in red, one of them with a Master Degree and the other one with a Bachelor Degree (L), while only 1 teacher of Tijuana in green color with a master degree. In this figure are identified with an asterisk 3 nodes that are identified as responsible, in year 1996 of first studies of online education registered at the university; ED190, ED189 and ED191.

Figure 1. Teachers involved in online education between 1996 and 1998, the node size represents their relative importance to the network measured by their In-Degree value and colors define their Campus; blue for Ensenada, red for Mexicali and green for Tijuana.

The giant network component is formed by six nodes connected while the remaining are isolated. The average degree of linkage of the network is 0.462 with 6 links, 3 of them to ED190 node gives a In-Degree of 3, and defined as the most influential node of the period. The density of the non-directed graph is 0.055.

1999-2002 period
In this period, 32 teachers are involved in online education with 15 links where there are 16 teachers of Mexicali, 6 Doctorates, 9 teachers and 1 person with a bachelor degree; in Ensenada we have 12 teachers, 8 Doctorates and 4 persons with a master degree; and from Tijuana we have 4 teachers, 3 with a Master Degree and one with a Bachelor Degree (Figure 2).

Figure 2 shows that the network has 3 components; the giant component of the network with 10 nodes and two additional components with 3 and 2 nodes. The most influential node of the period was the MD162 with an In-Degree of 5, followed by the node MM168 with an In-Degree of 3. In this case the density of the non-directed graph is 0.036.

2003-2007 period
In this period there were 65 teachers who were involved in online education, but only 11 links are recorded. From this group 28 are from Mexicali, 9 Doctorates, 17 master’s degree and 2 graduates. In Ensenada 19 teachers are incorporated, 8 Doctorates, 9 with a Master Degree and 2 graduates. In Tijuana 15 teachers, 4 Doctorates
and 11 with a Master Degree while in Tecate; a
teacher is incorporated and in San Quentin is
incorporated one doctorate.
The 11 links cannot form a giant component when
they are not concentrated in a few nodes; however
the most influential nodes are those that have just
an In-Degree of 2 corresponding to MM91 node of
Mexicali and Tijuana TM94 node. The density of
the non-directed graph is only 0.003.

2008-2009 period
During this period of two years, 27 teachers were
involved in online education, and because of the
absence of links between them, it can be say that
its influence to get involved into the online
modality comes from agents of other periods.
This period incorporates 12 teachers of Ensenada,
4 Doctorates, 6 with a master's degree and 2 with a
bachelor degree, Mexicali have 7 new teachers, 3
of them which have doctorate and 4 teachers with
a master degree while in Tijuana are incorporated
8 teachers, 6 with a Master Degree and 2 with a
bachelor degree. Obviously the not-directed graph
density is 0.0.

3.2 Influences between periods
1996 to 2002 period
The influence that exerted the teachers that
adopted online education in the first period of
1996-1998 over the teachers that adopted online
education in the next period, 1999-2002, can be
seen in the Figure 3 where the node ED190, pioneer
in 1996, it is the most influential node with an In-
Degree value of 10 followed by the MD162 node.

Due to the beginning of online education occurs in
Ensenada, it is expected that their influence is
relevant not only in the Ensenada campus, but in
its distribution to other university campuses. So
we can see from the first period in Ensenada that 6
of the 9 are mentioned as teachers that were
influenced into involved in this modality. The
links between Mexicali teachers becomes stronger
in the second period.
This network have 31 nodes with 39 edges with a
giant component with values similar to the whole
network, 29 nodes, 93.55% of total nodes and 38
edges corresponding to the 97.44% of all edges in
the network. The density of the non-directed graph
is 0.084 indicating a very connected network
between all its nodes.

1996 to 2007 period
The influence that teachers had into the inter-and
intra-periods from 1996 to 2002 can be seen in the
Figure 4 where the most influential nodes remain
the ED190 node of the first period and from the
second period is MD162 node with an In-Degrees of 20 and 14 respectively. Teachers of the third period mention to 17 teachers of the first period and to 27 of the second period indicating a greater influence of the members of the second period over the third and the first period. Despite this, such individual nodes, the influence of ED190 node from the first period is substantially towards to the members of the third period as is shown by the links of the third period directed at this node. On the other hand it is evident the influence of MD162 node in the second period to the third period teachers.

For the third period, from 2003 to 2007, the MD93 node was the most influential with In-Degrees of 4 and analyzing the figure shows that 3 of these In-Degrees comes from the previous period, which suggesting that their influence was accentuated during the third period, possibly influenced by the MD162 node of the second period. These three periods form a network of 73 nodes and 95 links with a giant component of 63 nodes, 86.3% of the total, and 89 links which correspond to 93.68% of the total. The density of the non-directed graph is 0.018.

1996 to 2009 period

The Figure 5 shows the links of inter-and intra influence of periods that teachers had from 1996 to 2009. The two most influential nodes are repeated from prior periods the ED190 node of the first period and MD162 node from the second period with In-Degrees of 24 and 18 respectively. While into the third period the most influential node is the MD93 with a In-Degree of 5. The teachers of the fourth period have mentioned to 10 teachers of the first period, 11 teachers of the second period and only 6 of the third period. This network has 96 nodes and 126 links with a giant component of 85 nodes which is the 88.54% of all the nodes, and 119 links that corresponding to the 94.44% of links of the network and a density of the non-directed graph of 0.028.

Periods and agents without a starting period reported

The influence of all the registered agents is shown in Figure 6 that corresponds to a network with 185 nodes and 259 links with a giant component of 157 nodes and 241 links which corresponding to 84.86% and 93.05% of the total respectively. The density of the non-directed graph is 0.015. This figure shows the influence of institutional programs in the node of UABC and external agents to the university into the External node. The most influential node considering all periods, is the UABC node with a value of 29 in its In-Degree, followed by ED190 node of the first period with a value of 27, the MD162 node of the second period with a value of 21 and External node with a value of 13 In-Degree.
Figure 6. Links between teachers in all periods and agents which its period of involvement is unknown. The node size represents their relative importance to the network measured by their In-Degree value and colors indicate their Campus; blue for Ensenada, red for Mexicali, green for Tijuana, gold for Tecate (K), dark green for UABC and purple for External agents.

Considering the intensity of links between the five networks, we can observe a higher intensity between the agent network without a defined period and teachers of the third period with 52 links followed by the second period from where emerge 29 links, the teachers of fourth period has 18 links and finally the first period with 17 links. This implies that agents without a defined period provide 116 of the 259 links that make up the totality, the 44.78%.

4. DISCUSSION
The results indicate that the online education diffusion in the UABC has been more a gradual process with an unclear purposes. It has responded to a series of individual efforts, rather than an explicitly and clearly oriented institutional policy. Besides, its behavior changes as frequently as administrative periods of the university. Thus, in each administrative period the diffusion of online education behaved differently.

Initially the online education diffusion in UABC was started by individual initiatives undertaken by academics who perceived it as a complementary alternative to conventional university education. Thus, the period 1996-1998 was characterized by the emergence of agents of change, which not only started to practice in this modality, but stimulated the interest of other academics. In this way, the influence of these agents led to the gestation of small communities (sub-networks), whose members shared information on their practices and
experiences from their involvement in online education. This dynamics resulted in the offer of the first bachelor’s and master’s degree online courses, the implementing of workshops for teachers interested in the modality, and a proposal to UABC authorities for the creation of a Distance Education area in the university.

The first stage results caused that the institution, in the next administrative period (1999-2002) take a more active role in the online education’s diffusion process, implementing some strategies, such as: 1) the incorporation of an strategic program for Online Education in the UABC; 2) the design and implementation of the Open and Distance Learning System; and 3) the in-licensing of Virtual-U has the LMS of choice at that time. However, in this same period is pending the formal incorporation in the university structure, of the proposed area for Distance Education. Besides the technological factor it is privileged over pedagogy.

This series of strategies, added to the inertia of the first stage, achieved that the network of this period increase in its number of nodes. Thus, to the 13 academic participants in the first period were joined by 32 academics, which resulted in the emergence of other change agents whose influence led to the articulation of new sub-networks and new positions of power.

The arrival of the third administrative period (2003-2007), brought a clear and structured focus around the use of ICT as a means of teaching and learning. However, its implementation was not carried out as originally conceived. The incipient groups around online education from previous periods where reassigned, and the design and implementation of the system in a major scale, were disrupted. However, in 2006 some change agents in a position of power manage to create the Open Education Center (OEC). As part of their first actions was to initiates a new campaign to involve academics into online education.

Such a scenario modified the evolving dynamics of online education into the UABC as during this third period the increase in the number of nodes was remarkable. At 45 participants from 1996 to 2002, they were joined by 65 new academics where involved in the online education modality. It is reasonable to assume that this growth was the result of the natural inertia of the first two periods and the actions taken by the OEC at the end of the third period. Moreover, in the network, the UABC appears as a dominant node for the first time, because along this period many of those involved indicate that UABC was the agent that influence them to get involved in online education, probably because of the actions defined by the OEC.

Finally, in 2008-2009, the new university administration does not define a clear policy regarding online education, this could explain why a significant drop in new participants was recorded into the incorporation of new participants in contrast with the 2003-2007 period. Only 27 new teachers were involved in online education, and no emergence of new agents of change and new sub-networks where registered. However, another important factor to consider is the fact that in the last period, only data from the first two years where obtained, so the number of new nodes incorporated is unknown for the complete period.

The trend that detects the diffusion of online education along these four periods suggests the need to clearly define a institutional policy and strategy to promote the online education potential in the university context. This policy, beyond of establishing guidelines and regulatory standards, should create the conditions for the diffusion of online education in a natural way throughout university and to encourage the emergence of changing agents within the own university community, who in addition to encouraging the adoption of this type of education are also able to identify new tendencies and niche of opportunities.

Encouraging the emerging of changing agents within the university, would create a more strong and distributed network that would allow online education maintain continuity in adverse contexts and that proper operation did not depend significantly on a small number of nodes. In turn, having a large number of agents of change stimulates the formation of communities that promote diversity of ideas and flow through the network, a fundamental element of any innovation process.

Finally, the rescue of previous experiences during this diffusion process is a valuable source of information that allows to identify good practices
and avoid replicating those that do not contribute
to the positioning of online education as a element
of innovation and change in the institution.

7 REFERENCES
Design and Application of an Automated Tool for Facing Autistic Challenges

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Abstract—Autism is the fastest growing developmental disorder in recent times. Its influence is no more limited to the western world only but has spread all over the world, especially the third world countries like India where several research developments have taken place in the past few decades. The progress of technology in the cure and care of Autism can be traced from the incorporation of various IT based tools in Autistic research. In this paper we have designed one such tool to make Autistic children learn about the functionality of certain basic school interactions that can make them confident and independent in their social life. We have deployed the tool on the Autistic kids of ‘Manovikas Kendra’, an NGO in West Bengal, India that runs a special school for them. We tested the tool for a week after giving them a three weeks training course. The results obtained on the performance of the children have motivated us to take further steps in this direction.

I. INTRODUCTION

The modern age has witnessed several perils of existence from global warming to Autism. That is not to say that Autism is an effect of the new age, but somehow its growth rate has increased in the recent times, as there has been an equal rise in its awareness. Autism is a disease that generally begins in infancy [1]. It is a permanent neurological disorder that throws a serious challenge to the concerned individual to learn, communicate or even interact with peers [2]. The disability ranges from mild to severe that is directly proportional to the behaviour of the Autistic person [3]. The Autism Society indicates that according to research done by the Center for Disease Control and Prevention in the year 2014, one percent of the total world population carries Autism spectrum [4]. It additionally indicates that an estimated one out of every sixty eight births in the U.S.A has Autism [5].

Fortunately, this is the era of technology and we as its part, must take full advantage of it to bring about real changes. The application of special gadgets or IT based tools for the betterment of the Autistic people is the need of the hour. However, a lot of positive work is already being done. Nowadays, different virtual environments [6], [7], [8] are created, robots [9], [10], [11] are made to interact with Autism laden individuals, mobile sensors are designed [12], [13], [14] and mobile applications are developed [15], [16], [17]. But these are large-scale developments and relatively costly. There should be a simultaneous focus on empowering the Autistic people with simple and low cost tools that they can operate with minimum effort and in turn lead their lives independently.

In third world countries like India where there is very poor infrastructure to properly assist the Autistic kids, especially the poverty stricken ones, these gadgets are of immense value.

Fig. 1. The happiness in an Autistic child’s face after the successful use of the application

To this end, we have developed an android application that focuses on reducing the Autistic children’s emphatic challenge of communication in the public sphere and enables them to follow their routine works at school with ease and self-sufficiency [Fig. 1.]. The tool contains different aspects of interaction with digital gadgets like smart phones and tablets that can be handled by them effortlessly to move towards the next level of improvement.

II. RELATED WORKS

In the process of designing the application, we have researched about several related developmental works in the field of Autism. Most of them are mobile applications to keep the Autistic kids at par with the age of digital efficiency. A brief sketch of those works is given below:

A smart mobile application named “iCanLearn” has been developed to create ‘social stories’ for autistic kids [15]. Since Autism awareness in the Arab-speaking communities in Oman is very low, another special mobile application has been especially designed to cater to their needs. It has been made
with simple tools using ‘animation and comparative images’ based on Omani culture for easy understanding of and access by the families of ASD laden children to make them differentiate between ‘Autistic and non-Autistic behaviours’ [16]. There is additionally, another mobile application for the Autistic kids in the Arabian regions. It is unique because along with aiding the kids it also examines its own effectiveness at the same time [18]. To analyze the ‘visual perception of the Autistic children’, an application named ‘Eye Gaze Point Estimation System’ is also available [17]. There has been the invention of a ‘mobile communication tool’ named ‘AutiSay’ to provide valuable support to kids for the purpose of communication [19]. Researchers have further made an exclusive monitoring system named ‘Do Well B’ which is ‘a study protocol for the application in Autism’ [20]. The manufacture of an ‘Android Based Wearable Smart Locator Band’ is beneficial for those having not only Autism but also Dementia and Alzheimer [21]. Finally, keeping in mind the ‘functional skills’ of the Autistic children, technologists have designed a ‘self-instruction’ mobile application [22].

All the above applications have their individual strengths and weaknesses. What is commendable is that efforts like these are creating new levels of hope and expectation every day which in all possibility is reducing the struggles of the Autistic people slowly. These works have inspired us to put in our best efforts to create an environment of empowerment and emancipation for the Autism affected children.

III. DESIGN OF THE SPECIAL CARE TOOL FOR AUTISTIC CHILDREN

Our android application has been designed keeping in mind those Autistic children who go to special schools. Taking into consideration five basic modes of interaction required out of a kid in a school, five individual image buttons have been instilled in it; they are “Welcome”, “Toilet”, “Tiffin”, “Bye” and “Alarm”. The logical background of the image buttons aims to establish their importance in an Autistic child’s social and public life and the technical background elaborates the design of the application.

A. Logical Background

A healthy social life is a major key to a person’s growth. Autistic kids suffer from a good social and public life because most people fail to understand them. A child’s first official correspondence with the outside world starts at school. Therefore it is very important that he/she is aware of the right modes of interaction and is equally equipped with them. Although it is the sole responsibility of the parents and the teachers of the concerned kids to teach them all about it, as socially aware researchers, it is not only our duty but also our liability to help them in every possible way. The application tool we have designed serves as a supplementary aid to develop in them a sense of confidence which is a very significant criterion in their growth. The rationale behind the implementation of the above mentioned modes of interaction are as follows [Fig. 2.]:

(i) Welcome- When a child first steps into the premises of the school, he/she enters a new world different from that of the protective atmosphere of the home. Therefore, it is of utmost importance to make him/her comfortable in the said environment. The “Welcome” button serves the purpose of a friend that receives the Autistic children into that new place thereby imbuing in them a sense of joy and belongingness to an otherwise different environment. By pressing the “Welcome” image button on reaching school, the kids can immediately hear a ‘Good Morning’ greeting through a background audio. This gesture has a positive psychological effect on them. It makes them feel wanted and thus removes their sense of isolation. They can henceforth move on to learn their part in the school with confidence. For many Autistic kids, every single day is a battle. Therefore, they need to feel welcomed in their school all throughout. If they hear this gesture every day, they can eventually accustom themselves with their surrounding and also draw happiness from it.

(ii) Toilet- The “Toilet” image button is very useful for those Autistic kids who are shaky and find it difficult to express to their teacher the need to go to the toilet as and when required. On pressing the button, such kids can convey their urgency to their teachers. Many Autistic kids who suffer from speaking impairment find the voice processing technique in situations like this beneficial. However, it must be noted in this context that it is always absolutely necessary to teach the children to be able to communicate themselves through their physical gestures. The application tool has been designed as an effective support system to their process of self- sufficiency. Unfortunately, many a times, the ways and means of communication of the Autistic children are not easily comprehended by those who are not trained to interact with them. In such instances, the android application is valuable in functioning as their voice. The schools can perform as a training ground in acclimatizing the kids with the technique of using the application as and when necessary.

(iii) Tiffin- The “Tiffin” image button serves two vital functions. First it is a gesture on the part of the children that they are hungry and second it helps them to adjust their hunger time with the official time of the tiffin hours of the school. This creates a sense of discipline which must be imbied by every child, whether Autistic or not.

(iv) Bye- Just like the “Welcome” button which starts the day of an Autistic kid at school, the “Bye” image button ends his/her day. By pressing this button, the children can realize that that particular school day is over and hence they can prepare themselves to return to their loving abode. There
is automatically a change in their attitude and mindset in returning from public to private life.

(v) Alarm- Finally, there is the “Alarm” image button. There are often situations when the Autistic children want to communicate things to their teachers on their own will aside the primary reasons of communication that have been discussed till now. Since Autistic kids seldom communicate, therefore such instances are rare. Our intention is to focus on such unique situations and trap them through this button. The “Alarm” button can be pressed anytime the kids want to interact with their teachers. It creates a sense of urgency which makes it necessary to hear them out.

B. Technical Background

The application has been designed for android platform using android studio IDK best suited for a 7 inches tab. Along with the above mentioned five image buttons, two separate buttons for backup and reset have also been included. On pressing the image buttons, the kids can hear a background audio based on its functionality.

Fig. 3. Technical Diagram of the Application

In order to store this event we have added a counter that records the data in the internal memory of the tab as a text file. On pressing the backup button, the data will be stored date-wise. Later it can be easily accessed from the internal memory of the tab. The function of the reset button is to clear out the previous data and make the application ready for a fresh use [Fig. 3.].

IV. Deployment of the Application in ‘Manovikas Kendra’

Any special application developed for the Autistic children needs to be implemented and tested to assess its smooth functioning before being available to them. To evaluate the effect of our application, we contacted the best Non-Governmental Organization in West Bengal, India named ‘Manovikas Kendra’ that runs a special school for the Autistic kids in Kolkata. We have been immensely fortunate in receiving a lot of enthusiasm and positive response from the authorities, and the professionally trained teachers of the school to help us experiment the application on the students.

‘Manovikas Kendra’ was founded on February 9, 1974 as a non-profit organization to conduct research for the betterment and cure of special children as well as provide education and training to them. It has been dedicated to their service since then. We visited the organization on the second week of February, 2015 after setting up a meeting with the authorities. For our visit we went fully prepared by installing the application in five 7 inches android tablets. The teachers were thoroughly explained the mechanisms of the application and the tabs were then handed over to them. They henceforth conducted an extensive training programme with the kids over a time period of three weeks, teaching them how to operate the application. According to the database of the institution, there are in total twenty-seven regular students in the school and thus only they were made a part of the training process. Ten of them have High-Functioning Autism (HFA) and seventeen of them have Low-Functioning Autism (LFA). It is important here to describe in brief about these two types.

Autism is generally divided into two major groups High-Functioning Autism and Low-Functioning Autism. Although many believe that the classification is arbitrary, yet it is still considered a barometer for grouping Autistic people. Simply speaking, persons who have severe Autistic disorder are said to have Low-Functioning Autism and the ones who are quite capable of managing their state of being are considered to have High-Functioning Autism. HFA and LFA are usually determined by conducting an IQ test on the affected persons. Those who score below 40 are put under LFA and those above 40 are put under HFA [23]. LFA candidates need major help in their day to day routine while the ones having HFA are more or less independent.

Since HFA and LFA kids have major fundamental differences, the training provided to them was also different. It was conducted in three diverse ways. The kids who have severe problems were trained by the method of physical prompt [Fig. 6.] whereby they were physically helped in the operation of the application. Those who are able to follow verbal instructions were trained by the method of verbal prompt [Fig. 5.] and the
ones who are capable of functioning independently [Fig. 4.] were given the liberty to learn on their own.

Finally when all of them were ready, they were asked to use the application from March 9, 2015 to March 13, 2015. After the five days, we went over to collect the data [Fig. 7.] and processed it consequently. The result found henceforth is given in the next section.

V. RESULT

The graphical representations below have been prepared based on the deployment of the application tools on the HFA and the LFA candidates.

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**Fig. 5.** An Autistic child in use of the application with Verbal Prompt

**Fig. 6.** An Autistic child in use of the application with Physical Prompt

**Fig. 7.** A sample data collection sheet

**Fig. 8.** Cumulative Performance of HFA and LFA kids against each button

**Fig. 9.** Percentage wise Performance of HFA and LFA kids against each button
HFA students have clicked the “Welcome” button, whereas 60% of the LFA kids have done the same. In the case of the “Toilet” button, 78% of the HFA kids and 31% of the LFA kids have pressed it. While 90% of the HFA candidates and 74% of the LFA candidates have clicked the “Tiffin” button, the “Bye” button has been pressed by 98% of the HFA students and 88% of the LFA ones. It is clear from the above statistics that more than 90% of the HFA kids have responded to the four basic functional buttons whereas more than 60% of the LFA kids have responded to them. The positive feedback of the LFA students is of utmost value to us. This shows that we have come a long way in our success with the application. While the percentage of the HFA students who have used the most critical “Alarm” button is 34%, the 2% of the LFA kids who have responded to it is a next to impossible achievement for us. All the other buttons are requirements but pressing this particular button is an instinctive response.

A man perfect

There is a huge scope for improvement in the figures as well as opportunity for us to take our vision further. However, we have learnt from the teachers of ‘Manovikas Kendra’ that the students have reacted to the application far better than the manual training they have been conventionally receiving. Their class performance in those particular five days has also been extremely noticeable. They have not faced much of a problem in carrying the tool since it is handy. This reflects that the children are possibly more comfortable in interacting with gadgets than they are with strangers. Their all welcoming first step towards acknowledging our efforts is a matter of ultimate satisfaction for us.

VI. Future Direction

The overwhelming responses of the kids have encouraged us to modify the application for the better in future. The intention is to add certain logical functionality to some easy to use gadgets and capture their reaction to it. We also plan to improve the “Alarm” button and habituate the Autistic children with it so that they can use it in any kind of emergency situation. In the days ahead we aspire to make the application available to all at a cheaper and transform as many lives as possible.

Fig. [10.] illustrates the day-wise performance of the candidates. It truly justifies the proverb that “practice makes a man perfect” since the performance of the students have considerably improved with each passing day.

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VIII. Conclusion

Third world countries like India are still lacking in Autism awareness. The rural parts in India have no knowledge of it. The biggest challenge is not only to invent new ways and techniques to help the Autism affected individuals but also to make those new inventions available to all and sundry at low costs. Fortunately, while one half of the humankind is hell bent on destroying the other with terrorist attacks, nuclear wars and neo-imperialist strife, the other half is desperate to protect what is left of humanity. This concern for the well being and protection of the humankind has inspired several individuals to take up leadership roles and bring about drastic changes in every field of life. The extensive research and education programmes on Autism are glorious examples of such progressive steps.

Fig. [10.] illustrates the day-wise performance of the candidates. It truly justifies the proverb that “practice makes a man perfect” since the performance of the students have considerably improved with each passing day.

Autism is one of those disorders that need to be handled with extreme care and caution. Since Autistic persons, especially the kids are overly sensitive, it should be kept in mind that in the process of being independent and digitally empowered, they do not lose themselves over it. Therefore, scientific research and inventions should always be in sync with the mindset and the absorbing capacity of the Autistic people. The research and the consequent process of making the application have made us aware of both the doings and the misdoings of technology. Fortunately the optimistic outcome of our efforts has signaled us that we are in the right path and encouraged us to continue in it to give the children a prospective future. Our biggest achievement has been bringing about a tint of smile on the face of the kids, a ray of hope in their minds and strength and courage in their hearts. Today, somehow their dreams have become ours, their determination and courage ours and their battle our own. We believe therein lies the true success of science and technology.

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REFERENCES


A Study of Teaching Problem Solving and Programming to Children by Introducing a New Programming Language

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ABSTRACT

Technology has been growing rapidly, and this fact that computers, gadgets and electronic devices have become part of our life is undeniable. Computer skills and programming languages have become as important as other essential subjects in schools. Researchers have done some researches in the area of teaching programming and problem solving to novices, this study aims to study whether it is necessary to teach problem solving and programming in early ages. This study also aims to review previous studies in this area. We attempt to introduce a new programming language which has been developed to simplify the method of learning and coding for novices and young learners. We have been developing a new programming language which the children and young learners considered to be the learners of this language; however professional programmers would be able to code with this language as well. There are many popular and powerful languages, Python for instance is easy to understand and code with, however it is still complex and difficult to learn for children, and on the other hands programming languages like Java and C++ have their complexity. The target users are children who have no knowledge about programming. Beside some inappropriate teaching methods and resources, the complexity of programming languages and lack of knowledge about problem solving, young learners find programming terrifying. Having a programming language with a simple syntax and methods will encourage students and failure ratio will be decreased. Children will have a chance to learn how to code and solve a problem by using and interacting with an easy programming language. By doing this research and using valuable resources, we would expect to have positive and effective changes in science and programming in near future, as the today’s children are the future of our society.

KEYWORDS

Technology, Programming, Learning, Novice Programmers, Programming Languages, Problem Solving

1 INTRODUCTION

Computing is considered as a career of 21st century and things around us these days are mostly computerized and computer based. Nowadays, students face a complex and changeable world. Students required to know new ideas, creativity and problem solving techniques to solve unconventional problems, however not everyone necessarily should become a problem solver and programmer [1]. In order to avoid the information explosion and to improve students’ problem solving skills, improving their systematic ways of thinking, problem solving and programming skills will be essential. Children’s capability to learn and do programming is not something new and it has been proven by some researchers which we are going to discuss in this study. Teaching programming to novices is a difficult task down to the complexity of the subject, difficult initial programming courses and negative views associated with programming which discourage students to pay enough attention to learn programming [2]. The reason of importance of Programming is that it helps the algorithmic thinking, a unique and different way of thinking for those who face problems in different disciplines [3]. Programming tools like Alice and Scratch are tools that can be used as a different way of teaching programming to children [4, 5]. These programming language tools use a visualized
environment with a drag and drop features and typing mode are minimized in them. They will let the user to create an animation based inputs, play games, or share videos through the internet. Greenfoot is another programming environment intended to teach young beginners and older novice users to do coding in Java. The framework is using a visualized two-dimensional grid which allows user to code [6]. Programming environments mentioned above need the ability to write and read which makes them difficult for children to learn and use. As other researchers and we believe, children have the ability to understand some programming concepts even if they are not yet at the reading stage, however as we discussed in previous studies problem solving techniques and learning the basic of programming are essential and need to be taught and learn beforehand. Novices and specially children need a simple environment and language that allows them to create and debug a program, practice the problem solving in less textual, easy syntax or visual mode. PiktoMir is one example of such environment that allows children to program a virtual robot behavior by using few pictograms [7, 8]. Kiss experience shows the LEGO-Mindstorm is a good tool for learning programming, because the students can interact with a robot and use its different functions and write programs and not facing any syntax error [9].

The structure of this paper is as follow: in the Literature review section, we review relevant works which have been done in the area of this research. In the section of introduction of the proposed language we will discuss and introduce the new programming language which we temporary named it Mint language. We will also review and discuss different aspects of Mint and the ways that new programming language will be helpful in assisting children to learn coding.

2 LITERATURE REVIEW

2.1 PiktoMir
PiktoMir is a visual environment which has been developed to teach programming to young learners. This program has a story about a robot which is living in PiktoMir and it presents by the instructor as an introduction to motivate children. The robot named Fidget cannot move and do any action autonomously, and it should cover coating damages which occur when the shuttles launch. Fidget is able to move and do some actions according to the commands which input by users, some commands are as following: FORWARD, TURN RIGHT, TURN LEFT, and FILL. Fig1 illustrates the programming environment and its features.

PiktoMir’s author conducted a study at the Moscow kindergarten. Participants in this study were 42 pre–school students, 22 boys and 20 girls between 5.5 to 7 years old, as well as, 35 kids aged between 6.5 to 7 years old were attended as a senior group. Experiment has been done during 8 weeks with two consecutive classes (20 min each class) every week. In the beginning of the course, kids learned about introduction of PiktoMir and games without using computer, for the next step they started to practice everything they learned with computer. In the end of the all sessions, kids were given a test to check their comprehension of the basic of programming concept. The test contained three blocks of tasks. The first block focused on linear programs. The test divided to three sections, tasks to use subroutines, loops and linear programming. Kids were required to navigate the robot by following the instructions (Fig 2). These tasks were designed to examine the ability of children to execute the algorithm.
The result of this experiment is to focus on a specific programming concept skill. After accomplishing some tasks almost all children except one of them (41 of them) learned how to write a linear program. 75% of them learned definition and use of loops and sub routines. Seven of children were younger than six years old which two of them were able to pass the test. This allows the authors to assume that children younger than age 6 have some difficulties to understand the programming concepts like loop. This research shows that PiktoMir can be used to teach basic of programming to preschoolers. In addition, most children found this program fun and enjoyable to use [3].

2.2 Alice
Alice has been developed as a project named “Learning to Program with Alice” in Carnegie Mellon University (United States) which aims to bring young people into the world of programming, through a completely visual 3D and animated environment [10]. As the children are fast and visual learners, learning Programming in a visual and 3D tool which changed from a text base programming environment to a visual entertaining model will be really effective way for them to learn with. Users learn more about object orientated programming as they can see a graphical representation of an Object, loop statements and some other statements. Alice interface gives the user the ability of dragging items which represents the actions or statements. In fact, by using this type of programming, students do not face syntax errors and some text base programming problems that affect the motivation of students in programming courses [11]. Fig 3 illustrates the user interface of programming Alice.

2.3 Scribbler
Scribbler is a robot which has the ability to be programmed, and some sensors indicate in this robot to detect object to find its path. This robot has a visual, graphical and user–friendly interface which allows user to program the robot easily; however traditional programming is still available and possible in this robot and some of languages like basic, Python and Java are supported. By interacting with Scribbler students will have a different experience and method to learn traditional languages. Students implement a code and control the robot through the interface, which is operational with icons, and by following the algorithm structure they will learn how to modify the robot’s behavior [12].


2.4 Scratch for Budding Computer Scientists

Scratch is a programming environment developed by MIT’s media Laboratory which allows user to create his/her own animation, game and interactive art. Scratch proposed to be as a first language for novice programmers in fundamental programming courses. The significant part of scratch is that it gives the user ability to program by using mouse; programmatic constructs are puzzle pieces which only can be fit together if they are syntactically correct. Scratch can be a gateway to other languages like python. This study goal was not to improve scores but instead to improve first-time programmers’ experiences. The result of this study was not only that Scratch excited students in the first time of use, but it also familiarized them with fundamentals of programming without any interfering of syntax. A survey conducted in this study to find out the effectiveness of Scratch in learning Java, most students (76%) responded a positive influence, mainly student without programming background. Those students (16%) who believed that Scratch was not effective to learn programming, all of them had programming experiences [13].

Figure 4. Scratch’s interface [13]

3 MINT PROGRAMMING LANGUAGE

INTRODUCTION

3.1 Aim of the language

The aim of this language is to implement an object-oriented language with beginner friendly syntax. As well as, an embeddable language usable wherever Java (more specifically, the Java Virtual Machine) can run, which is essentially on any modern operating system. The design philosophy of this language gives as much freedom and control to the programmer as possible, to let them build the application they want to build. The language itself is easy to learn, run and implement as this language described before aimed to be use for basic and young programmers, however in the advance mode of this language programmers are able to code and implement their advance codes.

3.2 How the programming language works

- The programming language (Mint language) is directly interpreted, using an interpreter written in Java.
- Mint lists and tables can hold objects of any type, but Java is statically typed with Array Lists only being able to hold a series of objects of the same type. Because of this type problem, all Mint objects aside from integers are actually referenced using Pointer objects – each pointer contains type information and the address of the Mint object. Integers are stored directly in the pointers, should be unchanged.
- To evaluate an expression like x = 4 + 3 * 5, Mint searches for expressions that can be simplified first, such as 3 * 5 becomes 15, and then expressions that can be simplified later, such as 4 + 15 becomes 19. Then 19 will be stored into x. Therefore, order-of-operations is always followed.

When creating user-defined objects, there is actually no difference between the current scope (a namespace for user variables) and a freshly created object. In fact, both variable scopes and objects are implemented using a Java class called MintObject. Scopes can be transformed into objects by using "return this" inside a subprogram, and variables inside an object can be put back into the current scope using "inherit object_name". This may be a little advanced for children and/or beginners who are first learning the language, however after learning the basic of programming they will be able to upgrade their knowledge and start learning the object-oriented programming in advance courses.
When you divide two integers, instead of rounding 1/3 to 0.333333... the language will actually store the numerator 1 and the denominator 3 inside a single object. This is for improved internal accuracy of calculations. However, the internal fraction 1/3 will naturally print as 0.333333... to avoid unwanted behavior and to avoid confusing beginners. Most languages do not do this, and simply round the numbers immediately, which can cause additional accuracy problems.

3.3 Advantages of the language
Language is very simple and syntax is clear and clean. Instead of excessive symbols, clearly chosen keywords make the language easy to read. "Functions" (which are called subprograms) are first class which can be passed around like regular objects. Lists can hold objects of any type (heterogeneous sequence) instead of limiting yourself to an array that must hold things of the same type. Tables (which implement HashMap-like functionality) do not have some of the limitations other languages impose. Mint can have multiple identical keys in tables, etc. Object system is simple and understandable.

3.4 Disadvantages of the language
We strongly believe that there are languages that are very powerful and bug free. As this language still in the developing phase it still has some problems. The problems and issues we already have found and we are trying to improve it, here called as disadvantages of this language.

When dealing with large amounts of data processing, Mint language runs more slowly than other languages. Mint is directly interpreted, and does not compile to virtual byte code and this is another reason for its slowness.

Table syntax {"a": 1, "b": 2} is more verbose than Python/JavaScript's{"a": 1, "b": 2}. Table modification is currently handled by adding extra pairs. This gives programmer more freedom but is more confusing than direct assignment like a["key"] = 3 in other languages.

Mint does not have the widespread and helpful community of Python, Java, Ruby, and other languages.

3.5 Structure and Syntax
Blocks are started immediately when control flow statements are used, such as if, while, for, and for-each. Blocks close with the keyword "end", similar to how it is done in Ruby. No indentation issues like you might have in Python. Only newlines are significant for separating individual lines.

Lines can also be separated or terminated with a semicolon with no ill effects. This is for people who prefer this kind of syntax.

Functions (known as subprograms) start with the word "sub", and close with "end". Lots of extra control flow. Traditional for-loop, for-each-loop, switch statements, and repeat-loop. "Repeat 12" will repeat the block 12 times which is easy to understand for beginners.

Functions can be nested inside each other. Functions can return other functions. Nested function is the way you put methods inside the objects. There is no class keyword - "sub" takes care of everything. Using "return this" will return a new object with all the methods the programmer will define.

3.6 Ease-of-use and user friendliness
The caret ^ does exponentiation like in mathematics or on a handheld calculator and it does not perform bitwise XOR, which may be confusing.

Implicit multiplication works. Like x = 2(2) + 8(10). Like in math, programmer does not have to use the star symbol if programmer does not want to use it.

In Mint, tables remember the order in which you place key-value pairs. Python and JavaScript forget the order, so when you pass over the dictionary or JS object, you may get the keys in random order.

Easy to access standard library, using the import keyword. Import "filename" will also import another file in the current folder. More
complicated imports like import "myfolder/stuff/something" can be used.

Mint is still a work in progress. In the future, Mint's syntax trees will be converted to bytecode for faster execution. Table behavior will be changed to better suit the programmer's needs, and to be more understandable. As well as, other features can be suggested and will be taken into consideration.

4 FUTURE WORK AND CONCLUSION
In this study, we have studied to identify importance of programming and problem solving in programming to be taught to children and young learners. The difficulty and complexity of programming languages and problem solving tools have been discouraging novices to learn and following programming as a passion. We have studied and reviewed other researches work, most researchers believe that it is a need to teach children and they also develop and design new methods to make it easy and possible for children. Furthermore, we have decided to design and develop a new programming language which give children and novices this opportunity to interact and learn programming language and problem solving with a simple and user friendly language environment. For the future work, we have plan to improve our language structure and environment, add some features and make it as simple as possible for novice programmers. As children are visual and fast learners, we are trying to make the language more visual like and the commands and syntax would be very close to English common vocabulary and statements.

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6 REFERENCES
The SDIW International Journal of E-Learning and Educational Technologies in the Digital Media (IJEETDM) aims to provide a forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments and applications in the field of computer architectures, information technology, and mobile technologies. Original unpublished manuscripts are solicited in the following areas including but not limited to:

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