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# **Portrait of a Deaf Mauritian Student: How I propose to use educational games to ease up struggles faced in French elementary classes**

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## **Abstract**

Yearly in Mauritius, only a few deaf and hard of hearing students manage to get a passing mark in French language at elementary level. This shows that those students are encountering difficulties to perform well in this subject; in that they struggle to read and write. French language is basically the second or third language of deaf and hard of hearing students; after the bilingual-bicultural model of MSL (Mauritian Sign Language) and English, and Creole. Since no single method addresses all needs and the focus of the research lies in the need to improve knowledge transfer from teachers to deaf students, a combination of methodologies is necessary; thus the importance of the living theory approach. The project shall encompass developing educational games, and multimedia through the pragmatic paradigm point of view, exploring the practical relevance of the tools; while the theoretical framework will be based on action research. The purpose of the research is however not to replace the actual means of teaching French language to deaf students; but to rather act a paradigm shift to the current teaching method. A preliminary research showed that people learn more deeply from words and pictures than from words alone (Mayer & Anderson, 1992; Mayer & Moreno, 2002); and that games can potentially shape users' behaviour (Dicheva, Dichev, Agre, & Angelova, 2015). Drawing from literature review to better understand whether or not Deaf and Hard of Hearing learners (DHH) may benefit from both multimedia and games in the classroom, a simple and appropriate learning aid which focuses on individually tailored behavior from specific criteria will be analysed. In this paper we will discuss the difficulties faced by Deaf students in French classes, how literature suggests that multimedia and gamification be used to ease up their struggles, and my proposed solution for a typical case study.

## **INTRODUCTION**

Yearly in Mauritius, only a few deaf and hard of hearing students manage to get a passing mark in French language at elementary level. This shows that those students are encountering difficulties to perform well in this subject; in that they struggle to read and write. In order to address this issue, literature has been reviewed so as to better understand how deafness affects language acquisition in children. We further explore a host of additional factors which makes learning to read and write difficult for multilingual deaf children. Finally, we propose an adaptive solution which is expected to improve the learning experience of the deaf Mauritian student.

## **A REVIEW OF DIFFICULTIES FACED BY DEAF STUDENTS & THE BENEFITS OF GAMIFICATION**

### **Hearing impairments and language development**

The age of the first exposure to a language is highly variable for babies born with profound and severe hearing impairments, and they are isolated from language spoken to and around them. The deaf child's exposure to a first accessible language is further delayed by a host of additional cultural and social factors. For instance, the age at which a child's hearing loss is detected varies largely and so does the age at which he receives special intervention. Often, when deaf children are born from hearing parents, and when special services are available to the child, the focus is on audition and speech training, omitting exposure to sign language. Even when powerful cochlear implants and hearing aids are used, listening and lipreading do not provide sufficient linguistic details for the child to acquire spoken language spontaneously as a first language within the normal development time frame. Deaf children must often demonstrate that they are unable to acquire language from audition alone before they are taught sign language. This delayed exposure to a first language affects the development of a second one. (Mayberry R. I., 2007; Padden & Humphries, 2005; Humphries, et al., 2014)

The limited hearing abilities of a deaf child can be augmented either with hearing aids or cochlear implant; increasing the child's awareness of sound. However the extent to which the aid or implant can help the child learn a spoken language depends on several factors, which include the extent to which speech sounds remain distorted despite amplification and speech frequencies the child is able to hear. It is therefore hardly surprising that the kind of proficiency in spoken language that normally hearing children achieve is not attained by deaf children. (Mayberry R. I., 2007)

Deaf children have limited and imperfect knowledge of the language that is mapped by the print system they are trying to learn. Obviously, children born of either deaf or hearing parents would learn the language differently. Although born to deaf parents who are often fluent to a sign language, the latter is not the language deaf children are trying to read. While those born to hearing parents are often not exposed to sign language at birth. Before sign language (ASL here) was recognised as a real language, deaf and hearing educators invented a number of different sign systems which are referred to as Manually Coded English (MCE). The goal was for deaf people to learn the structure of English through manual patterns of signed English while simultaneously speaking the language. Although seemingly an excellent idea in principle, MCE systems are difficult to process in practice for both teachers, who have to sign every spoken word, and for the deaf children who often distort the system to fit more closely to natural sign languages such as ASL. Often, the signers the deaf children interact with at home are themselves novice signers like the children. The linguistic input the deaf children receive will therefore vary in both time and quality; affecting their mastery in a sign language when they start learning to read. (Mayberry R. I., 2007)

Goldin-Meadow & Mayberry (2001) found that deaf children do not necessarily read through codes based on phonological sounds as do hearing children. Language processing and structure is not the product of the sensory-motor modality through which it is sent and received, but rather of the human mind (Mayberry R. I., 2007). Morford & Mayberry (2000) also found that learning a sign language (ASL) does not interfere learning to read printed English, and that knowledge of a language, even a manual language with different structure from the language captured in print, is better for learning to read than not knowing any language.

According to Goldin-Meadow & Mayberry (2001), the first step to improve the reading skills of profoundly deaf children is for them to learn a language, be it sign or spoken. For children born to deaf parents, no intervention is normally necessary at this stage, since they are continuously exposed to a sign language; whereas those born to hearing parents need interventions in several aspects such as early detection of hearing loss, and continuous contact to fluent signers. However, only knowledge of a language does not guarantee success in reading. The profoundly deaf children need to learn the mapping between the sign language they know and the printed words, in the hope that they learn the printed language.

Further research is necessary, though, to develop techniques to teach deaf children how to map print into sign (Padden & Ramsey, 2000), and how instructions can be best used to turn signers into readers. (Goldin-Meadow & Mayberry, 2001).

## Challenges faced by deaf students in reading and writing

It is important to know that reading and writing require two related capabilities; firstly you must be familiar with a language and secondly, you must understand the mapping between that language and the printed word. (Mayberry & Marentette, 2000) Deaf and Hard of Hearing learners (DHH) are disadvantaged on both counts. For example, learning to read requires DHH learners to learn the mapping between the spoken language and the printed words, and this is not easy for them because they do not have access to phonological code and many do not know the language well since it is often considered as a second language for them. (Goldin-Meadow & Mayberry, 2001)

For the Mauritian deaf community, French language can be considered as a third language; given that the first learnt is Creole (being the native language) and/ or the MSL. The grammatical syntax of a sentence in sign language is different from that of a spoken language (Perlmutter, 2017; Dictionary.com, 2017); adding to the challenge faced by deaf students as compared to their hearing peers. In MSL, words in a sentence are signed in the following order: starting with the object, followed by the subject and verb (OSV - Object Subject Verb); while the structure of a simple sentence in French language starts with the subject, followed by the verb and object (SVO – Subject Verb Object) (Rowlett, 2007).

During their study, Boutla, et al. (2004) observed that despite the difference in short-term memory span in deaf people; theirs and their hearing peers' working memory resources were comparable; meaning that both have similar ability to manipulate and maintain linguistic information. The shorter short-term memory span in ASL users was probably due to the reliance of their hearing peers on auditory rather than visual information in linguistic short-term memory; thus affecting the likelihood of transfer to long-term memory. (Boutla, Supalla, Newport, & Bavelier, 2004; AuBuchon, Pisoni, & Kronenberger, 2016; Silvestri, 2016)

Learning to read and write is a language skill that is acquired under limited circumstances. Chinese-speaking children do not learn to read by associating elements of Chinese to an alphabetic system but to an ideographic script. French-speaking children learn to associate sounds of French via its written text, and not from fingerspelled handshapes. In the same way, signing deaf students form associations between signs and their printed word. They acquire languages by seeking links between accessible systems, and not between words they cannot hear or speak, but between signs, fingerspelling here, that have some tangible link to its printed text (Padden & Ramsey, 2000). These links were found to not be entirely fruitless. In their study, Padden & Ramsey (2000) found that the better readers in their sample were those who were better at recognising fingerspelled words and writing them down in print. They also argued that this ability of linking signs to printed text is not easy and natural; it has to be cultivated from consistent and massive exposure orchestrated and organised by one's culture. Deaf children who grow up with a sign language are exposed to early language experience which undoubtedly contributes to reading success, but they also grow up learning strategies for linking systems (Padden & Ramsey, 2000). Adding to the difficulty is that of learning and differentiating between two or more spoken languages; which is the case for multicultural countries like Mauritius. Deaf Mauritian students have to learn and differentiate between both French and English languages via the MSL at school. Multilingual deaf children represent a kind of linguistic diversity that has not been adequately addressed and is worthy of continued research attention (Howerton-Fox & L. Falk, 2019).

## Benefits of Gamification and learning

“Gamification”, as defined by Deterding et al. (2011), is the “use of game-design elements in non-game contexts”. According to the scholars (2011), the term was first used and documented in 2008, and started to gain popularity in the second half of 2010. However, the concept itself is not a new one (Dicheva, Dichev, Agre, & Angelova, 2015). The idea of using game elements and game-thinking to engage audiences and solve problems has been used by the military for hundreds, if not thousands, of years (Zichermann & Cunningham, 2011).

Psychologist Mihaly Csikszentmihalyi described a state known as “flow” (Csikszentmihalyi, 1990). During flow, the experience of immersion and gratification are normally felt, propelling people at the peak of their performance and creativity. Games have the ability of inducing such a state which is ideal for learning (Deterding, Dion, Khaled, & Nacke, 2011). In his bestselling book, titled “Play: how it shapes the brain, opens the imagination, and invigorates the soul”, Stuart Brown makes a compelling case for play in all the aspects of life, including that of learning (Brown & Vaughan, 2009). He postulates that play is at the center of innovation and creativity. Advantages of gamification are known to be physiological (McGonigal, 2011). Neuroscientists have measured an increase in the release of the chemicals epinephrine, norepinephrine and dopamine in the brain, that makes players more receptive to learning (Guitierrez, 2012; Nacke, Bateman, & Mandryk, 2014). Dopamine is seen as a “motivational salience” that conditions the brain for new learning (Berridge & Robinson, 1998). The process of learning requires neural connections to be made in the brain to store information in the memory (Entwistle, Ramsden, & Morrison, 1983); frequently coming from a response to an actual event such as when playing games (Miller, 2013). Knowledge, attitudes and skill sets are important outcomes built from learning games (Guitierrez, 2012). Gamification is often associated with problem solving skills like evidence based decision making deduction, and spacial and linear thinking (Zichermann & Cunningham, 2011; Kapp, 2012). Finally, gaming also allows the player to fantasize about aspirational roles; exercising his imagination (Miller, 2013).

The advantages of gamification are further explored in a pragmatic point of view, in the following section under the Game Model.

## **MY ADAPTATION OF A PERSONALISED SOLUTION**

As at date, literature suggests that there is hardly any French language learning tools connected with pedagogical knowledge and technological tools suitable for the Mauritian context. Rather than just being seen as a new pedagogical tool, the game I intend to develop should address the issue of enhancing the teaching and learning process. It is also important to note that research conducted by teachers and psychologists has indicated that each individual’s learning process varies from another because of the existence of diverse biological and psychological factors. The proposed adaptive solution is drawn from the fact that learners are dissimilar in learning, and the lack of pedagogical resources in teaching French language to deaf Mauritian students. To address the different difficulties faced by the latter, a student model and game model have been designed. The student profile has been adapted to a similar style as proposed by Santally & Senteni (2005), while the proposed game has been modelled in terms of some of the main properties of gamification. Figure 1 - The Adaptive Solution illustrates how the difficulties faced by deaf students are mapped onto the Student model which in turn interacts with the Game model to generate the solution which addresses the problem.

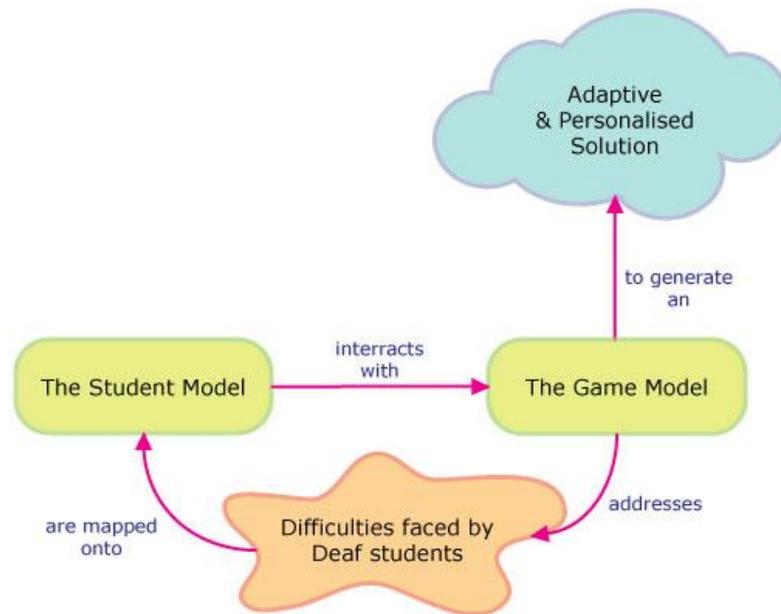


Figure 1 - The Adaptive Solution

## The Student Model

Drawing from literature (Santally & Senteni, 2005), a student model was derived so as to illustrate the different properties which will be addressed based on the reviewed difficulties faced by deaf students. In this paper, the following components were listed as necessary: the cultural and social background, cognitive style, learning preference, learning difficulties, player type, and the performance.

### *Cultural & social background*

This property takes into consideration the different influences that may be used to explain changes in the deaf student's ability to read and write. Often, a student's academical performance is influenced and affected by the people around them and the environment in which they grow and learn (Morford & Mayberry, 2000). The cultural and social background will be further classified as follows: (1.) Home: accounting for the parents' or carer's involvement in the student's education, (2.) Teacher: the pedagogical influence of the teaching method used, (3.) Peer effects: a motivated student may influence his friend in learning but the contrary may also be true, (4.) Principal: the principal can influence the climate of the school, encouraging student responsiveness or bureaucratic control.

### *Cognitive style*

Cognitive styles, like personality traits, are considered by most psychologists to be fairly consistent and lasting modes of functioning. They describe the ways in which people perceive, think and remember information, and can be classified as follows: Field dependence/sensitive and Field Independence. The latter is indicated by the degree to which a person focuses on some aspect of experience and separates it from its background. Morgan postulates that when the field or background is not clearly organized, people who are field dependent will often accept it as it is, whereas those who are field independent would most likely impose their own structure on the material (Moran, 1997). A field independent learner will normally be skilled at classifying information and working further with it (Ehrman & Leaver, 2003).

### *Learning style*

Learning styles are the ways in which people feel comfortable when perceiving, remembering and retrieving information for learning or problem solving (Ortega, 2009). In this paper, we will consider Honey & Mumford's (1986) four learning styles: Activists, Reflectors, Theorists, and Pragmatists. Activists are enthusiastic and welcome new experiences and challenges; they like to take direct action. Reflectors, for their part, like to think about things in detail before taking action; they take a thoughtful approach. People who prefer logical and objective sequential approaches to problems are theorists. They like to see how things fit into an overall pattern. Pragmatists are practical, down to earth and like to solve problems while experimenting new ideas; they like to see how things work in practice.

### *Learning difficulties*

The main learning difficulty considered in this paper is the inability for deaf students to use and rely on their auditory memory to learn.

### *Player type*

Players normally have some favorite types of games and often they feel more engaged with some game mechanics than others. Focusing on personalised gamification rather than games, player types need to be directly related to game elements and mechanics. A recent contribution by Nacke et al. (2014) in the area, BrainHex gamer typology has been considered in this paper because it is supported by an online survey taken by more than 50,000 players and is not based on a specific game genre. Inspired from neurobiological research, BrainHex includes 7 archetypes with specific traits: seeker, survivor, daredevil, mastermind, conqueror, socialiser and achiever (Nacke, Bateman, & Mandryk, 2014). The seeker is curious about the game and enjoys moments of wonder; while the survivor enjoys the experience of fear and the relief felt afterwards. The daredevil for his part focuses around thrill seeking, risk taking and excitement. Players who enjoy devising strategies and solving puzzles while focusing on making the most efficient decisions are the masterminds. Defeating impossibly difficult foes and struggling until victory is achieved are categorised as the conqueror archetypes. The socialiser takes people as primary source of enjoyment. They like talking; helping and hanging around people they trust. Finally, the achiever; unlike a conqueror who is challenge oriented; is motivated by long-term achievements. (Nacke, Bateman, & Mandryk, 2014)

### *Performance*

Performance, here, refers to the academical results and grades of students over three years of longitudinal study. It also takes into account the scores obtained through the game model.

## **The Game Model**

The game model is closely linked to the student model through the property of player type. It is an important part which addresses some of the different difficulties faced by deaf students through the student profile. We discuss the model in terms of effects gamification has on students: motivation, engagement, mastery, feedback, recognition, autonomy and objectivity.

### *Motivation*

While the goal is to create and maintain intrinsic motivation, gamification is the application of extrinsic motivators (Richter, Raban, & Rafaeli, 2015). Intrinsic motivation, according to Deci et al. (1999), energizes and sustains activities through the spontaneous satisfactions inherent in effective volitional action. It is manifest in behaviors such as play, exploration, and challenge seeking that people often do for no external rewards. It is thus a prototypic instance of human freedom or autonomy in that people engage in such activity with a full sense of willingness and volition. A close examination of Deci et al.'s meta-analysis (1999), and reanalysis (2001) indicate that extrinsic rewards do not have pervasive negative effects on people's intrinsic motivation. As

postulated by Morgan & Fuchs (2007), motivation is necessary to best help poor readers become proficient; as is the case with deaf Mauritian students.

### *Engagement*

Gamification desires to combine intrinsic motivation with extrinsic one in order to raise motivation and engagement. Game elements such as rewards can be arranged to progressively shape performance, to cultivate initial interest in an activity and build skills, and to maintain or enhance effort and persistence at a task (Deci, Koestner, & Ryan, 2001). Persistence at a task over time is engagement; effectively fostering repetition. Repetition in turn holds information for longer periods of time, affecting the likelihood of becoming a permanent memory trace, presumably in episodic long-term memory (Entwistle, Ramsden, & Morrison, 1983). The experience of learning to read, that is recall and retention, can therefore be enhanced through gamification.

### *Mastery*

Game playing is associated with trial, error, failure and eventual success through practice, experience, reflection and learning. A key objective of most games is not to forbid failure but to develop a positive relationship with it. Failure is not seen as an end, but as a step on the journey to mastery (Lee & Hammer, 2011). Deterding et al. (2011) state that mastery has the ability to encourage users and give them a feeling of accomplishment; eventually leading students in a state of 'flow' which is the most effective and efficient way of learning. This state is described by Csikszentmihalyi (1990) as being fully engaged and focused in an activity.

### *Feedback*

Gamified learning interventions seek to maintain a positive relationship with failure by creating rapid feedback cycles and keeping the stakes for individual learning episodes low (Lee & Hammer, 2011). This game design element is important so that participants can quickly learn how to improve at the game; leading to mastery. Urhaet al. (2015) found that positive feedback could raise users' motivation and self-esteem.

### *Recognition*

Allowing students to earn recognition and rewarding learners can keep them motivated and engaged in the gamified learning environment; fostering efficient and effective learning (Csikszentmihalyi, 1990). Game mechanics such as leaderboards, points and badges are often used to reward a student's accomplishment and contributions.

### *Autonomy*

Autonomy, as described by Deterding (2011), is one of the most important aspect of gamification; in that if a user feels that he is forced to perform a task, he will far less likely going to enjoy the process no matter how engaging or fun the action might be intrinsically. Instilling a sense of autonomy and choice creates deeper and more meaningful motivation and engagement.

### *Objectivity*

Implementing gamification allows for collection of data which can be used for statistical and behaviour analysis (Morford, Witts, Killingsworth, & Alavosius, 2014); painting an objective picture of how players are actually doing. Iosup & Epema (2014) used game analytics to analyze the behaviour and performance of students in the gamification of an educational course. They stated that game analytics allowed them to understand what students were interested in, how each performed, and where they needed more guidance; and as a result some lecture information were repeated to students who had not yet assimilated.

## **CONCLUSION**

This paper describes the different difficulties faced by deaf students in the classroom; in that they struggle to read and write. Necessary composite skills such as fingerspelling, morphological analysis and phonological analysis all converge to create the deaf reader. The picture that emerges is that each deaf student is unique and

will take a different path to language acquisition affected by cultural and individual capabilities. This propels the need to propose an adaptive framework; modelling a student profile and game model. The models both map and address the difficulties reviewed through the solution of personalised gamification. As reviewed in literature (2014), game analytics will be used to collect data so as to analyse the performance and behaviour of students. This will enable the deaf education teacher to identify the difficulties faced by each of his students, their preferred method of learning, and make informed decision pertaining to his teaching method and the pedagogical tools to use so as to bring the best out of the children's learning experience based on real data. The portrait of a successful deaf learner must indeed be a unique one.

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