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The Design of Team Formation System - A Coordination With The Perspectives of Delone and Mclean IS Success Model

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Abstract: Instructors must constantly think of more innovative teaching and learning techniques to ensure that the graduates they produce are in line with the changing needs of the industry. One such technique is project- based learning; the learning technique in which students are divided into smaller teams. From previous researches, team formation using personality traits was seen as more appropriate to form an ideal and balanced team. To do so, students must answer questions that will be analysed and based on the analysis, their personality traits are identified and incorporated into teams of various ideal personality traits. Problem occurs as this process is seen as a daunting task for the instructors. The preparation of questions, analysis and team assignment are being carried out manually without the help of a system-based platform. Thus, the development of team formation system is a better way to facilitate the manual process. But before the development begins, the design prototype should be carefully planned to ensure that no delays of time and more cost will be incurred. As such, this paper is written to study and produce a prototype design of a team formation system in accordance with the well-known Information System (IS) Model; the Delone and Mclean. The methodology for constructing the design prototype is divided into three steps: 1) Exploratory, 2) Design and 3) Coordination. To increase its efficiency, the produced design prototype also includes an algorithm to automate the team formation process.

Keywords: *Delone and Mclean, Design prototyping, Project-based learning, Team formation*

INTRODUCTION

Producing dynamic and quality graduates is a never-ending issue to be discussed. With higher expectations from the industries today, coupled with the rapid growth of new inventions and technologies, has challenged the instructors in higher learning institutions to constantly think of more innovative teaching and learning techniques. This is to ensure that the graduates they produce are truly appropriate with the ever changing requirements from the industries. One of the teaching and learning techniques is project-based learning, a technique in which students are divided into smaller teams, typically between 3 to 5 students. Using this technique however, the main problem that is often overlooked is the imbalance among team members. Duhigg (2016) noted that a tradition with unwritten rules which usually referred as group norms becomes the foundation to form teams among the students. With that tradition in hand, students simply use social relations as the only criteria in choosing their teammates (Srba & Bielikova, 2014). This has made students of minorities with a weak social background becoming the parasites in a team. Hence, according to Sherstyuk, Olekh, & Kolesnikova, 2016, students will face difficulties to constructively cope with the roles that they have been assigned and therefore influence the evaluation of the project as a team. In consequence to that, previous researches have emerged with the formation of teams using personality traits as an alternative in producing an ideal and balanced team. One of them is Myers Briggs Type Indicator (MBTI) that have been in existence since 1943. According to Bayne (1997) the popularity of using MBTI in team formation still holds strong due to its relevancy especially in education, team development and group functioning. Apart from the MBTI, several other personality traits are also identified; Six Thinking Hats (6-Hats) that has been reinvented by Dr. Edward de Bono (McAleer, 2014) and Five-Factor Theory of Personality that emphasized on Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness (McCrae & Costa, 1999). To group the students into one balanced team, each of them need to answer a few questions first before they are placed under one group once the instructors have finished analysing their answers. Here, it can be seen that the implementation is conducted manually by the instructors. The instructors are the one who prepare the questions, distribute them, analyze them and based on the analysis, they are also the ones who place the students with various ideal personality traits into one team. Obviously, it becomes a daunting task for

the instructors and making some of them decided to not continue to put the control to form teams solely in the hands of the students. Parasites among students in a team are difficult to eliminate. Therefore, the development of

team formation system is seen as a better way to streamline the manual process, reducing the burden on instructors and thus, enable students to have their ideal team as early as the first week of the semester.

To develop the team formation system, the phases in System Development Life Cycle (SDLC) Model can be followed as this model has been extensively used by most researchers. This SDLC Model generally consists of 4 phases and it highlights that thorough design must be carefully planned prior to the implementation (coding) phase. Ragunath, Velmourougan, Davachelvan, Kayalvizhi & Ravimohan (2010) highlight that this is to realise projects that can be completed within a set timeframe by eliminating any unseen expenses which occur due to conflicts. Thus, with the intention to develop a team formation system without any interruption and further obstacles, this research is conducted to study and produce a prototype design of a team formation system that is in accordance with the well-known Information System (IS) Model; the Delone and Mclean. The author put into center the Delone and Mclean Model as this model has been kept updated accordingly by its own creators. This can be seen when service quality is added as the third dimension apart from the original two dimensions; systems quality and information quality that already existed within the original model (Delone & McLean, 2003). The following sections in this paper are organised as follows: 2) Background of Study, 3) Methodology, 4) Findings and Discussions, and 5) Conclusion and Future Work.

BACKGROUND OF STUDY

In this section, various methods of team formation using personality traits in project-based learning are explored. Once the characteristics of each personality trait in each method have been understood, the importance of having a well-planned design prototype prior to the system development is studied. Since a well-planned design prototype must also be carefully aligned with IS Success Model, the significance of selecting the Delone and Mclean Model is being discovered by the author.

A. Team Formation Using Personality Traits in Project-based Learning

The foundation for an effective project-based learning is held by the formation of an ideal and balanced team. Ideal and balanced here refers to the presence of team members with variety of personality traits. With such diversity, they each highlight their own strengths and cover any weaknesses that the other team members have in completing the assigned tasks. In line with the innovation in education, there have been various ways to form teams using personality traits. MBTI, 6-Hats and Five-Factor Theory of Personality are some of the well-known methods that have been widely used until today. The brief concepts, evaluation tools for traits identification and balance of personality that each team should have by using the MBTI and 6-Hats methods are further explained in Table 1.

Table 1. Concepts, Evaluations, and Balanced Personality in a Team Using The MBTI and 6-Hats Method

	MBTI	6-Hats
Brief concept	The personality traits are categorised into four big families; attitudes, psychological perception, action decisions and mental functions. In each big family lies more detailed traits as listed below: a) Attitudes 　| Extraversion (E) 　| friendly & outgoing 　| Introversion (I) 　- quiet & reflective b) Psychological perception 　| Sensing (S) 　| being direct through factual senses 　| Intuition (N) 　| express subjective perceptions with more creative sights c) Action decisions 　| Thinking (T) 　| actions are decided through logical and rational conclusions 　| Feeling (F) 　| actions are decided through personal experience and others' personal opinions d) Mental functions 　| Judging (J) 　| have structured plans and decisions in mind prior to implementation 　| Perceiving (P) 　| Open-minded and likes to be uncertain and indecisive prior to implementation	The categorization of personality is illustrated through the use of six hat colors; white, red, black, yellow, green and blue. The characteristics for each hat color are briefly described as below: a) White 　| well-versed in facts and numbers, but have very little tolerance in emotions. People sometimes call them the computers. b) Red 　| they are the opposite of white hat, where emotions and feelings are always in their mind. However, people with white hat usually look at only the bright sides of things, making them often referred to as emotions-positive. c) Black 　| this personality also relates to emotions and feelings like the red hat but, they are very often look at the negative or dark sides of things especially during the brainstorming session. d) Yellow 　| yellow color that resembles the color of the sun symbolize the optimism and positive thoughts. People who wear this hat color always sees the positive sides in making judgements. e) Green 　| creative-minded person who have passion to endlessly derive out new ideas, new inventions, new techniques and etc. f) Blue 　| a controller who likes to organize all other hats. Due to their nature as controller, they are the ones who define the problems and determine everybody's tasks.
Evaluation tool to identify the students' traits	Using the 36 questions test "Keirsey Temperament Sorter"	Using the 6HTFS instrument with 30 questions in it
Balance of personality in each team	An ideal and balanced team must consist of: An extrovert A judger A perceiver A thinker A feeler	An ideal and balanced team must consist of: A green hat wearer A yellow hat wearer A black hat wearer A blue hat wearer

References : Waite & McKinney (2018), De Bono (2017), Sukiman, Rahman, Bakar & Suhaimi (2018)

Apart from the two methods explained earlier, the Five-Factor Theory of Personality is also the commonly used method by instructors to team-up their students. The Five-Factor Theory of Personality is also known as Five-Factor Model (FFM), and it accesses the students' personality according to five different dimensions as illustrated in Table 2.

Table 2. Five-Dimensional Concepts and Personality Evaluation Using The FFM Method

Dimension #1	Neuroticism	Most of the time, people who strongly possess this trait have the negative emotions circling their mind, making emotional stability quite difficult to accomplish.
Dimension #2	Extraversion	Extraversion people are energetic, confident and talkative and therefore, they have very less issues in making new friends and to socialize with anyone anywhere.
Dimension #3	Openness	Suitable with the word *open*, people with this trait are open-minded people that always considers all kind of reasons and justifications before reaching the ultimate decisions.
Dimension #4	Agreeableness	People with strong agreeableness trait is the easy-going person who always provides full cooperation to their superiors or subordinates.
Dimension #5	Conscientiousness	The words self-discipline, self-organized, dedicated, determined and hardworking are sturdily connected to the people with strong conscientiousness trait. They prefer all their activities to be planned ahead and impulsive acts should never exist according to them.
Evaluation tool to identify the students' traits		An assessment with 240 questions (the longer version) or an assessment with 60 questions (the shorter version)

Reference: Clinebell & Stecher (2003)

B. The Importance of Design Prototypes and Its Relations With the Delone and Mclean IS Success Model

Design sketching prior to the implementation process is not something new in the domain of system development. As the terms credit and debit are acquainted to banking professionals, so is the concept of design before implementation for Information, Communication and Technology (ICT) professionals. Design prototypes are occasionally referred to as blueprints, or virtual prototyping by some ICT professionals. d'Ippolito (2014) added that the provision of design prototypes prior to system development are important for providing problem-solving solutions along with an attachment of specific reasoning. Design prototypes must capture not only the typical requirements of users, but also the tailored needs that often relate to the

systematical, managerial, directional and environmental dimensions (Leiva, Maudet, Mackay & Beaudouin-Lafon (2019); bin Ahlan (2013).

According to Dwivedi, Wastell, Laumer, Henriksen, Myers, Bunker & Srivastava (2015), in any ICT projects, there are times where its implementation is assessed as a success by the developers, but on the other hand, evaluated as a failure by the other groups such as the top managers. In this regard, coordinating the design prototypes with the perspectives of IS Success Model is extremely helpful in avoiding such unwelcome scenarios. The author has chosen the Delone and Mclean Model to be its comprehensive guide, like a lighthouse to a stray sailor, in producing a competent design prototype for this study. The author choses this model not merely because of its popularity, but based on the fact that the creators of this model keep on updating their own model according to the revolution and current issues in system development.

According to DeLone & McLean (1992) and Al-Debei, Jalal & Al-Lozi (2013), the first version of Delone and Mclean's Success Model was introduced in 1992, with the aim of resolving differing opinions among stakeholders on how to measure system implementation success. Since then, many researchers have used this model as a comprehensive guide in measuring the success of their systems as well as the information circulation that occurs in the system. However, after a few years, systems usage were no longer solely focused on the day-to-day operations of an organisation. Systems have begun to be used as intermediaries between customers and organizations in various transactions. Looking at this scenario, coupled with the modifications suggested by researchers, triggered Delone and Mclean to do several adjustments to the first model. Fig. 1 shows the differences between the first and the modified models of Delone and Mclean IS Success Model.
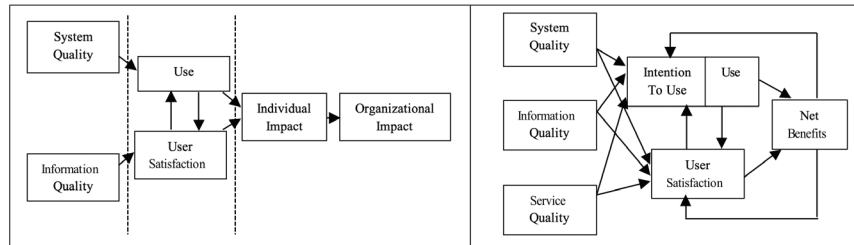
Fig. 1. The First and The Modified Version of Delone and Mclean IS Success Model

METHODOLOGY

This study was carried out in three main phases, as described below:

Phase I: Exploratory phase in which the existing literature pertained to "project-based learning", "team/group/team formation/group formation/ team design/group design using personality features", "design construction/ design prototype in the SDLC Model" and "the importance/relevance/ implications of the Delone and Mclean Model in Information Systems" has been studied. To ensure that all literature is up to date and consistent with the world of higher education in the field of ICT, the author has made it clear that the period of past literature should not be below 2014 unless it is a genuine theory written as a chapter in a book. All keywords used were within the scope of the Information Systems. IEEE Xplore, Web of Science (WoS), Scopus and ACM Digital Library were among the online databases used by the author in carrying out this research.

Phase II: Design phase where the recommended Graphical User Interfaces (GUIs) of the Team Formation System were drawn. Designs took into account users' ICT background as some of them may have limited experience in adapting systems in their teaching and learning environments. There were fields in gray to indicate that no edits were required as the data was consistently extracted from the datastore. In addition, the principles contained in the handbook for user interface design (Rosenblatt, 2013) were applied to guarantee system user friendliness and in turn, enhance the system's acceptance among users and their tendencies to continuously

implement the system especially in project-based learning.

Phase III: Coordination phase. Strategically, the effectiveness of a system is seen in terms of its continuous use usually over a period of 3-5 years without any major modification that could result in a sudden increase of cost and time. Thus, with the aim to prevent any misapplication among users towards the to-be built Team Formation System, this phase of coordination revolved around mapping the features that were drawn during the design phase to the elements in the well established Delone and Mclean IS Success Model.

FINDINGS AND DISCUSSIONS
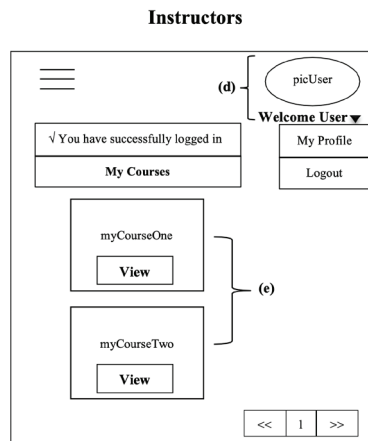
Instructors

Fig. 2. The Homepage Once Instructors Have Successfully Login
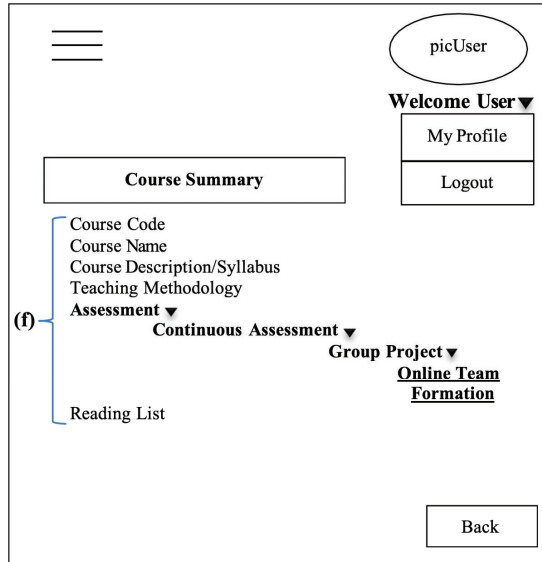
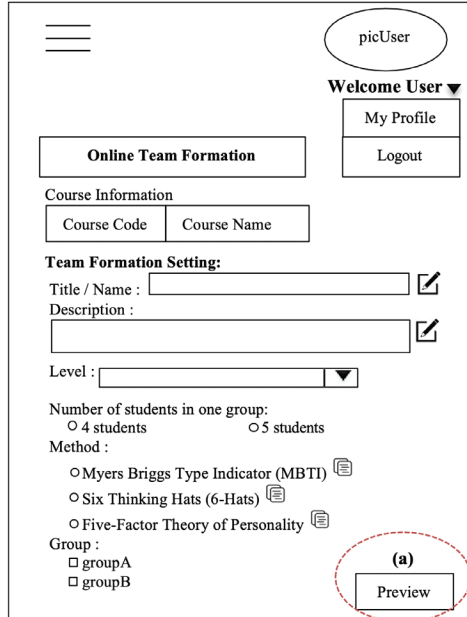**Fig. 3. Course Summary Displayed Once The View Button Is Clicked By Instructors**

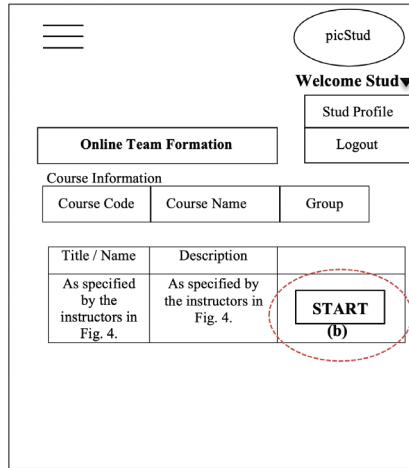**Fig. 4. Set Personality Related Questions**

Students

Fig. 5. The Page Where Students May Start Answering The Personality Questions According To The Time and Date Set By Instructors
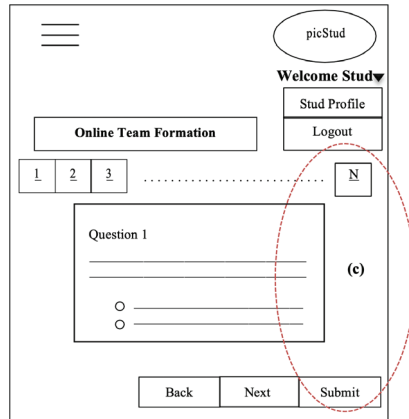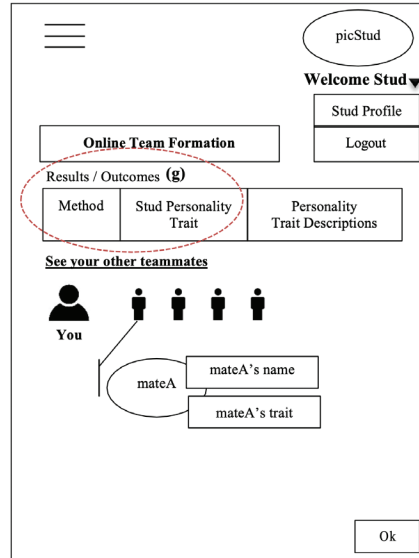

Fig. 6. List Of All Personality Questions

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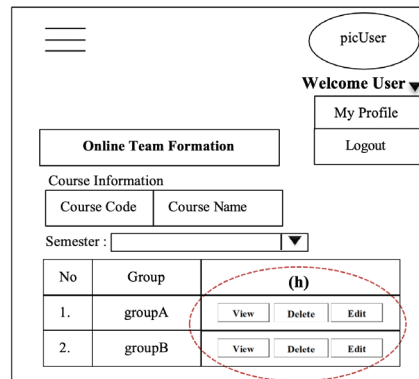**Fig. 7. Results Of The Personality Trait**

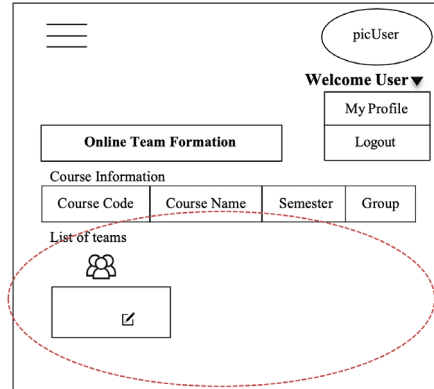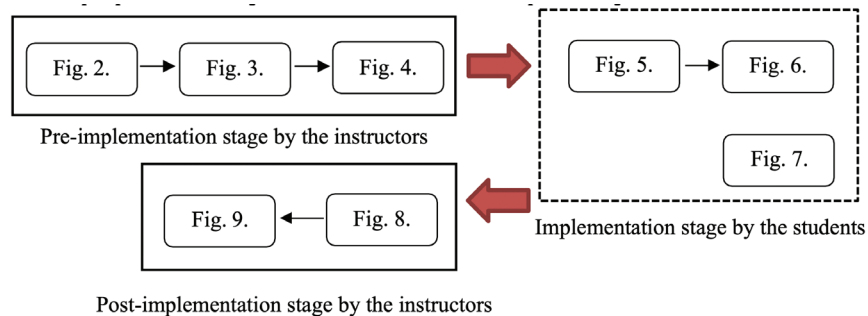**Fig. 8. The Access Control Granted For Instructors**

Fig. 9. Summary Of Traits In A Group

Fig. 2. through Fig. 9. shows the design prototype for the team formation system designed according to Delone and Mclean's perspectives. All diagrams can be divided into three important stages as shown below:

Pre-implementation stage by the instructors

Implementation stage by the students

Post-implementation stage by the instructors

The pre-implementation stage is used entirely by the instructors for the purpose of preparing the questions. Here, options are given to instructors where they can select appropriate personality traits and limit the number of students in a group. Next, the implementation stage takes place. This stage requires the students to answer all the questions and at the end of this stage, the students will learn about their own personality and which team they belong to. Because the first answer is usually the best answer to describe the students' behaviour, students can only answer the question once. The post-implementation stage concludes the design prototype of this team formation system. This stage focusses on reporting where instructors can see all the teams that have been formed in the class and in addition, instructors can

insert names for each team to facilitate them in group assessments. For the purpose of coordinating the prototype design with the perspectives of the Delone and Mclean Model, Table 3 goes into greater detail.

Table 3. Coordination of Prototype Design With Delone and Mclean IS Success Model Perspectives

Perspective of Delone and Mclean Model	Figure	Label	Explanation
System Quality	Overview		Adaptability, availability, reliability, response time and usability are the five success metrics listed by Delone and Mclean under this perspective. It holds that the systems must be embedded with usability functionality so that even users with limited ICT backgrounds can adapt to the system without too much hassle.
	Fig. 4.	(a)	The preview function is embedded with the aim for the instructors to see the usability and reliability of the questions generated before granting the access for the students to answer. In addition, instructors are allowed to control the time, date and duration for students to answer the generated questions.
	Fig. 5.	(b)	The start function is closely related to the time, date and duration that the instructor has set. This means that students will only be able to answer questions generated at the date and time specified by the instructors.
	Fig. 6.	(c)	In order to know the right personality, students need to answer all questions. Accordingly, the submit function will only be activated once students have completed answering all the questions.
Information Quality	Overview		Data that is conveyed to provide useful insight is called information. In any system, completeness, ease of understanding, personalization, relevance, and security are the success metrics acknowledged by Delone and Mclean. Programmers must ensure that the information contained in a system is relevant and personalized according to one's position in the organization.
	Fig. 2.	(d)	This section contains information related to the instructor's profile. To maintain confidentiality of information, all information is extracted only from the university database. In addition, there are options for instructors to update their information such as new passwords and
			telephone numbers. Once the information is updated, the university's database is also automatically updated with only the latest instructor information.
	Fig. 3.	(e)	The information in this section is extracted from the university database. The way information is processed and updated is similar to information processing in label (d). The only difference is that it provides information on the subject taught by the instructor for the current semester.
	Fig. 7.	(f)	Fig. 3 shows information regarding the subject when the View button as shown in Fig. 2 is clicked by the instructor. Again, all information on the subject is valid and genuine as it is extracted from the university database. For the purpose of facilitating understanding, the link to team formation system is included as a subset in the assessment section as team formation is required for evaluation for group work projects that are part of the continuous assessment.
	Fig. 7.	(g)	This is a very crucial part of the design of the team formation system. Apart from needing students to get precise data on their personality traits, ideal groupings must also be generated. Therefore, the clustering algorithm is recommended to get ideal groupings as students are clustered in smaller teams with various ideal personality traits using the detailed score specified in the algorithm (Sadeghi, H., & Kardan, A. A., 2016)
Service Quality	Overview		Quality of service encompasses the overall support that the system provides to users, and thus responsiveness is one of the success metrics in measuring the success of a system development.
	Fig. 8.	(h)	The system provides responsive control to the instructors where by using these three buttons, they are allowed to 1) view various types of personality traits for all students in any given group, 2) to erase students' records when necessary, for instance, students have graduated and, 3) to change the date, time and duration for students to answer questions that have been generated.
	Fig. 9.	(i)	With this system, instructors have a complete understanding of where they have access to see how balanced teams are formed using the aforementioned cluster algorithm. In addition, they get access to insert the team's name to facilitate them during the evaluation process.

With the coordination described above, it is anticipated that the team formation system that will be developed using the design prototototype generated through this research, has net benefits that will make the system highly scalable; the to-be developed system will be able to sustain strategically for longer period without the need for any regular updates. The net benefits of task productivity can be clearly seen as the instructors' valuable time can be saved as they no longer have to manually prepare all questions about personality traits, analyse the questions, and therefore they can set aside time for other educational purposes such as subject consultation. Along with easy-to-learn embedded system functions, it motivates instructors to continue adopting the system, making task innovation another net benefit as the preparation of manual questions regarding personality traits is no longer needed.

CONCLUSION AND FUTURE WORK

In conclusion, team formation according to different personality traits will give tremendous benefits to organisation specifically. This is because different types of people with different personality qualities will develop more effective teams. Many organisations will value teams which are build on diversity and therefore, it is imperical that instructors to employ this system to create effectual and operational teams. A team composed with a diversity of personality traits will generate higher success for a given assignment and this can be achieved with this system as it will help instructor to sort out the best suited team.

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