

# Analyzing the Students Behavior with Down Syndrome in a Gamified Learning Environment

Marvin R. Arenas, Josephine S. Dela Cruz



**Abstract:** *The main purpose of this study was to analyze the behavior of students with Down syndrome in a gamified learning environment of SPED school in Baguio City, Philippines. Education focused in the area which uses unique instructional methods, materials, learning aids, and toolkit to meet the educational needs of students with learning incapacities. This study investigated the extent to which a sample of special education teachers addressed various topical issues with students who have learning disabilities and behavior disorders. In collecting data, a survey instrument was employed to gather information pertaining to topical issues that involve sensitive subjects typically not addressed in the traditional academic curriculum in school. The authors also utilized literary studies, and observation, draws together the findings from a series of interviews, and applies these in an educational context. The data were analyzed with psychological, educational, and socio-cultural approaches, with qualitative descriptive analysis. Down syndrome (DS) is the most common genetic cause of intellectual disability worldwide, with language being one of the most affected area. The authors hypothesized factors that contribute to engagement with a learning activity and strategies and provide an example of the use of these factors in practice, and other hypotheses were supported by data. Based on the rating, the authors motivated to enhance the functionality of the Gamified Learning Environment (GLE) in the future. The target user strongly agrees with the ratio of 4.6 which means that the GLE has the functionality needed in their school course and has a greater impact to their academic performance.*

**Keywords:** *Behaviour, Education, Down syndrome students, Gamified learning environment.*

## I. INTRODUCTION

This study investigated the extent to that a sample of education lecturers self-addressed varied topical problems with students who have learning disabilities, backwardness, or behavior disorders. A survey instrument was used to assemble data referring to topical problems that involve arguable or sensitive subjects usually not self-addressed within the ancient educational syllabus at school. Survey results pointed to treatment maintenance, generalization, and assessment and remediation of academic problems as the highest ranked priorities. Activity Theory Framework also used in this study prior to the framework suitable for students with Down syndrome (DS).

Over the past decade, inclusive postsecondary opportunities have become more available to students with intellectual and developmental disabilities than ever before. With greater demand for such opportunities as well as greater awareness of the possibilities for youth with intellectual and developmental disabilities, developing new programs on elementary, secondary and tertiary campuses is increasingly attainable. Special education is a unique education provision, for students with disabilities and disorders. It encourages academic progress and personal and social development. It aims to enhance the behavior of the students through giving reinforcements and many different teaching methods and strategies. Several people think of special education as discrete classes or separate schools, but special education is actually a variety of specially designed instruction. This instruction includes a combination of supports and services, which is intended to meet the unique needs of a student with disability. Special education can comprise anything from a different way of teaching, to special equipment to help students with disability with their school accomplishments. The differences among most children are quite minor, allowing them to benefit from the general education program. Those student with disability are those who encountered problems in education and their act is higher that needs changes in their curriculum to help them fulfil their capability. Students with DS can share positive physical traits, and have an individual differences prior to the level of broad knowledge incapacity that will range from minor to intense. The student with DS may have problems such as heart defects, respiratory problems and eye defects [1]. DS is a very common disorder and almost everyone knows somebody that has been affected by the genetic disorder. Children with Down syndrome have delays across different developmental domains including language, gross motor, fine motor, cognitive, personal-social and self-help skills. DS recorded as one of the most mutual causes of insignificant to sensible learning problems, upsetting between 1 in 1,500 and 1 in 400 babies born in dissimilar countries, reliant on mothers' ages, and during the early screening procedures [2]. Teaching DS students requires a lot of efforts and resources. Teachers should always repeat the same lessons several times due to lack of memorization and recognition of objects and concepts. In giving directions to the class, teacher should leave a pause between each step so student can carry out the process in their mind. Teachers can also provide visuals via the board or overhead, and also use flash cards. The ability to describe, assign and attribute certain mental states is referred to as Theory of Mind [10].

**Revised Manuscript Received on 30 July 2019.**

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## Analyzing the Students Behavior with Down Syndrome in a Gamified Learning Environment

Theory of Mind (ToM) – that has a deeper emotional states to the self and to others – has mainly been discovered in relation to typically developing (TD) and autistic individuals [11]. In the previous eras, SPED teachers' in Baguio City common strategies in teaching DS are making their students cooperative in learning through having games, storytelling, hands-on activities, brainstorming and discussion. Students with intellectual disabilities are very challenging to teach, and can learn best with the use of different methodologies that engage their senses such as using images, sounds and clips. When we talk about student with DS, they better understand the learnings using language than to communicate emotionally. Thus, most often than not intellectual skills are miscalculated. Every DS student can be treated based on individual assessment prior to his or her assets and desires. Several studies have been done to compare the progress and academic achievement of children and young adults with DS that were educated in a mainstream classroom to those that were educated in a special education classroom [3]. Students with DS are likely to need support with speech and language, memory and processing information, social skills and independence, literacy and numeracy. You may find they have strong empathy with others, good social skills, good short-term memory and visual learning skills. Student with Habitually DS are more on graphical representation when it comes to their learnings. With this, it is easier to accommodate them by showing some form of demonstration using graphical representation, instead of the traditional classroom setup. Though, growth are not equally affected in all areas of concern. There is an exact shape in intellectual and behavioral structures that are detected among with DS that dissimilar with normally developing children which has other causes of intellectual incapacity. Assessing the new validation needs, the main problem to be solved with this research is to determine if the teaching resources are appropriate for students with intellectual disability as well as to their behavior [4], based on the premise the limited time that the students with Down syndrome pay attention during the class sessions. In one study indicate that increasing students' awareness of their behavior can have a positive impact on their study practices and results [5]. Most students with mild learning disabilities spend at least some portion of the school day in the regular classroom. They spend time in the regular classroom because some parents want their children to act like a normal student in a regular class. Because of this, many of these students find it difficult to keep up with their nondisabled peers. Their teachers often find it difficult to spend significant amounts of time providing them with individual attention. Technology has proven to be an effective method of giving such students opportunities to engage in basic drills and practices, simulations, explorations, and communication activities that are matched to their individual needs and abilities. A research examining the potential benefits of computer-based instruction is grounded in basic learning theory and is the same for all students, including both those with or without mild disabilities. Technology is a natural part of living that plays an important role in different aspects of life. Nowadays, technology gives a huge impact in changing the educational system and provides new teaching strategies to catch

students' attention which includes the exceptional learners. Special education is designed to arrange the teaching procedures of teachers and address the needs of every student with learning difficulty. Thus technology also helps to expand the students' ability to obtain more knowledge about the world. There were studies that indicate the use of technology to enhance students' acquisition of skills and content knowledge through the use of computer to transport a well-made and well-accomplished education. The method used in this study to assist student engagement and learning was gamified learning system (GLS). Games can be used as a supplement or an alternative to the traditional lecture format. The advantage of using GLS is that it is a fun and engaging method that allow students to demonstrate their understanding of the material prior to the exam in order to alert them to which material they need to review further. In addition, GLS allows teachers to review a great amount of course information over a short period of time. GLS can include such games as puzzles, consonant vowel consonant, role play and the like [12]. Computer games are sometimes described as a "Skinner box" because of the way they offer reward or punishment for the player's behavior. Several games requires a lot of trials to achieve certain goal like a typical test. In behaviourist theory, a reward or positive reinforcer is anything that increases the frequency of a behaviour. Conversely, punishment or negative reinforcer is something that decreases the frequency of a behaviour. By integrating ready-made computer games into the classroom with the use of gamification is really a big challenge to the teachers. The desires of gamification which combine the intrinsic and motivation has something to do with an extrinsic one to be able to increase the inspiration and engagement [6]. Gamification is a manifold socio-technological phenomenon with claimed potential to provide a multitude of benefits [16], such as enjoyment as well as social benefits through communities and social inter-action. The impact of gamification really an important issue to prioritize because of the augmented attention prior to gamification usage [7] at the institution. In the study of Lambton College in Sarnia, Ontario, they decided to include gamification into their curriculum to achieve the desire of their student's prior to engagement. Another study in Fanshawe College in London, Ontario, the use of gamification has a significant impact not only in the youngsters but also adults in terms of cultivating their literacy skills [13]. To test the students engagement in learning is really hard for post-secondary surroundings is serious as student engagement

“with the positive outcomes, characterized by first-year student grades as well as the first and second year student determination [14]. The theory of gamified learning provides a theoretical framework to test the impact of gamification efforts upon learner behaviors and attitudes, as well as the effect of these behavioral and attitudinal changes on learning. It does so by providing mediating and moderating processes linking specific game elements to learning outcomes [15].

In this example, game fiction must successfully increase learner engagement, and learner engagement must strengthen the relationship between instructional content and outcomes. The effects of being evaluated the strength on in-seat and on-task behavior of student’s attention leads to a higher concerns [17]. This study provides answer to the needs of the students with DS prior to their behavior in their academic performance in a Gamified learning Environment. It shall also be useful to the teachers for it provides them materials to support their teaching methodologies for students with disabilities and special needs.

**II. OBJECTIVES OF THE STUDY**

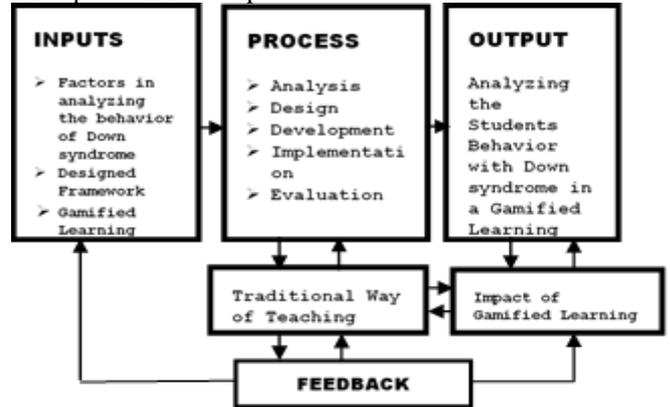
The main purpose of the study is to enhance learning abilities of the DS students by analyzing their behavior in a gamified learning environment. The study was conducted at SPED School in Baguio, Baguio City in 2019. Specifically, the study was able to present the factors in analyzing the behavior of students in a Gamified Learning Environment, framework that is suitable for students with DS and significant impact of the Gamified Learning Environment to the academic performance of students with DS.

Feedbacks, especially those from teachers, influences students’ social acceptance. The present study extends the previous works [14], and investigates the influence of teacher feedback on social acceptance of students with DS compared to typically developing children in two different school. Participants may either be taught in an inclusive classroom in which they have many different experiences with non-typically developing classmates (i.e. students with DS) or in a regular classroom that permits little or no personal experiences with classmates with disabilities.

**III. MATERIALS AND METHODS**

This study utilizes the descriptive-development method of the research. It is said to be a descriptive method because it is a fact finding study that involve describing, explaining, and interpreting the conditions of present. Through descriptive method, it is also concerned with conditions, practices differences or relationship exists and interaction between the participants. On the other hand, it is developmental because the developers will design and develop system based on the specification of the clients. Developmental method is a systematic study of developing, designing and evaluating instructional programs, process that must meet the criteria for the acceptability of the system. This study adopted the developed Gamified learning system intended for students with DS and used as a tool prior to the results validation. This study decided to use the Input-Process-Output (IPO) diagram as our guide. In software engineering, IPO diagram known with regards to system analysis approach because of its graphical performance that really has a dynamics features in terms of data processing. An input-process-output diagram includes all of the materials and information required for the process, details of the process itself, descriptions of all of the products and by-products resulting from the process. The input is composed of the factors in analyzing the students’ behavior in a gamified learning environment, the framework suitable for students with DS and gamified learning system. The process includes developed system as a tool used and the

traditional way of teaching. Teachers can use activity area with games as a motivational tool for students. In front of their peers, the students get inspired when they know that soon they will be verified. Thus, students interested in studying the concepts they have freshly studied. Activity area allows students to build on prior information and support concepts which may have been unresolved to them. The output is the Analyzing the Students Behavior with Down Syndrome in a Gamified Learning Environment: which is a new tool that can be used to improve the traditional way of teaching. Fig. 1 shows the paradigm of the study which uses the Input-Process-Output Model.



**Fig. 1: Paradigm of the Study**

**IV. RESULTS AND DISCUSSIONS**

The researchers found out that SPED school in Baguio City are using a traditional way of education. The authors decided to adopt a developed gamified learning system that will suit to the learning instruction for the DS students through multimedia technology-based learning system.

With the observations, interviews, and documentation the developers found out what will be the best tool on how to designed and develop the gamified learning system effectively for the DS students is through the use of multimedia. Student participation data in pre- and post-class activities (e.g. thinking activities, quizzes) suggested that gamification strategies positively affected students’ behavioral engagement, especially in stimulating learner’s behavioral engagement, especially in stimulating learners to complete more activities on time and being persistent with their participation. Teachers of DS students has also a big role in the early intervention of the game like the usual class in their classroom to assess their students for better results in order to analyze their behavior during the given period of time. “Despite the level of motivation and ability, a trigger at the appropriate time is necessary to bring about a behavior predictably [9].” The appropriate trigger should be situated or available especially to DS students at the right moment, not only for the implementation of behavior, but also to foresee future behavior, moreover having the right trigger at the right time makes the users satisfied, and vice versa, the presence of the wrong trigger at a wicked timing may have undesirable effects, users may feel upset and frustrate, leading to the development of negative feelings toward activity.



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Triggers are very important in any user behaviors even if the users are motivated and have the ability to perform a task; in order to avoid any commotions and the feeling of reluctance a good trigger must be considered. But for the students with DS, we cannot predict if when is the right trigger in a right time because of their unusual capability and individual differences. In this case, proper guidance and observations really needed.

## A. Factors in Analyzing the Behavior of Students

As for the initial interview of some teachers teaching the students with DS of SPED-Baguio, these are the tantrums observed as they getting older:

When restricted with what they enjoy doing, when they urge to do something, when they meddled in the middle of their task, prolonged absences, class suspensions, vacations, wish not granted, not feeling well during their menstruation period for the women, transition period (daily living skills, personal social skills, occupation guidance and preparation) and home related issues that they brought up to their school. Table 1 shows some of the learning style factors and remedies.

**Table 1: Factors and Learning Style Strategies**

AREA	FACTORS/ LEARNING STYLE	TIPS/TACTICS/ STRATEGIES
Classroom Information and Curriculum	Students with Down syndrome are visual learners  May suffer some degree of hearing loss and have fewer short-term memory channels.  <u>Fine Motor Skills</u> – Because of hypertonia (decreased muscle tone) and motor-planning difficulties, printing numerals can be frustrating and fatiguing, and turn a math lesson (understanding and processing math concepts) into a handwriting lesson.	Use teaching methods that involve cues and objects.  ✓ Pair pictures with spoken words. ✓ Present information visually (e.g. overhead projector, posters, pocket charts, chalkboard). ✓ Use simple directions. ✓ Break down directions into small steps. ✓ Allow students with Down syndrome to circle correct answers or use stamps, number cards or tiles.
	✓ Are not proficient in auditory processing and auditory memory. ✓ Have difficulty retaining directions	Be aware that some students may lack the fine motor coordination to use a keyboard and mouse effectively.

or information that is only processed verbally. ✓ Need to process new skills they have learned before moving on to others.  ✓ Have a slower rate of learning than peers.	Assistive and/or adaptive equipment such as specialized key guards or alternative keyboard can be used. Allow adequate response time. Assign fewer problems to a page. Give students more freedom to choose their work activities. Foster independence and self – reliance by balancing developmental and chronological needs as higher academic expectations are set in the classroom. When presenting independent work, try to divide it into small segments (e.g. fold test in half). Give more time to complete tasks. Reduce length of assignments.
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## B. Activity Theory Framework

Online courses or instructive software presented to learner’s in terms of modules towards educational gamification concern. The best thing to understand if how the learners being observe pleasurability in gamification after several trials or testing, has an important consideration. Activity theory depicts in Figure 2, and was elevated by the Russian psychologist Lev Vygotsky was the serious design theory to guide the observed research activities. As learning is a social behavior, it is necessary to analyze the learners’ inclinations for dissimilar types of agreeable learning experiences from a complete point of view. The Subject is composed of individual or group in the activity. It also includes the objects that can act as means for the subject in the activity. They can implement rules or any regulation that can give inspiration on how the movement takes place. In terms of engagement, the social group must participate.



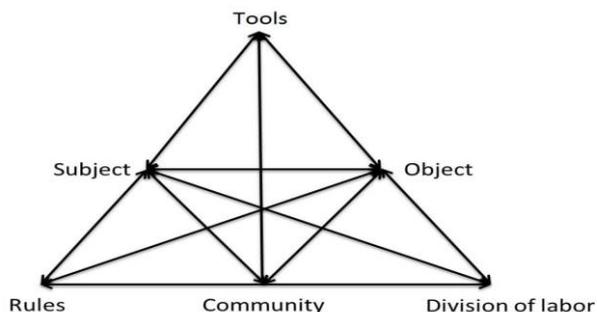


Fig. 2: Analysis of movement and facilitating relationships

According to the theory, the method in activity analysis has a significant impact to evaluate difficult learning atmospheres, on how the students interact with the technology during classes. In a qualitative research, activity systems method is important because it is intended to improve understanding of human activity positioned in a complex setting and is graphically signified by a sequence of triangle diagrams. With this, the researchers and the audience can easily recognize the relationship between each element to the others. Figure 2, depicts the model below (Figure 3). The researchers easily understand the qualitative data which came from interviews and groups.

The activity needs to be examined on how the students learned in the educational contexts. The subject in this activity is the DS students which needs to be examined. To understand the activity, they need to interact as a class or a team. Bear in mind, agreeable learning experiences is the goal of this activity that the students must experience. About the learning purposes in each dissimilar course are the guidelines that affect this activity. The learners of this activity are the online and/or face-to-face learning surroundings. The students and the instructor make the separation of work in this activity.

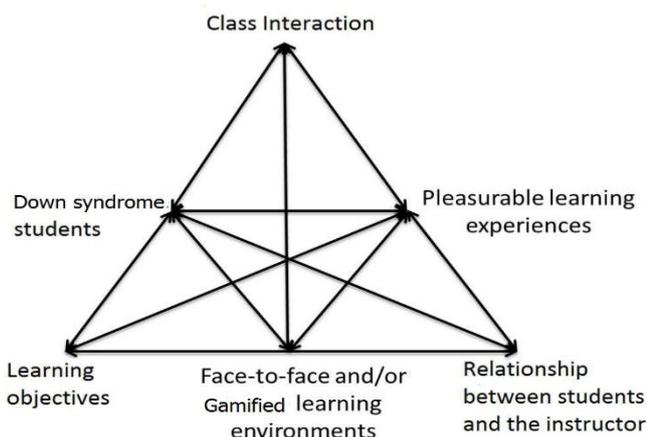


Fig. 3: Activity scheme analysis method in estimating pleasurable in informative gamification

**C. Significant Impact of the Gamified Learning Environment to the academic performance of students with Down syndrome.**

Users' observation carried out during the pilot test and the opinions collected in the teachers' interview performed after the field test allow us to describe the behavior of the users with DS during the gaming sessions as attentive, taking the video game seriously; they like the video game and feel motivated to play; and they focus their attention, even

students with attentional problems[18]. Performing tasks that can cause experiences of failure may demotivate people with DS, because of their low tolerance to frustration. Therefore, the feedback offered to the user by the game is always positive, both when the user performs the activity correctly and incorrectly.

Based on observation, it seemed impossible on how quiet they are, even the ones who are more active. Some of them are much focused. They feel the responsibility of doing it well, they are super serious and super formal. It caught our attention how they remain staring at the screen. Teacher reported: "Mika is a girl that has a mild DS status. [During the game session] she has been very attentive, focused and giving the answer immediately. She has done everything right. But above all, the attitude of being calm, following everything correctly, super responsible". Compared to the traditional teaching method the learners seem bored on viewing the cards and boards. Table 2 shows the results of the questionnaire for each group of players interviewed after the pilot test with the assistance of the teachers. Players expressed the fact that they liked to test the game and would like to continue the story later.

Table 2: Overall Acceptability of the GLE

Statements	Overall Acceptability	
	Response	Description
01. Instructional Content on the GLE has been presented effectively.	4.6	SA
02. I learned about the CVC, Riddle, Memory Games, Math and Typing through games using GLE.	4.6	SA
03. I enjoyed the experience of using the Gamified Learning application.	4.6	SA
04. Using the Gamified Learning is easy for me.	4.6	SA
05. The activities /story presented in the GLE is useful.	4.6	SA
06. The user would like to play again in the future and the user would like to know how the story continues.	4.6	SA
07. There was sufficient time to finish the activities.	4.5	SA
08. My level of involvement is high.	4.6	SA
09. The components of GLE suit to my curriculum.	4.6	SA

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10. Using Gamified application really improve my academic performance.	4.7	SA
11. The user/learner manifest to have learned something with the video game.	4.6	SA
12. This was really a useful learning experience.	4.6	SA
<b>Pooled Mean</b>	<b>4.6</b>	<b>SA</b>

Legend: SA-Strongly Agree; A-Agree; N-Neutral; DA-Disagree; SD-Strongly Disagree

The target user is satisfied with regards to the content of the Gamified Learning Environment (GLE). Based on the rating, the authors are motivated to enhance the functionality of the GLE in the future. The target user strongly agrees with the ratio of 4.6 which means that the GLE has the functionality needed in their school course and has a greater impact to their academic performance. Table 3, 4 and 5 also shows the results of the T-test from the levels of easy, intermediate and hard which has a higher performance rate.

**Table 3: T-test Results (Math)**

	Math T-Test Result		
	Easy T-Test Result	Intermediate T-Test Result	Hard T-Test Result
P=Value / T-Test Result	0.119588506	0.341223218	1.32557E-09

**Table 4: T-test Results (Riddles, CVC and Typing)**

Riddles, Cvc ,Typing T-Test Result			
Riddle T-Test Result	Cvc T-Test Result(Vowels)	Cvc T-Test Result(Consonant )	Typing T-Test Result
5.25515E-20	0.052559208	0.000940494	0.058009211

**Table 4: T-test Results (Memory Game)**

Memory Game T-Test Result		
Easy Time T-Test Result	Intermediate Time T-Test Result	Hard Time T-Test Result
0.171200427	7.15987E-07	0.127444017

## V. CONCLUSION

The technology incorporates multimedia and the curriculum-based assessment was the basis of the authors on determining the content of the gamified learning system developed; the system provides a more interactive way of teaching and new learning environment for the learners. Thus, it could support the traditional method of learning since it allows a user to study the lessons that are based on the curriculum-based assessment. The authors have viewed and studied the future outcome of the game-based learning system and its implications to behaviorism. Based on the literature and the study findings we can say that learners should not to distract when they are highly goal oriented. When the gamified learning is entertaining DS students are likely to engage more. When the students are overloaded with

the information in the gamified learning they get irritated, therefore goal impediment has a significant impact to the negative experience. The gamified learning system features resulted in positive effects on learner's academic performance among DS are mathematics, riddles, consonant vowel consonant (CVC), memory games, achievements, leader boards, and levels. Thus, it could support the traditional method of learning since it allows user to study the lessons that are based from the curriculum-based assessment. Based on the results of evaluation, different factors in analyzing the behavior of students in a Gamified Learning Environment that need to consider in teaching students with DS and the designed framework using gamified learning system helps students with special needs in terms of their academic performance and behavior. The attribute of learning is improved when teachers or educators must have to consider the ethical considerations specially students with disability.

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