**Team Formation: Learn & Make An Effective Team**

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**ABSTRACT**

**Purpose –** The aim of the research is to investigate the pre-processing functions of team formation based on personality types, learning styles and CGPA clustering. The research is also developed for the identification of factors of team formation.

**Methodology –** Research methodology for the research consist of four steps of the research that include the preliminary study that identifies the objectives and critical literature. It is followed data collection from a university and data mining techniques. A framework of the mechanism is developed and performance evaluation using multiple classifying and clustering techniques are conducted. The scope of the data are sets of students at university level, where mining techniques are used to understand the personality and CGPA in formation of teams.

**Findings** – Results show that for students at university level , have the most reasonable team style is to use learning teams. The reason behind this is because using the team style, is effective for University level students as each course differs, and the model is mobile and versatile. Using WEKA data mining classifying techniques shows that the value of the data set with regards to personality is at approximation of 40-50% accuracy. This shows that the data set needs to be increased in volume for better deployment of personality. Data clustering techniques show that students of the university are generally the same. However, the students of higher and lower cumulative grade point average should work together for better team.

**Significance** – Educators and students of university can benefit from the study. The reason behind this is because the system investigates personality and grades to make students participate better in class and obtain 21st Century learning environment. The research, is significant because it approaches personality plus, Felders’ Learning Style and CGPA, which is the main focus in learning industry based on 21st century cognitive development.

**Keywords**: Team Formation, Personality Plus, Felder’s Learning Style, Cumulative Grade Point Average.

**INTRODUCTION**

Education is an important factor in the development of a country. The students should be facilitated through learning in such a way that they obtain depth in the knowledge from learning and teaching. Every student has different ability of learning, and different personality styles. Furthermore, the focus of our research work is the team formation for the improvement of CGPA of students. The paper will focus on the solution of team formation with the help of Felders model and personality plus model.

Dingsoyr et al. (2006) indicates 21st Century learning to be a form of modern knowledge acquirement. The research further describes the statement by elaborating on 21st Century education exposure to be a fission of the growth of technology in the global platform. In his article on 21st Century learning, the research shows the shift from material labor to immaterial labor and weightless production is a form of uprising new demands which are process-orient skills that include flexibility and problem solving skills. Yengin (2014) states that cognitive skills is an important aspect to the 21st Century Learning culture. These skills highlighted by (Yengin 2014) include professional “effective communication, analytical and meta-cognitive as well as team

Yengin (2014) suggest further that 21st Century learning also involves the role of teachers, changing their teaching style. Teachers, will be able to transfer the knowledge through modern scenarios with support from 21st Century technology teaching tools and modules.

21st Century learning when highlighted in a literacy education environment of students learning has a large proportion contributed from the aspects of curriculum. These experiences of curriculum in the line is obtained through the investigation of problems when framed, then broken down. These problem-based tactics contributes in the acquiring the techniques and methods of 21st Century Learning. The 21st Century Learning is also defined by the ability to learn and memorize factual knowledge that centric towards gain and use of information, the management of resources, the teamwork and the usage of technology in the learning (Fischer 2013).

Education Week magazine defines 21st Century learning skills as the tools and skills needed by the students for current contemporary career and job market lifestyle. The 21st Century style can be applied in the student’s life in the school, work and civic of the person. (Rich 2010). Kolyda and Bouki (2013) defines 21st Century learning to be a combination of teamwork, knowledge accumulation and design thru creation in the 21st era and the contextual knowledge.

The difference of learning from the centuries of the 19th, 20th then 21st century can be highlighted thru the design and implementation of technology in the education and knowledge obtainment subject. The digital platform act as drivers for individuals to learn and access knowledge by evaluation stated (Dingsoyr et al. 2006).

While the real meaning of 21st century learning can differ from institution to institution, the broad term, is loosely define to adaptive solidarity, these skills of 21st century learning is related with a few common characters of skills as depicted in Figure 1.

Figure 1: Skills of 21st Century Learning, Adapted from (Rich ,2010).

As for the applied skills environment, it will include the analytical skills aspects of the “critical thinking”, problem-solving, infer, analyze and synthesize information. Scientific, economic, finance and technology knowledge application is a part of circular skills knowledge. Other skills that are also part of the 21st century learning environment are the research skills and practice, and inquisitive questioning skills. Global environment awareness and health lifestyle literacy are also important characters for a 21st century learner. Yengin (2014) describes inventive thinking as an approach to 21st century. Innovation skills is instilled when a student is able to use the mental model of creative thinking to solve real-world problems.

At a soft skills point, the characteristics that are involved include presentation and communication skills. Public speaking and debating methods are the actions to define the skills. Ethical and moral behavior of fairness and just-speaking are further elaborations on these skills. Listening also plays a vital importance in acquiring 21st century learning skills stated (TechThoughtStaff 2017). Yengin (2014) suggest social skills that are listening skills and emotional control are integral part in characterization of 21st Century Learning.

However, (Kolyda & Bouki 2013) states that the 21st Century skills is divided into four main branches of skills which are the “Connect”, collaborate, build of knowledge and contextual implications of knowledge. The research reacts to the term “connect” to be define as “Connectivism”. In the new era described by Siemens to be the “digital age” tyros can connect and team together with each other in a highly transparent and easy manner. The internet becomes the platform to convert physical presence of environment to plethora of information available online. The decisions of these concepts of “Connectivism” is based on the rapidly changing foundations. New and constant data is widely available thru the internet. However, the filter of the data of which data is important is crucial. It is highly important to understand the data.

Kolyda and Bouki (2013) points the next skill is “Collaboration” or teamwork. This skill theory is also highlighted in other researches as an important skill for 21st century learning. Kolyda and Bouki (2013) describes the skill to be a tool that provides students with a channel for them to connect and remain interconnected to learn develop new knowledge that students will find difficult to understand if learnt alone. Social networking sites provide a technological platform for these individuals to interconnect and learn as team outside the formal classroom environment. Goto, Batchelor, and Lautenbach (2015) suggest characterization of skills in terms of “collaboration” is when the students understand the importance of shared responsibility and vital decision making procedures is part of a team effort. The skills refer to both authentic and new era 21st century learning skills.

Next, Kolyda and Bouki (2013) suggest the skill of construction of knowledge as part of the 21st Century Skills learning. It is determined by the students to use application of knowledge by using the interconnectivity between two or more subjects together. Simply, students will be able to relate two different subjects together. The research provides an example of the knowledge of mathematics, whereby students learn multiplications and addition and fractions and the knowledge of students obtaining in science subject such as study of atoms in chemistry. The skill is accessed when students are able to connect and related the subject of science and mathematics together. For example, if students, could be able to indicate the heaviness of a molecule since a molecule has many atoms and contributes different mathematical waves of weight. Goto, Batchelor, and Lautenbach (2015) informs, the idea of knowledge creation is the collection of eradication that are new to students. The knowledge gained by students is thru interpretation, analysis, synthesis and application. The assumptions sometimes correlate to interconnection with context in “interdisciplinary” manner. Critical thinking skill is an essential skill needed by the 21st Century learner. The skill is displayed by using understanding to concepts, analysis, synthesis and evaluation. Properties involved in the process include “clarity, precision and fairness”.

Lastly, Kolyda and Bouki (2013) suggest the idea of Contextualize skills in the essence of core skills of 21st Century learning. The context differs from demographics and psychographics and geography of students. Technology becomes a support to create proper context when knowledge is presented to students and knowledge is being absorbed by students. The use of presentation, visuals and computer aided support as tools and methods to create contextualization instead of mathematically reasoning for problem solving and reasoning is part of the 21st Century Learning skill. Contextualization is an advocate to circular skills and transverse skills.

Differing from Kolyda and Bouki (2013), Goto, Batchelor, and Lautenbach (2015) advocates the “self-regulation” to be a skill needed for 21st Century Learning. Deadlines, scheduling management, task “breakdown” and decisions of priorities of task are the sub-sections of the self-regulation skill. Yengin (2014) suggest the “self-regulation” skill to be self-planning, self-monitor, self-evaluation and learning where the skill shows to the individual how much the student has learnt. Basically, learners re-test themselves to identify how much they have learnt and such related to 21st Century skills.

Other skills that Goto, Batchelor, and Lautenbach (2015) highlights include the learning of ICT. The skill is developed as the ICT integrates with the “multi-modal” construction of knowledge construction support and problem-solving resolution thru the usage of technology of ICT. Honoring Yengin (2014), ICT literacy is an important skill required by the 21st Century Learning, which students must be able to apply ICT environment in the other skills involved the 21st Century learning. Yengin (2014) explains 21st Century skills to summed as “creativity, innovation, cross-cultural understanding, critical thinking, effective communication, collaborating in teams, flexible and self-learning” and being IT savvy.

Creativity is defined in Yengin (2014) as the ability to do integration amongst the original and novelist ways for the combination of several ideas. It is also being defined as social culture and a mantel combination skill.

Cross-cultural skills are the ability to understand and react to difference in culture without the impact of misunderstanding in the environment. (Yengin 2014).

*Comparative Study of Team & Group Learning.*

There is various description to understand what group is. A group is a certain amount of people greater than 1 person who are aware of the others in the surrounding in a psychological view and recognize themselves as part of the group which is based on Schein model (Mujkanovic & Bollin, 2016). These individuals do not necessarily need to achieve the same aim but rather have different roles respective of their needs. Therefore, various groups are created for different reasons and are based on different results as shown in Figure 2 below.

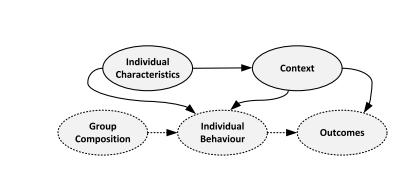


Figure 2: Adopted from Group Outcome Model in (Mujkanovic and Bollin 2016)

The model is created based on collaboration of work and technology together with enhanced learning. The dash-lines components describe key components that define group outcome. In general, there are an array of ways to measure group outcome. Mujkanovic and Bollin (2016) uses this model to control composition in the group. A group is when the sum of individuals co-ordinate on an independent effort basis (Sisson, 2013). A group normally consist of a minimal of 3 people who define themselves as an independent unit (Fritz ,2018). A class of two or more people when defined by the organization or thru “social needs” is referred to as a group (Surbhi ,2015).

The term team is said to be a comprehensive inter-dependent and is “committed” to achieve the provocative targeted goals (Sisson, 2013). These individuals are inter-dependent of each other goals. Thus, an atmospheric environment of jointed responsibility is present and hence formulating a strong bond and drive for the team to perform. A team is a set of minimum of three individuals which can consist of a variant of background with the environment circle itself (Fritz, 2018). They work together for a set of specific; unique goals. In a team, the recognition of expertise of every member of team is highlighted with focus to the intended goal achievements. Finally, teams are stated to be temporal (Fritz, 2018). A set of people gathered together for the attention of achievement of a common objective as stated by (Surbhi, 2015).

The similarities between a group and a team are inclusive of the point that is both sections must contain at least 2 individuals working with each other (Surbhi ,2015). These two sections also inform that leadership and “Sharing of information” is required if the section is categorized in these sections. Thus, the differences are presented in Table 1.

|  |  |  |
| --- | --- | --- |
| Group | Criteria | Team |
| Only consist of one head | Leadership | Consist of more than one head |
| Individualistic responsibility | Responsibility | Shared responsibility |
| Focuses on individualistic goals in the project | Goals | Concerned in achieving shared team goals |
| Project product outcome is individually based | Products | Project product outcome is wholesome team based |
| Individually solve problems | Problem Solving | Solve problems together |
| Independent | Dependency | Interdependent |

Table 1: Adapted from (Surbhi, 2015)

The differences of a team from a group is similarly different manner (Buschman, 2012). Bushman indicates there are “7 differences between a group and a team” particularly in the aspect of purpose. As stated, the purpose of a group creation is to be for administrative purposes. In a team, the span of understanding differs as a team understands that any goal cannot be achieved individualistically rather as a whole where the responsibility is handle wholesome thru a binding and connections. A major difference between a group and a team is a team goal is commodity based, where the goals are common and all individuals are connected to each other (Wengrzyn ,n.d.). A group however is formulated with focus onto “carry out will or action”. A group creation is based on a reason or cause and a team development is based on a common goal completion.

Another aspect of difference between a group and a team is the aspect of “role awareness” (Buschman, 2012). As for a group role understanding is individualistic and no two individuals can comprehend the task of the other individuals. However, in a team everyone contributes to knowledge. Thus, a collective atmosphere of knowledge created within the team. Another aspect that differs group from a team is dispute solutions. In a group environment, manager plays a relevant role in the eradication of blame amongst each group members. The key component in teams is the ability to “listen” to other members of the teams. Verbal communications amongst team members are communicated with each other and not at each other. The contribution of managers in a “team” is only when conflict rises to threatening limit. The differences between a group and a team is in the component of trust and management (Buschman ,2012). In a group, sensitivity to verbal communication is essential. A team differs in this manner, and any information communicated is valued by the team and there is no idea or suggestion that is communicated as “stupid” in the team. Management of a team, inter-support between members of team can be communed as cohesiveness between each member of a team is present and the working together of a team is highly relevant. In development, groups are formed to enhance their skills thru project based learning. In the case of teams, the teams are formed in collaborative purposes and are opened criticism (Buschman, 2012).

The term *Team-based learning* is coined to reflect pupils gratification, peer-to-peer knowledge learning, and task completion to achieve higher order cognitive skills. Matalonga, Mousques & Bia (2017) shows 4 principles that include formation of group, students denote account of actions, ability to learn to develop and finally the consistent and instant feedback. Team-based learning formulates students skills that mainly include “professional, problem-solving, interpersonal and personal” learning approaches (Battur et al. ,2016). Educators or the students themselves can associate themselves to the teams for their team-based learning experiences. Team-based learning suggest that the term team-based learning infers the hypnopedia approach to the students obtain ability to the learning process that emphasizes a set cognitive skills (Romero-Fuerte, Steffen & Eleirawi, 2016). Team-based learning consist of four principles.

The first principle is getting students into small groups which is essential for the purpose of the team-based learning. In order for the teams to be a success, these student groups must be aligned with a certain skill set that required of them. Preferably, the line-up of students is arranging in accordance to the lecturers or educators’ preference, as they would be able to indicate their students’ performances. The second principle is peer evaluation is ideal as it acts as the base of all team-based learning constructions. Evaluation of peers is an important aspect of team-based learning as evaluation indicates the lecturer the performance of each individual student throughout the course of the activity or task. The third principle is execution through the access of assignments. Lecturers provides students with the necessary assignments to evaluate their understanding on the particular topic. The forth principle is the feedback and evaluation from the educator is of highest importance. Its relevance is highlighted in the research to be the form of the retention of knowledge. Team-based learning is devised for constant feedback provision states (Matalonga, Mousques, and Bia 2017).

Group-based learning displays students collaborating together in a series task to complete a “joint” learning activity (Caeiro-rodríguez, Llamas-nistal & Anido-rifón ,2005). Technology plays a dominant role in the development of the group-based learning approach. The main theories that have been defined in prior research on the topic of group-based learning includes, the theory pupils understand the particular knowledge or the subject matter is better defined when the students participate in the construction of the knowledge. Real-world application context of knowledge in real time is also a contribution to group-based learning.

The term cooperative learning can be deduced to be a victorious teaching blueprint, that involves small teams designated by the superior based on the capability and the capacity to incur knowledge of a given subject by a conduct of activities and task (Alexender et al., 1992). Each individual of the team ensures the “responsibility” of the cohesion and combination of knowledge gain, knowledge taught, support of communication of knowledge to other members of the team and the overall achievement stature and ambience. Another statement with regards to the meaning of a cooperative learning is the research suggest cooperative learning to be a sum of team members teaming up to complete an activity, or a task or to create a solution to a problem or to produce a product (Utakrit & Saelee, 2017). The limitations of these roles are only relevant to educational needs. Application of critical skills to develop a fresh product is hind with the small groups.

Table 2: A comparative of cooperative learning and collaborative learning (Utakrit and Saelee 2017)

|  |  |  |
| --- | --- | --- |
| Cooperative Learning | Subject matter | Collaborative Learning |
| Provides a platform for students to learn, commune and integrate with each other with support from each other, for a challenging curriculum. | Purpose | Provides a platform for individuals to interact with each other to achieve a common goal. |
| Whole and complete participation of participant of the activity. | Requirements | Requires the people to “interact” with each other. |
| “Jigsaw” puzzle format, as each member in the team has to pick a piece of the puzzle and fit it with each other to complete the full puzzle. | Project Format | “Spider Web” concept, where, each member negotiates and shares responsibilities for the completion of a task. |

Table 3: The types of Cooperative Learning (Utakrit and Saelee 2017)

|  |  |
| --- | --- |
| Type of Cooperative Learning | Explanation |
| Informal | The type of cooperative learning is a short-term approach. Typically, it last for a few minutes to a whole period in the classroom environment. It formats to be a non-structured group work. It means to break the subject matter into several sub-section called “supplements”. Finally, the goal is to ensure cognitive learning is achieved. |
| Formal | The type of cooperative learning is structured type of learning. It has to consist a minimum of two to maximum of four persons. Usually, it last more than a class period. It consists of a joint task work. The outcome is a produce finish product for a solution. |
| Base | The type of cooperative learning is in structure. The base cooperative learning must consist of a minimum of three to a maximum of five members. The purpose is to provision peer support. Each member of the team is long term accountability for the students. Overall, the purpose is to improve students “performance”, experiences, and quantity and quality of learning. |

***Personality Plus Model.***

Personality of individuals in the terms of the model personality plus model can be easily detected thru the identification of an individuals’ daily impulse and response. (Sargent 2005)

In accordance to four Temperaments: Sanguine, Phlegmatic, Choleric, and Melancholic Personality Types 2018) the traditional method of healing thru medicine using the four temperaments test. In the form of medicine, the four temperaments are highlighted as humor, or bodily fluid. Each of the personality characteristic from the temperament relates to a type of bodily fluid. Sanguine, is represented by the bodily fluid of blood. As for the characteristic of phlegmatic, the representation is phlegm. As for choleric character it is stated by yellow bile. As for melancholic, it is stated as black bile. The theory highlights that an individual’s etiquette and image is directly affected by the principally highest character. These characters of personality traits are able to be classified into four different quadrant dependent on the personality type (Krast 2014).

Sanguine:

These are people who are segmented into the top right of the quadrant. They are social and can make friends quite easily. Individuals with the personality are loud. (Krast 2014) Sanguine character of people have a show performer sense of vision and ingenuity. Nonetheless, the negative aspect of the showmanship relates to irresponsibility of performance as based on (Littauer n.d.). Sanguine character are people with the personality are easily bored and their boredom directly affects their relationship with others. Yet, when these people like something, it is able to turn into an addiction that is discrepant. Their creative outlet channels need to pursue an art-centric lifestyle, which impact their career choices. These art eccentrics aspects tend to provide a mindset to answer questions based on physical descriptions of a subject matter (Krast 2014).

Phlegmatic:

This personality plus, inscribes the personality character to be amicable one. (Littauer n.d.) The mellow on sensitive nature of the person with the personality drives their calm and supportive nature to the pre-dominant presence and focus in their character. Hence, making these people more agreeable and rational. Phlegmatic people fully commit themselves in their relationships especially when it in regards to loved ones. Similarly, attributes of being “thoughtful, controlled, adaptive and diplomatic” is part of the nature of these individuals. (Sargent 2005). Their calm and collected embrace of phlegmatic people position’s them in lower right side of the quadrant (Krast 2014). Interpersonal harmony” and adjacent relationships tend to play the role of the loyal and loving character in their relationships. Relationships are valued and phlegmatic personalities mediate rapport and unity to resent conflicts. Charitable deeds and helpfulness is their strong pursuit. Thus, a career step in the direction would open opportunities to jobs such as nursing, educating, psychology, child development and social services.

Choleric:

The personality character of choleric into the top left side of the quadrant. Choleric characters are the most dominant of the four quadrants where people are extroverts and object-orientated. A choleric person is also achievement driven, where straight-forwardness is a major contributing factor in their lifestyle.

Generally, choleric character attributes are venturesome, brave, vocal and mulish. (Four Temperaments: Sanguine, Phlegmatic, Choleric, and Melancholic Personality Types 2018) . Leadership in taking action is a positive strong suit in people of the character. Thus, instructing others rather that asking other to do a particular task in work environment is standard. Motivation, similar-mindset and control, builds on these individuals. Hence, if working with people of similar character is not possible, they prefer to work alone. However, in doing so, this leads to a major weak spot which is the need for the people of the personality to aspect others to be obedient and respect and listen to them (Krast 2014),

In the quadrant, the Melancholic is the bottom left part of the quadrant. (Krast 2014). Introversion yet task-orientated inclines them to be position whereby their polished, on-time and pay attention to detail. (Littauer n.d.) & (Krast 2014), They are not out-going people, which tend not to travel, even for work. They would rather stay in their hometown and thought to be non-venture capitalist. (Four Temperaments: Sanguine, Phlegmatic, Choleric, and Melancholic Personality Types 2018). Thus, Melancholic character attributes mainly are detail-conscious, organized, “respectful” and deep (Sargent 2005).

Hence, area of job placement in management, social, administrative and mathematical orientated career like accounting and finance is the preferred result for these individuals. (Four Temperaments: Sanguine, Phlegmatic, Choleric, and Melancholic Personality Types 2018)

Thus, in identification of personality one must observant, adaptive and notice changes easily states (Krast 2014).

Grading Styles.

Grades depicts an “intra-university” determinant for the demographics, psychographics and structure of a department of the university. (Achen 2010) The grading structure constructs itself upon administrative fees, where by students pay these fees and build a reputation of performing well by scoring high grades in order to possess their degree.

Sometimes, grades elasticity can become rigid in structure states (Achen 2010). The site believes the grades have been so part of the academic custom, that institutions do not even request for the reason behind the means of the grades. It is to be believed as grades can affect student’s motivation and learning. (Grillos 2017) The definition of grades as stated are sorted as two different variants of responds. The first section of respondents are students who suggest grades are, reflection students’ knowledge, ability, efforts, errors and quality of work. It also informs us that the responds are for teacher’s evaluation. The second variant of respondents is based on the article are general public. (Krigline 2003) The definition of grades enlighten includes a “measure of intelligence”, academic potential and development. It also states that grades are a measure of language and a comparative study of others in the classroom environment.

Bell Curve Grading Style.

The term Bell “grade inflation” to be the continuous evolution of the grading structure in the universities across the past decades. (Achen 2010) The journal further highlights the only measure to inverse grade inflation to deflation is thru a strict curve format. The bell curve structure to have a percentile score rate of 100, where students are graded with a letter grade of A, B, C, D, E and F for their grades. (Tanner 2014) Each of the grade coincide with a numeric range of percentile of a total of 100.

The “A” candidates to be outstanding achievers. Their score range 90 to 100 percentile. (School 2018). The study is that the students have mastered the learning objectives and made the requirements and applies the skills learnt during in class environment. The “B” scoring students are entitled with the high level performers. Their score range highlights as a score of 80 to 89 percentile. The score range indicates the students performs higher than average and grasps approximate amount of learning objectives. These students apply the knowledge correctly in situations. The “C” grading structure is identifying as satisfactory scorer. Their grade numeric ranges from 70 to 79 percentage. These students also mastered the learning objectives but have not learn to apply it in potential situations. In the case of “D” candidate they contain the base knowledge and understanding of the subject yet remain not understanding the implementations. As for the “E” scorer they obtain a passable grade but lack understanding of the objectives of study. Finally, for the “F” candidates are below the acceptance level, and they do not understand the objectives and the learning outcomes of the course.

*Cumulative Grade Point Average (CGPA)*

The definition of grade point average (GPA), a label of high scoring and the capacity of wellness of performance of course in general. (Potter 2017) GPA refers to the student fixed average performance over a given semester, (Sadler 2015). The elucidate of the CGPA is the accumulated mean of the all examinations throughout the whole course of the student study in varsity. (Yogendra and Andrew 2017),

In its ideal state, CGPA is used by employees as the basis of the employment and the hire for the potential employees. The reason behind it, the job employment, is based on skilled trained during the study in the university states (Yogendra and Andrew 2017).

How does Grade Point Average & Cumulative Grade Point Average (CGPA) work?

In order to calculate the GPA and CGPA of a student, the qualitative value of a single letter grade must be represented by an equivalent numerical value. (Sadler 2015 Generally, it is labeled as A=4.00, B=3.00, C=2.00, D=1.00 and F=0.00. It is the weighted average of the numerical representation of the value of the grade during the given semester. The value of the grade, based on (Sadler 2015), the credit hour of the particular course multiplied by the numerical score of the grade. Thus, GPA of the specific semester is the mean average of the numeric value of grade multiplied by the credit hours. (Chathuranga 2016)

GPA in a variant yet similar standpoint, where grades are provided with a quantitative value in numeric format. (Potter 2017) However, the method by stating the value of the grade as a multiple of 4. (Potter 2017)

The calculation of Grade Point Average. (Chathuranga 2016) describes the calculations to be, GPA as the total credit-weight score divided by the total credits earned by the student. (Chathuranga 2016)

Hence, CGPA, it is the accumulated mean average of the GPA throughout the entire course of the students’ study life the university.

**METHODOLOGY**

***Introduction***

There are four phases for this research development. These phases include the preliminary study, where initial study of the research is carried out. Followed by the data collection, where the data is being accumulated and collected for the use of the research. Next is the framework design, in which a conceptual proposed framework is developed. Finally, the performance evaluation, whereby the performance and testing of the data is conducted.

***Preliminary study***

Preliminary study of the research is the initial exploration of the research. In the research, the first step of the preliminary study, is identification of problem, which is how to identify and understand the steps for developing a well-devised team for the project. In the preliminary stage, objectives of the research are also formulated which are defining the pre-processing steps for team formation and the identification of factors that influence a team. Critical analysis of literature is conducted to investigate the parameters of research and the result is deliberated. The analysis includes the roles of 21st Century learning, team formation, studies on personality plus model, Felder’s Learning styles and cumulative grade point average.

***Data Collection***

Data for this study is collected from Universiti Teknologi PETRONAS. The data consist of learning styles and characteristics of students’ name, student identification matric number, cumulative grade point average, students gender, students first highest personality, students second highest personality, students learning style and being from all four dimension of the Felder’s Learning style, which include active reflective, visual-verbal, sensing-intuitive and sequential-global of engineering students collected through online form.

The data set contains 109 students from the engineering classroom, of chemical engineering where the students took the subject during the September 2017 semester period. These students were chosen since the base of the students tested during the creation of the personality plus model and Felder’s learning style, were students of an engineering background.

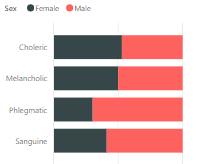


Figure 3: Bar graph of different personality of students based on gender.

The graph shows the students of the data set from a university, where the number of students is 109 students who consist of different gender, which displays their highest personality. The graphs show that the highest personality amongst the male students is the phlegmatic personality, where the data shows 23 students of the 109 students have phlegmatic as their highest personality. The female equivalent only consists of 10 students. As for the Melancholic students, in the data students of both genders of the personality are equally distributed at 12 students each gender. The choleric students depict a higher percentage of female students than male students at 9 female students having choleric as their highest personality score and only 8 male students of the classroom that have choleric as their highest personality. Sanguine students consisted of 20 male students and 14 female students having sanguine as their highest personality.

The graph of Figure 4 shows students counts of the highest personality based on the student’s capacity to be either global or sequential. According to graph, students of who accounted for highest personality of choleric consisted of 5 students (13.5%) who are categorized as global. Students who are melancholic and phlegmatic accounted for the same value in the global learning style dimension at both personalities having 8 (21.6%) counts of global learning style candidates. Sanguine candidates who are global had 16 (43.2%) students. As for the sequential learning approach, more students were placed under the sequential approach. It consists of 12 (32.4%) Choleric personality, 16 (43.2%) Melancholic personalities, 25 Phlegmatic and 18 Sanguine personalities.

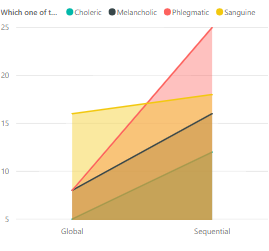


Figure 4: Graph that depicts the personality of students against the global-sequential learning style.

Based on Figure 5 students are divided to either having sensing or intuitive learning styles. According to the data, students that have the intuitive learning style consist of 6 choleric highest personality students, 6 melancholic highest personality students, 10 phlegmatic students and 17 students who have Sanguine personality. Another account of 17 students who have Sanguine personality are part of sensing learning style. 23 students whose learning approach of are sensing are phlegmatic personality, and 18 of them are melancholic. The other 11 students with the sensing approach are Choleric in highest personality.

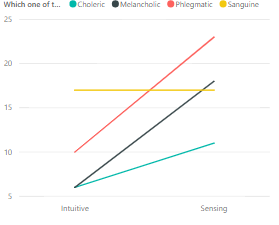


Figure 5: Graph that depicts the personality of students against intuitive-sensing learning style.

As results of the graph in Figure 6, verbal candidates consist of 3 choleric, 3 phlegmatic, 7 melancholic and 11 sanguine. However, the students who learn from a visual approach, consist of 14 students with choleric highest personality, 17 students with melancholic, 30 phlegmatic and 23 sanguine personalities.

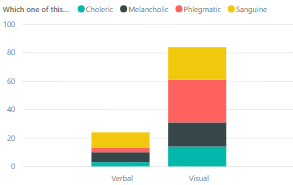


Figure 6: Graph that depicts the personality of students against the global-sequential learning style.

In the graph as below of Figure 7, active learning approach students consist of 8 choleric students, 15 melancholic students. The results also show 12 students who are phlegmatic that have active approach to learning style. There are 22 students who are Sanguine highest personality that approach active learning style. As for the reflective learning style, the results show 9 choleric highest personality students, 9 melancholic personality, 12 sanguine and 12 phlegmatic students with highest personality. The next step is data pre-possessing. This step involves the data cleaning and data summarization to prepare the data for clustering and classifying tasks using WEKA. WEKA is an open source data mining tool that has a collection of data mining tasks written in Java. It also supports data pre-processing and visualization tools. After critical literature approach conducted, on the types of teams available for the team project work, a conclusion of a single model of team formation is selected as the most suitable team model for team formation.

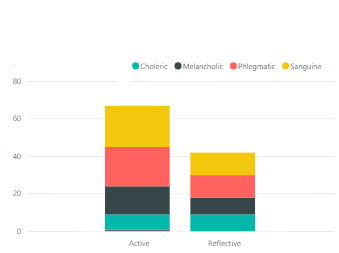


Figure 7: Graph shows students active-reflective learning style based on highest personality.

***Framework Architecture Design:***

The next phase of the research is the development of framework of the learning analytics. The framework is developed based on the critical literature analysis and data of personality, learning and CGPA. The framework represents the components and the process of learning analytics. The process shows the steps starts from the users, data mining techniques that includes clustering and classifying and lastly the outcome of the analytics.

***Performance Evaluation:***

The final phase is the performance evaluation that inculcates the parts of data mining techniques of classification and clustering in WEKA.

**RESULTS**

***Learning Teams***

Based on the preliminary study and the data collected, the Learning Team Model is identified as the most suitable factor of team formation. The main reason behind the use of the model, known as “Learning Team” is because of nature of the project work in the varsity environment. In a university, the class size, number of students and time frame of a specific course in the varsity is variant. The dynamics of using learning teams according to (Brookfield, S.D., & Preskill 1999) is able to be vibrant in class information and be versatile and mobile. Finally, the use of the learning teams will be ideal as a well-devised team consist of four students. In conclusion, the use of learning teams for the formation of teams in research is optimum.

***Framework and architecture mechanism of team formation***

After the data collection and visualization of data, a proposed framework is constructed for team formation. Figure 8 shows the proposed framework for team formation based on learning analytics.

Student data

Data Visualization (Dashboard)

Learning Style clustering

Data preparation

Group Formation

Figure 8: framework architecture of mechanism of team formation.

The framework consists of three main segments; data preparation interface, learning style clustering and visualization segment. Data for all students are captured through online forms based on the candidate’s personality, learning style, cumulative grade point average and personal details.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Current CGPA | Sex | Which one of this personality gives you the highest percentage? | Which one of this personality gives you the second highest percentage | In terms of learning styles, are you reflective or active? | In term of learning styles, are you sensing or intuitive? | In term of learning styles, are you visual or verbal? | In term of learning styles, are you sequential or global? |
| 2.89 | Male | Sanguine | Melancholic | 4a | 4b | 6b | 6a |
| 3.74 | Male | Melancholic | Choleric | 7a | 3a | 1a | 3a |
| 3.13 | Female | Choleric | Sanguine | 10a | 6a | 3b | 7b |
| 3.0 | Male | Phlegmatic | Melancholic | 1a | 3a | 11a | 1b |
| 3.80 | Male | Melancholic | Phlegmatic | 2a | 1a | 2b | 3a |
| 3.88 | Female | Melancholic | Choleric | 5a | 3a | 5a | 1a |

Figure 9: Tabulation of 5 students samples before data pre-processing.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Current CGPA | Sex | Which one of this personality gives you the highest percentage? | Which one of this personality gives you the second highest percentage | In terms of learning styles, are you reflective or active? | In term of learning styles, are you sensing or intuitive? | In term of learning styles, are you visual or verbal? | In term of learning styles, are you sequential or global? |
| 2.89 | Male | Sanguine | Melancholic | Active | Intuitive | Verbal | Sequential |
| 3.74 | Male | Melancholic | Choleric | Active | Sensing | Visual | Sequential |
| 3.13 | Female | Choleric | Sanguine | Active | Sensing | Verbal | Global |
| 3.0 | Male | Phlegmatic | Melancholic | Active | Sensing | Visual | Global |
| 3.80 | Male | Melancholic | Phlegmatic | Active | Sensing | Verbal | Sequential |

Figure 10: Tabulation of 5 students samples after data pre-processing.

The cleaned data is used in WEKA for learning style clustering task. The outcome from this task is a list of learning style clusters.

***Data Clustering***

Clustering data mining is used in the research to identify the closeness and similarity of data in the data set with regards to personality and relation to team formation as displayed in Figure 11. As shown in Figure 11, the students from the data set generally shows an approximation of equal distribution of personality traits with respective grade point average. However, some outliers are present, mainly the personality of Sanguine students who have a lower CGPA at a CGPA of below 2.00, which is below the minimum CGPA that required for the students to be considered as pass. A major reason behind the passiveness of the students and lack of participation in the classroom, as well as lack of interest shown by the students’. One the higher upper quadrant of the graph, personality of Melancholic personality dominant students tend to excel in their performance higher CGPA which is greater than 3.95.

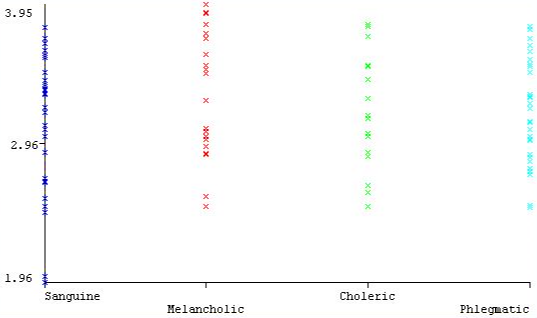


Figure 11: Graph displays the students’ personality against CGPA of September 2017.

First, the highlight is on students with the cumulative grade point average of approximately 1.96 in Figure 12. These students have highest personality of Sanguine and second highest personality of Melancholic. It indicates the reason behind the students’ low performance in class. Generally, Sanguine and Melancholic are passive characteristics and are non-aggressive. These students still keep the traits of creativeness and agreeableness but lack the capability to show their potential. In aspects of team formation, these traits are not favored by teams especially in project work. This is because the lack of enthusiasm and eagerness to participate is a major contributor to their CGPA fall. As for the concern of the teams, on contrary to their lack of participation, these students, if plays role of silent partners, can potentially be a major positive influencer to the dynamics of a team. Creativity and attention of detail of these students can contribute to well-developed project.

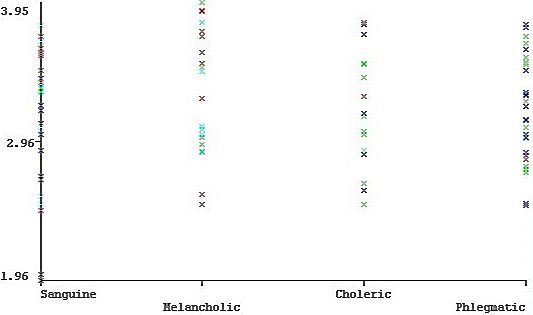


Figure 12: Graph displays x-axis of highest personality and y-axis CGPA with the data of the second highest personality.

Based on Figure 12, the results also show students with on the higher quadrant of CGPA, which have CGPA of 3.5 above, a great number of them possess Choleric and Phlegmatic in their highest or second highest personality trait. The reason behind their potentially higher CGPA is mainly focused on their aggressiveness and outspokenness to participate in the classroom. In group formation these students with the higher grade point average should be place with the students at the lower CGPA spectrum. The dynamics although seem challenging actually will team up well. Thus proving students in formation of team should consist of all groups of personality. In the perspective of the support of learning using the team formation, the team dynamics need to look the learning styles of the students to prove these students can support each other.

***Team Formation Process.***

The process of team formation follows a step-by-step set of processes that are as follows:

*STEP 1: Defining the group size*

1. Let size of required team be ‘n’; T=n.

The n in the algorithm is defined as the total teams that are needed to be formed based on the available students.

1. Number of team members, Tm=n/4

If remainder ≠ 0;

Then;

Remainder =Gn

In order to identify the number of teams are able to have, a data set must be divided by four. The reason behind the division by 4 is because 4 members are ideal number of members for a team. If there is a remainder of student(s), these students are placed into a separate list known as Gn.

1. Loop continues up till (n-Gn) =Gt; where Gt= team.

The loop continuous until all students are place into a team of 4 and the remainder is placed into the “Gn” list.

In our case study, the students size of the classroom is, Dsize=109. Based on the case study, students will be divided into 27 teams consisting of 4 members and the remainder 1 candidate will placed in the remainder list.

1. For i++= 1 to Gn;

The teams are made according to the student’s highest personality style; where team must consist of a member of personality Group P, group phlegmatic. Phlegmatic is placed as the first priority for the members of the formation of the group. It is followed by the Group M, melancholic students, then Group C, choleric and finally Group S, sanguine personality.

*STEP 2: Formation of Teams.*

For the formation of a team the team must consist of all four categories of groups of personalities.

1. Gteam=Gp+Gm+Gc+Gs

The formulae show that students are picked for the formation of the team based on a student selected from personality phlegmatic. It is then followed by selection of students of personality Melancholic. Then it is choleric student is selected and finally student from the sanguine group is selected.

1. Loop i++, where Gteam=Gp +Gm+Gc+Gs until Gp or Gm or Gc or Gs = 0.

Personality of phlegmatic students should have a global and active learning style. The melancholic students should have sensing and verbal learning style. As for the choleric these students should have the sequential and reflective learning style and the sanguine personality should have the visual and intuitive learning style. It is based on their personality approach that the learning style related to them are most suitable in the scenario of team formation.

1. Use case statement when Gp or Gm or Gc or Gs = 0.
2. Case 1; Gp=0.

Write “You are missing Phlegmatic personality students”. “Your team will not be optimum anymore”.

Students list lack of the students of phlegmatic personality. Thus, the users should look into personality melancholic or choleric that should have learning global and/or active learning style.

1. Case 2; Gm=0.

Write “You are missing Melancholic personality students”. “Your team will not be optimum anymore”.

Students list lack of the students of melancholic personality. Thus, the users should look into personality phlegmatic or choleric that should have learning sensing and/or verbal learning style.

1. Case 3; Gc=0.

Write “You are missing Choleric personality students”. “Your team will not be optimum anymore”.

Students list lack of the students of Choleric personality. Thus, the users should look into personality melancholic or sanguine that should have learning style of sequential and/or reflective learning style.

1. Case 4; Gs=0

Write “You are missing Sanguine personality students”. “Your team will not be optimum anymore”.

Students list lack of the students of Sanguine personality. Thus, the users should look into personality phlegmatic or choleric that should have intuitive and/or visual learning style

**CONCLUSION**

***Conclusion***

In conclusion the objective of the research is to investigate the pre-processing functions using WEKA classifying and clustering techniques with regards to the personality, learning style and cumulative grade point average of the students at the university, which is Universiti Teknologi PETRONAS. The research is also designed to understand and suggest the most feasible team style for students to perform project work task at the university level.

Based on the research, the most suitable team formation for project work at university level can be formed by using the learning teams, team formation. The proposed framework is also an initiative for the ease the mechanism of team understanding and formation. It makes learning in the 21st century easier and simple. The research of data clustering also shows that students of higher and lower standards of CGPA should work together for a more effective learning and development.

***Recommandations***

*Improvements on framework architecture mechanism*

Improvements on the framework architecture is a recommendation. The framework architecture of the mechanism of the team formation can use improvements on the mechanical approach of the system.

*Use multiple data “classifying” techniques.*

The use of more classifying techniques will be able to identify a more accurate set of value of the dataset. In other words, using more data classifying techniques will be able to improve the accuracy of the data. It will be able to show the value of the data set, meaning the data value is good enough for the multiple algorithms used.

*Data Sample Size.*

A larger data set consisting of more data is a way to improve accuracy of the research. In the use of more data, the ability to display data closeness with higher precision and accuracy is able to be achieved.

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