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Gamification in Education: A Methodology to Identify Student's Profile

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Abstract—This paper presents a methodology to identify the students' gamification profiles for educational projects. Gamification is the application of game elements and game principles in non-game contexts. We propose a process to identify profiles in gamification through the use of ludic activities and gamification driven questionnaires. The choice of activities follows some information of the target audience, such as: age range, cell phone use, internet access and other data. The use of questionnaires is necessary to cross-check the activity data, analyze data and identify the resulting gamification profile.

The proposed methodology consists of six steps process: making a baseline, defining core drivers, defining activities, preparing a questionnaire, planning data collection, and analyzing data. The purpose of the process is to identify which gamification core drivers (the motivations) may be most effective in attracting students' attention.

Gamification is a powerful tool to attract students. Also, a good gamification rise their interest up to learn and caught attention for a long period of time. A good gamification educational project will produce a very attractive educational game. The resulting game will motivate students to do something different: to study in a new way.

We used Yu Kai-Chou's Octalysis framework to identify and model the student profile. The final gamification project is also an Octalysis model. The Octalysis framework is based on basic human motivations according to eight core drivers, which are: Epic Meaning & Calling, Development & Accomplishment, Empowerment of Creativity & Feedback, Ownership & Possession, Social Influence & Relatedness, Scarcity & Impatience, Unpredictability & Curiosity and Loss & Avoidance.

Finally, in order to test and evaluate the methodology, we applied the whole process on four classes of two different public schools. The 98 students are from different ages and different grades (7th to 10th grades). The results indicate the process is useful to identify the students' gamification profile, the activities and the questionnaires provide a good data set to identify the core drivers and the resulting gamification project clearly depicts the final profile.

Keywords — *Gamification in Education; Student's profile identification; Motivation and Engagement*

I. INTRODUCTION

Nowadays, the learning process has become very attractive. The newer generations make intensive use of modern digital technologies. They are natively digital users and like to learn through interaction, specially, using technology [1]. Those users prefer to autonomously discover the content and learn the contents at the internet [2]. And as they are so involved with

technology, spend some time playing games is a very common activity for them.

In such scenario, the use of game elements in a non-game context [3] seems a natural choice to be used in education of newer generations [4]. Gamification advocates the use of design elements and game principles to increase engagement, motivation and user pleasure in performing daily tasks [5,6,7].

The organized set of design elements and game principles for a certain public is the gamification project (GP). A game, digital or not, is an implementation for a given GP [7,3,6]. To build a GP, someone must: (1) identify the audience gamification profile, (2) identify the gamification target and, finally, (3) organize some set of game and design principles to reflect the audience profile along the time.

This work proposes a methodology to identify the audience gamification profile for students. To this research Yu Kai-Chou Octalysis framework [6] was used to model students profile. The methodology enables us to track students' actions and map them as a gamification profile. Also, was created and applied dynamics and questionnaire to evaluate students' individual behavior (simulating a game).

This exploratory and empirical research is structured as follows: section 2 presents related works, section 3 depicts the developed methodology, section 4 presents its application on a case study, in section 5 presents the data analysis and its results and, finally, section 6 presents the conclusions.

II. RELATED WORKS

The choice of the gamification framework is important to our proposal, as the intended goal of a framework (business, educational or general purposes) and the way they represent the user's characteristics impacts the identification of profiles. Also the techniques for user testing are important.

A. Gamification Frameworks

Werbach and Hunter [8] proposed the 6D framework. It consists of the application of 6 elements of business to map the players. Like Kumar proposal [9] those frameworks are better used for business audience and are not easily adapted to the education audience.

The gamification process proposed by Marache-Francisco and Brangier [10] is user-centered design and aims to overcome development difficulties in integration with the development processes. Their proposal identifies and describes

each process phase and is directed to produce quality gamification. While noting the relevance of identifying and adapting to different types of player profiles, they do not classify different users' profiles.

The framework Octalysis proposed by Yu-kai Chou [6] is a focused on human motivation where player profiles are defined according to their trend in eight core drives. In Octalysis, it is possible to plan the gamification that best fits the different types of player profiles. In our analysis, Octalysis showed to be the most adequate framework to build educational gamification project. Next section presents the Octalysis framework.

B. The Octalysis framework

The Octalysis framework proposed by Yu Kai-Chou [6] presents eight basic motivations called Core Drivers (CD). Each CD lead users to play a game (or gamification) and categorize a wide range of game techniques associated with each Core Driver.

According to Chou, the 8 Core Drivers represents a motivation a player would have when playing. The 8 cores are:

1. Epic Meaning & Calling - when the player believes that she is doing something greater, for a greater good or that she has been chosen to do something transcendental.
2. Accomplishment & Development - when the player observes their progress, skill development and, eventually, overcoming challenges.
3. Empowerment of Creativity & Feedback - when the player is involved in a creative process where she repeatedly has to discover things and try different combinations.
4. Ownership & Possession - when the player is motivated because she has the sense of ownership or ownership of something.
5. Social Influence & Relatedness - when the player is motivated by social elements that influence people, including: orientation, acceptance, social responses, companionship, as well as competition and envy.
6. Scarcity & Impatience - when the player is motivated by the desire for something they cannot have.
7. Unpredictability & Curiosity - when the players are motivated by wanting to figure out what will happen next. If they do not know what will happen, they brain is involved and thinks about it many times over.
8. Avoidance & Loss - when the player is motivated by the prevention of something negative that may occur.

For each core driver, Chou presents and categorized a set of game techniques. Some examples of game techniques are: Narrative, Beginner's Luck, and Elitism among others 90 techniques.

A graphical representation of Octalysis is the octagon as shown at Figure 1.

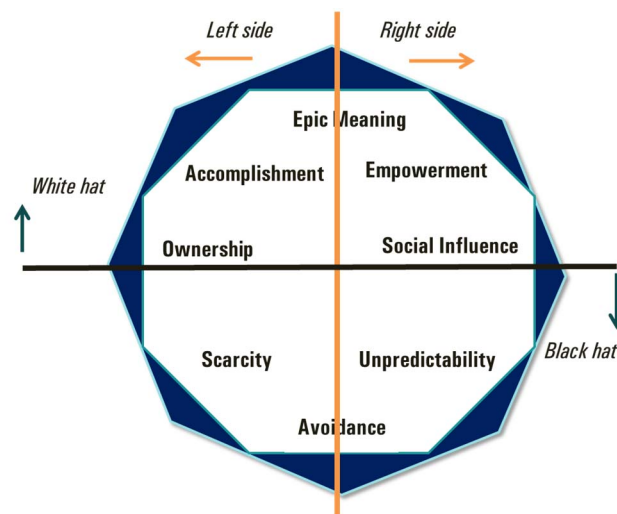


FIGURE 1: THE OCTALYSIS GRAPHICAL REPRESENTATION

The CD on the right side are considered right brain core drives, being more related to creativity, self-expression, and social aspects. The CD on the left side are considered left brain CD, being more associated to logic, calculations, and ownership. Also, left side appears to be more based on extrinsic motivation and, on the other hand, right side have a tendency of being based on intrinsic motivations [11].

We used Octalysis as it provides an easy way to model the students' gamification profiles as set of graded core drivers. As a result, a set of students (the class) could have a profile: competitive, collaborative, anxious, supportive among others, that is mapped as a set of motivations. By using techniques that strengthen the corresponding motivations, there will be a strong engagement of the student in the activities of the game, producing a sense of gratifying and rewarding activities.

C. User testing technique

Nicolaci da Costa et al [12] proposed a methodology to underline general profiles called MEDS. MEDS is a qualitative method that was conceived in the area of clinical psychology.

The authors define the MEDS as a strong interdisciplinary method, and that your development was influenced by linguistics and theories of social construction of subjectivity. Is important to notice that the authors define MEDS as flexible and adaptable to the study context, but it's important to follow its process, which is:

- Objective Design - This step enables in-depth investigation of the proposed issue, this can be made as a question. A clear objective establishes the limits that prioritize depth instead broad.
- Recruitment of participants - Recruitment is linked to the purpose of the research. In depth research the number of participants is small and attention is also needed in recruitment. MEDS suggests that homogeneous recruitment should be carried out, always taking into account the objectives.
- Preparation for data collection - Semi-structured interviews where it is suggested a script to questions.

The structure of the script or definition of the collection instrument should be made based on the defined objective.

- In-person interviews - According to MEDS the interview should look like a conversation and it is suggested that only one interviewer participate so that the interviewee is not shy.
- Drawing up the script - The script items represents all the topics to be addressed in the interview and the questions adapted throughout the interview. Provision should also be made for drawing up a consent form and conducting pilot interviews.
- Data Collect - With MEDS data collection can be divided into the following topics.
- Invitation - The invitation to participate in the interview should be preferably face-to-face and the interview should be conducted where the interviewee feels comfortable.
- Conducting the interviews - In order for the goal to be achieved and the interviewee's information to be achieved, the interviewer should avoid suggestions, direct responses, or interrupt the interviewee. All items defined in the script must be addressed during the interview.
- Preparation for data analysis - Responses should be transformed into text and require prioritization according to defined objectives. Attitudes such as hesitation should also be described.
- Data analysis - MEDS defines an explicit discourse analysis, using data such as intonation, pauses or hesitations, if that information is relevant to the objectives. The first part of the analysis gathers all responses from all participants and relates to the items in the script, so you can get an overview of the data. The second part of the analysis consists of analyzing each response in search of inconsistencies or contradictions between responses. With these two parts it is possible to do the in-depth analysis already quoted and understand all the information.

MEDS is not a way of surveying gamification profiles, but in several steps of the application, it is possible to notice the need to plan and adapt to understand the target audience.

III. THE PROPOSED METHODOLOGY

Using the Octalysis model proposed by Chou [6] and using MEDS [12] methodology, we create a methodology to identify the gamification profile for the students. The methodology is depicted in Figure 2.

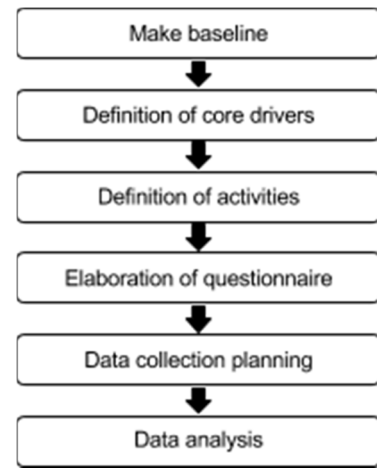


FIGURE 2: BLOCK DIAGRAM FOR THE METHODOLOGY

The methodology consists in a six step process described in next sections.

A. Make baseline

The characterization of the target audience consists in the creation of a baseline on how well-known characteristics of the target audience. The survey of the characteristics is made from a bibliographical research. Characteristics such as age range, cell phone use, education level, internet access, game behavior, and other known information about the target audience should be taken.

B. Definition of the core drivers

From the characteristics raised as baseline it is possible to associate core drivers that have similar elements. According to the analysis of the characteristics of the target audience, the core drivers that best describe the audience are defined.

C. Definition of the activities

According to the core drivers identified, a bibliographic research must be made on literature related to practices, for example #Workout [13]. The choice of such activities/dynamics allows the verification of the core drivers. Adaptations can be made to ensure a more efficient data collection.

D. Elaboration of questionnaire

A questionnaire should be developed to construct a database to be analyzed statistically. It contains questions that, allow crossover to identify whether core drivers used in the activities are actually appropriate for the target audience. The questionnaire may also contain questions that check the other undefined disk drives.

E. Data collecting planning

According to defined activities, the planning of data collection should increase the efficiency of the dynamics execution. Use of video recordings, audios, notes among others ways of documentation must be defined.

F. Data analysis

At this stage the identified core drivers are confirmed. The collected data allow identifying which core drivers defined in the baseline effectively influence the target audience of the sample.

The approved core drivers can be used as basic elements for the design of the gamification project, considering that, according to Octalysis, in each core driver is associated with a set of game techniques that describe it.

According to [14] a gamification may cause less motivation for students when misapplied. The application of this methodology is looking for increase the chances of success in assessing and improving people's performance in their activities [10].

IV. APPLYING THE METHODOLOGY

The following is a description of how the proposed methodology was tested. A group of 98 young people between 12 and 17 years old, from four classes of two different schools, was submitted to the study, participating in the activities and answering the questionnaire at the end of the process. After a study, the use of group dynamics was defined to get more data from the target audience.

Four dynamics were performed where each one of them as a specific objective in different social levels, to know how to work better this results in future researches. This impact on how young people relate to each other and how they make up to reality that surrounds them.

The dynamics involved questions about the problems of the school and the city in which they live, and how they manage to improve the things around them in a group for the common good. At the end of each dynamic, certain rewards were presented that would be delivered to students when they finish all the challenges. Thus, with a reward on a table, they feel motivated to keep participating in the dynamics. At the end, they were asked to answer a questionnaire to help improve the research. After answering the survey, they received some candies and chocolates for the collaboration with the survey.

A. Make baseline

The target audience defined is the students of two public schools in Brasilia - Brazil. To be more specific, students from 7th to 10th school grades. After that, it was checked out the age range according with the Brazilian structure of education. Therefore, the target audience age of 7th grade is thirteen years old and sixteen years old for 10th grade. The possible differences ages between students are not considered.

To define the internet access baseline we take into account that 71.1% of the population of the Brasilia has access to the internet and 87.1% have access to cell phones [15].

The academic performance in Brazilian basic education was also researched. According to the Basic Education Development Index¹ (IDEB), the index for target audience in Brasilia is below the target value in recent years (Table 1).

TABLE 1: IDEB FOR THE BRAZILIAN EIGHTH GRADE

Year	Target Value	Reached
2011	3.7	3.9
2013	4.1	3.9
2015	4.5	4.0

B. Definition of the core drivers

To define the core drivers, a research was made to identify what motivates the most the youngsters in many areas, such as what kind of movies, games and activities they enjoy. After collect this data and analyze the framework proposed by Chou, it was made possible to relate their preferences and the core drivers. At the end of this part, the main core drivers are studied to find out what could be used to motivate the target audience in other areas, such as school, for example.

C. Definition of the activities

The methodology used to understand the target audience profile was made through a survey (questionnaire) and experiment [16]. The first allow a direct answer from the audience about the subject. The second creates a controlled environment, in this case group dynamics, to see the chosen characteristics. Each method has its own advantages and the utilization of both together was important to have a better result.

A big research was made to make this experiment, aiming to find out what kind of dynamics could be used with the students. The goal is not make only an analysis of a survey, but a union between techniques, dynamics and survey, to ensure the most accurate result as possible. And to accomplish that goal, was necessary to observe how the students were reacting when submitted at each challenge proposed by the dynamics.

To select the appropriate dynamics able to establish a connection between the dynamic and the core drive, the context of each dynamic was analyzed to see if it fits a desired core drive. After that, based on the available time to collect data from the target audience, the dynamics was once more filtered until remain just one dynamic to each core driver.

The dynamics selected are the ones described on this section. Each one has a main core driver, but can contain aspects of other core drivers.

The first one was called “My other half is with you” and is related to Social Influence core driver. During the dynamic, a list of phrases written on pieces of paper are cut in the middle and shuffled. Each person receives a piece of phrase, and the objective is found the other half that completes that phrase.

The second one is “The problem with my city/school”. The dynamic consisted of making the youngsters think about the problems around the place they live or study and what they could do to solve them. The scope (school / city) depends on the age range of the target audience, the first one is more appropriate for the young ones to make easier for them to define the problems. The dynamic is related to the Epic Meaning core driver.

¹ <http://ideb.inep.gov.br>

The next one is related to the Empowerment core driver and is called “Living with masks”. Many profiles are presented to the audience, and they needed to choose the one that more fits their own personality.

The last one is “Two for everybody”, related with Scarcity core driver. The objective is, in two minutes, that two persons must cooperate to complete one mission and ensure that everybody receives the prize (for example, a chocolate bar).

D. Elaboration of questionnaire

For the creation of the survey, some principles were followed in its structure [16]: to start in the general subjects and then go to the specifics, to follow a logic order and to make related questions grouped. The first questions of the instrument are more general about games. Next there are questions more specific about what the target audience likes and how they behave. This maps the behavioral characteristics to the chosen Octalysis core drivers.

Next, there are questions about the dynamics applied. The purpose of these questions is to validate the observations made in this part of the methodology. Finally, there are the demographic questions like age, grade, and access to electronic devices and so on.

The choice of the items scale in the instrument was based on the kind of calculation and interpretation of the results in the data analysis phase. Most of the items of the instrument are in the Likert scale of five values [16]: Very weak, somehow weak, neutral, somehow strong and very strong.

Demographic questions are the only ones that are not in this format and one open question about the dynamics.

The main goal of the questionnaire, besides collect data, is to ensure an accurate definition if the core drivers identified are the ones that really motivates the target students. Also, to make clear the relation between the core drivers, the dynamic and the questionnaire, take as an example the core driver ‘Epic Meaning’.

To verify the core drivers at the target students, we used the previously four dynamics. The dynamics consisted of making the youngsters think about the problems around the place they live or study and what they could do to solve them. In the questionnaire, one question was about how motivated they felt during each dynamic.

Next, we present the resulting questionnaire:

Q1 - What is your opinion on non-digital games? (Ex: sports / card games / board)

Q2 - What is your opinion on digital games? (Ex: video games / mobile games)

Q3 - In a game, are you motivated to feel chosen to save the world?

Q4 - In a game, are you motivated to earn points and evolve skills?

Q5 - In a game, are you motivated by doing creative things?

Q6 - In a game, are you motivated by winning and accumulating items?

Q7 - In a game, are you motivated by playing with friends?

Q8 - In a game, are you motivated not to miss opportunities?

Q9 - In a game, are you motivated to discover new and unpredictable things?

Q10 - In a game, are you motivated not to lose what you have already won?

Q11 - In Dynamics 1 (My other half is with you), how do you felt?

Q12 - In Dynamics 2 (The problem with my city/school), how do you felt?

Q13 - In Dynamics 3 (Living with Masks), how do you felt?

Q14 - In Dynamics 4 (Two for everybody), how do you felt?

E. Data collecting plan

With the questionnaire ready to be applied, it’s necessary to plan the execution of dynamics and data collect. It was defined some ways to collect data in addition to the questionnaire, like annotations, photos and videos.

To execute the data collection is necessary to decide where and with who collect this data. Based on an estimative of target audience, the next step is providing the material necessary to apply the dynamics.

First, we chose two schools and ask them for permission. Next, we chose two team members of our team, one to apply the dynamics and the other to collect the data (questionnaire, videos and notes). For each class, the dynamic last about one hour plus half an hour to collect the questionnaire.

Next, we present the data analysis and the results for the collected data.

V. DATA ANALYSIS AND RESULTS

The collect data result in a database, videos, audios and notes. In this work, we analyze the 98 responses of the students of the four classes.

A. Cronbach’s Alpha

We use the Cronbach Alpha [17] as a measure of internal consistency, ensuring the reliability of the research items. We obtain the value 0.66 for the questionnaire.

B. Calculate the averages

Next, we calculate and analyze the averages for each of the eight core driver (questions 3 to 10), distinguishing between all data and separated school grades. The result is shown in Table 2.

TABLE 2: AVERAGES FOR THE COLLECTED DATA

Core Driver	Average per school grades				
	All data	7th grade	8th grade	9th grade	10th grade
Accomplishment & Development	4,30	3,85	4,35	4,19	4,67
Social Influence & Relatedness	4,29	4,10	4,47	4,21	4,40
Unpredictability & Curiosity	4,07	4,00	4,00	4,00	4,23
Empowerment of Creativity & Feedback	4,00	4,15	4,00	3,74	4,17
Ownership & Possession	3,98	3,55	4,12	3,97	4,20
Avoidance & Loss	3,68	2,95	3,53	3,67	4,27
Scarcity & Impatience	3,63	3,30	3,65	3,67	3,80
Epic Meaning & Calling	3,39	3,25	3,59	3,29	3,47

Table 2 is ordered by the average of all data. The best ranked CDs for all classes are: Accomplishment, Social Influence, Unpredictability and Empowerment of Creativity.

The result indicates that such students will be driven: (1) to making progress, developing skills, and eventually overcoming challenges, (2) to social elements as mentorship, acceptance, social responses, companionship, as well as competition and envy, (3) on a harmless want to find out what will happen next and (4) to be engaged on creative processes where they have to repeatedly figure things out, try different combinations and have feedback.

Using such core drivers on a gamification project will have good impact on those students.

On the other hand, at the lower part of the table are the following CDs: Ownership, Avoidance, Scarcity and Epic Meaning. This indicates that those students are lower influenced by loss of something (as fail on exam), owning goods (virtual or not) that are rare or not (scarcity), they do not like activities that produce impatience and, finally, they are very realistic (opposite of Epic Meaning).

C. Validate the dynamics

Note that Social Influence was activated by Dynamics 1 and Empowerment of Creativity by Dynamics 3. Also, Scarcity and Epic Meaning are activated, respectively, by Dynamics 4 and 2.

From Table 2, we observe that the first two dynamics (1 and 3) reinforce the well classified core drivers: Social Influence and Empowerment of Creativity. Also that the last two dynamics (4 and 2) reinforce the worst ranked core drivers: Scarcity and Epic Meaning.

This indicates the dynamics are producing the intended impact: potentiate the student understanding of a given core driver context.

D. Analyse individual groups

To create a good gamification project, it is important to analyze group subsets. Our subsets are the school classes, as they are composed by different age students. Table 2 indicates the individual values core driver per class, depicted on Figure 3.

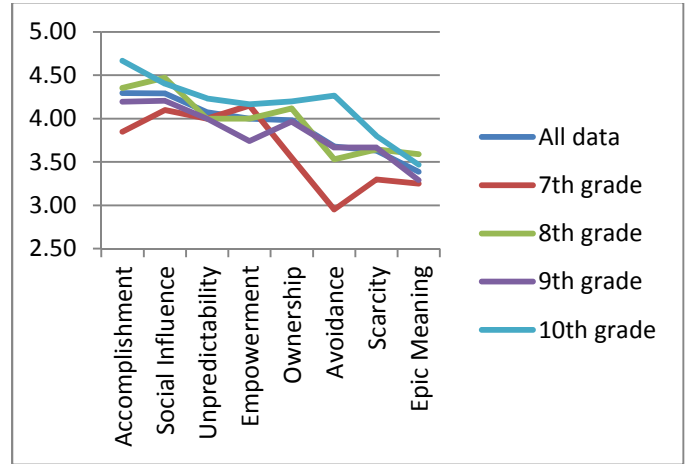


FIGURE 3: CORE DRIVERS AVERAGES PER SCHOOL GRADES

Most grades on Figure 3 follow the global average tendency. Observe that the 10th grade has the same tendency on a higher degree. This indicates that the corresponding gamification project will have higher impact on it. On the other hand, the 7th grade has inconsistent values and is not inline to the global tendency. This indicates that the gamification project will have different impacts on them.

Using the subset groups, it is possible to create distinguished gamification projects. But this is not our case. To lessen the effort, we prefer to focus on a single gamification with slight variations in the final implementation of the game.

E. The final Octalysis analysis

Finally, we used the data to produce an Octalysis view. This enables us to have better analyses for the gamification project, having a look on how core drivers interact each other.

The first step is to transform the average table on a ranking one (Table 3). Each core driver average is ranked based on its relative value at the same column.

TABLE 3: CORE DRIVERS RANKING PER SCHOOL GRADES

Core Driver	Core Driver Ranking				
	All data	7th grade	8th grade	9th grade	10th grade
Accomplishment	1	4	2	2	1
Social Influence	2	2	1	1	2
Unpredictability	3	3	4	3	4
Empowerment	4	1	4	5	6
Ownership	5	5	3	4	5
Avoidance	6	8	8	6	3
Scarcity	7	6	6	6	7
Epic Meaning	8	7	7	8	8

Now it is easy to see the impact of each core driver for the school grades. Note that some as almost constant as Social Influence and have some variation as Empowerment and Accomplishment, both on the 7th grade.

In the second step, we transform the ranking table on an inverted ranking table. Just change each cell by:

$$\text{New_cell_value} = 9 - \text{Old_cell_value}$$

Finally, using the inverted table we produce a radius graphic that resembles the Octalysis octagon (Figure 4).

Now we can clearly see that Social Influence, Unpredictability, Empowerment of Creativity and Accomplishment have the most impact on the gamification.

Also observe that the first three core drivers are on the right side of the representation, indicating that the audience has very strong emotional and intrinsic motivations. Only Accomplishment has expressive values on the left side.

Intrinsic motivations are very powerful. Users motivated by them are rewarded by themselves. They don't need a goal or reward to use your creativity, hangout with friends, or feel the suspense of unpredictability [18]. Another interesting characteristic of intrinsic motivations is that they have long time duration.

By the other hand, the left side indicates extrinsic motivations. They motivated users that want to obtain something, whether it is a goal, a good, or anything cannot be obtained. A useful characteristic of extrinsic motivations is that they are very clean activities. Users clear identify them and know how to interact. The pitfall is that as soon as the user achieves the goal, she becomes disinterested.

Summarizing, extrinsic motivations are very good to initiate a game, but not to continue on it. On the other hand, intrinsic motivations are had to be initiated, but produce a long time game.

Our analysis, based on Figure 4, indicates a long standing gamification project (3 core drivers on the right side) where the students start by the left side core (Accomplishment).

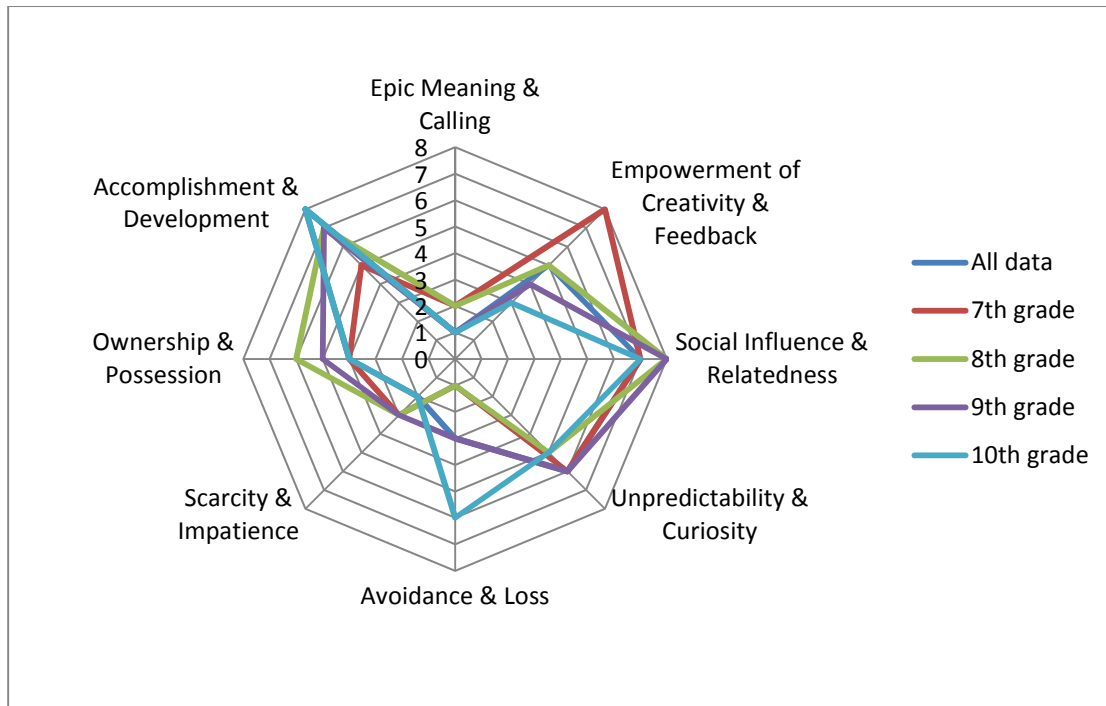


FIGURE 4: OCTALYSIS DISTRIBUTION FOR ALL THE SCHOOL GRADES

VI. CONCLUSION

We have both proposed a methodology to identify students' profiles for educational gamification project. The methodology is based on the application of dynamics on classes, application of questionnaires and data analysis. The analysis uses both statistical methods and their transformation to the Octalysis framework.

We test the methodology on four classes of two different schools. The classes are from different school grades: 7th, 8th, 9th and 10th. We applied four dynamics on each class and collect data from questionnaires, videos and notes.

The results indicate the main game motivations of the students and enable us to create a clear gamification project base on the identified gamification profile for the students' audience. This is the aim of our proposed methodology.

Now, we are in the stage of implementing the game to the gamification project. This will enable us to collect more data and validate or not the obtained gamification project.

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