Team Member Selection: A Functional-Based Approach

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Introduction and Motivation

The modern learning approaches in engineering education require substantial training of students within a team-based environment[1,2,3]. The success or failure of these student teams depends heavily on the composition of the team. Therefore, the proper selection of the team members is critical to successful team functioning and, ultimately, in achieving the desired outcomes of the learning environment. A variety of approaches for the selection of team members have been used. For example, colleagues at the FAMU-FSU College of Engineering used a "balanced" type of approach based, mainly, on the student grades obtained in previous courses. In this selection approach, the idea is that grade distribution will bring the balance of skills needed for successful team functioning. Others simply allow the students to choose their members with (many times) the total number of students per team as the only guideline. In other universities (e.g., West Virginia) instructors frequently use a "dual" selection approach. The students choose pairs and then the instructor forms the teams by pairing the pairs. This method allows for partial input from the students as well as from the instructor. The approach hopes to achieve the skill level needed by an effective integration of personality and by providing some diversity in the composition.

All the approaches described above fail to fully recognize one of the key aspects within the team environment: The different functions needed to attain a successful and meaningful team performance. Therefore, we believe that there is a need to introduce a more logical and systematic approach in order to address this issue. This contribution focuses on the development of student teams for learning processes based on a *functional approach*. Consider other educational environments where the team-based approach has been used effectively for a long time. For example, team based sports have been using a functional based approach to team member selection from the very beginning, with a clear focus on the goals of the team: Learn the sport and win games. For instance, in the game of soccer, the coaches use a functional based approach. Each team is composed of eleven players with a very specific role assigned to each one of these players. There are, basically, four levels of functionality: the keeper function, the defenders, the midfielders, and the forwards or attackers. It is an analogous approach that we're

proposing here. To the best of our knowledge, this type of approach has not previously been used in Engineering Education.

A successful soccer team consists of members that are able to perform their specific functions efficiently and with the benefit of the team as their objective. At the different levels of development, players usually show a natural predisposition to play a particular position and what it is even more important is that they have a clear idea of what position(s) they do not want or are not suited to play. For example, the position of keeper is the one that requires a particular type of personality and a very unique training with respect to the others functional roles. Thus, some players are much more suited to this role than others. Once a higher level of mastering has been reached, the player enjoys being an expert in a particular position. When the professional level is now considered, soccer knowledgeable people would not think for a minute to ask superstar Mia Ham or Brazilian legend Pele to play the goalkeeper position since they are, as is well-known, magnificent strikers and goal scorers! Conversely, nobody that knows soccer would ask Brianna Scurry or Russian legend Yacin to play on the field since they are exceptionally qualified keepers.

Based on the description above, it can be inferred that this basic idea of team selection based on functional position should be considered for possible adaptation in forming student engineering teams. The various aspects involved in this approach are described in the following sections.

Rationale for the Functional-based Approach

The lack of functional roles as a criterion in team member selection for student teams is an issue that needs to be addressed. A potential highly effective approach to team member selection could be developed based on the success and experience available in team member selection in team sports. The key elements here are:

A. Identification of the purposes/goals of the team
B. The identification and characterization of the basic functions required for the successful performance of the team.
C. The procedure(s) to select team members that can deliver effectively the function identified in the team.
D. The training of the players (students) in the aspects required by the given position. (A crucial aspect that is frequently missing.)
E. The understanding of the effective integration of the various functions when performing as a team.
F. Monitoring procedures to ensure that what was agreed upon in B above is applied accordingly.

The starting point of any successful organization or corporation is the definition of their goals and purposes. Likewise, when forming an academic engineering team of students, one important consideration is the goals of the team. For example, is it a temporary team (for an in-class activity or for a few weeks) or a more permanent and long term team (to be maintained over several semesters or quarters)? Is it a team designed to perform only analytical/computational tasks or is the focus on experimental activities or both? Will an experimental illustration be required as one of the team outcomes? This very brief synopsis of the potential goals of the team

indicates that quite a range of activities, requiring a variety of skills, must be performed to attain these objectives.

Do the scenarios described above bring confusion and hesitation to students? The answer to this question has two alternatives. If the instructor does not offer any assistance to the students in identifying important and common aspects needed to approach the tasks as a team, then in all likelihood the students will end up with confusion. In contrast, if the instructor *coaches* the students as a means of facilitating the team's identification of the key elements needed to achieve successful team performance, the situation is transformed immediately into a rich learning environment. One of the first issues that must be considered is the potential number of the members in the team. From the student perspective this is important in order to have an idea of the magnitude of the resources they will have available. Usually, based on our experience in the team-based environments, teams of three students are a good option. Teams with two students are also useful to balance the number of students in the teams. Afterwards, the focal point of the analysis is how a team of three students would be able to accomplish their goals. Point B, above, is now the one that takes central stage.

Once corporations or business organizations have identified their goals, in order to achieve these, regardless of what they actually are, a person to manage or lead such an organization is selected. Therefore, a *team leader* emerges as one of the key functions. Team leaders do not accomplish goals without a supporting group that actually carries out the tasks. This need leads to the identification of a *team engineer*. This particular function must be fine-tuned for the type of team goals, i.e. theoretical, computational, or experimental. Finally, managing to complete the necessary tasks to meet the goals requires clear ideas. Therefore, a *team idea person* or *innovator* to think "outside the box" and research options is a natural choice. In general, these functions are not completely independent and they can be performed by more than one individual at a given time, just as in the game of soccer a defender can temporarily play the midfielder position. These functions are usually identified by students in a collaborative way with the instructor. Some of the names of the functions may change from course to course but the essential characteristics are the same.

Well-identified functions have been identified for a three member team, i.e. a team manager or leader, a team engineer, and a team "idea person". This is equivalent to the sports team situation, once the specific sport has been selected. It is clear that in order to fulfill these identified functions, they must be defined and/or characterized in the same way that a keeper position or a defender function has well-defined roles in a soccer team. Students are invited to assist in the characterization of these functions in a collaborative way with the instructor. Table 1 illustrates typical student results after this exercise.

Table 1: Characterization of Functions from the Students Point of View

Team Leader: Supervision (organize, coordinate, delegate), background research.
Team Engineer: Work with calculations, experimental data collection, and application of theory.
Team Idea Person: Development of new concepts, brainstorming, optimize efforts

Now, we turn the attention to point C, above, where students are faced with the task of the identification of potential candidates for the functions described in Table 1. Several ways can actually be used to select the best potential candidates for these positions. We have used the "functional résumé" in which the students "apply" for the position with a very good description of merits, i.e. background, previous experience and/or inclination of what "they are good at". A panel of students reviews these applications and determines if the qualifications, offered by the candidate, actually meet the specifications of the positions. Generally, student assessment here finds that some candidates are qualified for more than one position. These candidates are declared as "multifunctional candidates" and they are reserved, for example, for teams with fewer students, such as a team of two, if needed. Examples of these functional résumé will be available for consultation.

Before a final assignation of students to the different positions or, alternatively, team functions, a review and analysis of the different functions are conducted as a way of summary. We have found this activity quite useful for those students who are not that familiar with team based instructions. In addition, team dynamics and productivity is addressed at this point. In some cases this is a brief review, if the students have previously had formal training in teaming, and in other instances it is a more involved discussion with additional resources being made available to the students.

Once the groups are formed, the students' attention is directed to the role of integration of the different functions and the monitoring process for these. We have found quite useful here the concept of an "*Agreement of Cooperation*" in which the students get together in their newly formed teams and, as the first task, they construct such an agreement of cooperation. These are the bylaws of the team and can only be amended with the agreement of the majority of the team members or as established by the agreement of cooperation. Finally, a detailed monitoring process for the activities of the team is also agreed upon.

After the tasks described above are finished, teams are ready to become operational. Many of the "traditional problems" found in team formation and team member selection do not even have the chance to appear during the process described above. Friendship, inclination to work with a given student, and personality have little effect on the team formation and, instead, a more professional and mature attitude emerges among the students. The entire process is a wonderful opportunity for the students to be exposed to some of the very same professional activities that will be required of them in real life work. Ethics and professionalism are stressed at all times during the process. Students are at the center stage of the development of their own "company" or business enterprise!

Cases Implemented: Some Observations and Analysis.

The procedure described above has been implemented and studied at the FAMU-FSU College of Engineering, Tennessee Tech University and Rose-Hulman Institute of Technology, in a variety of courses such as Momentum Transfer, Heat Transfer, Kinetics, and Introduction to Process Design. A close coordination with the laboratory work associated with these courses has been followed in some cases in order to assess the impact of the approach on the students in other team settings.

The assessment of the impact of the approach on improving learning is, in general, not easy to perform. However, some of our primary objectives were assessing student satisfaction, student appreciation of professional attitude and ethics, and the potential use of the methodology in subsequent courses. These aspects have been assessed by two key tools: The exit interview of randomly selected students and by direct observation of students in teaming in the Unit Operation Laboratory (UOL). This lab is usually taught subsequently to the courses where the functional approach to team member selection was implemented.

In general students have shown during interviews a very good level of satisfaction. They are pleased to see a framework or rationale for team selection that is based on meaningful characteristics that are closely related to both student interest and ability and activities. In particular, they expressed their satisfaction at having the opportunity to be a part of the process that leads to a selection. In this approach there is no need for the instructor to be dictating who is paired with who or, alternately, the only guideline for team selection is the friendship among members of the team. Moreover, the students indicated that this approach afforded the opportunity to meet new students and to develop a "new" work habit. At the FAMU-FSU College of Engineering the approach brought a systematic way to form teams that are culturally diversified without the need for "diversity" or other factors being an imposed selection parameter. In addition, students revisited the pros and cons of having friends as teammates when a given task must be accomplished. Thus, a more professional view has emerged.

The functional team approach was considered useful for forming teams when it was required for the UOL. These teams are self-selected, without instructor input, and only with a number as a constraint. Students were able to look for a *positional* member when they faced the possibility of having to increase the number of members. Another possibility observed was the ability to "re-enforce" a team when a member either was not pleased with the group or when the team thought they needed to make changes to achieve better performance during the time in the UOL. The framework given by the position was very helpful in their identification of the new student. In addition, the UOL instructor observed fewer problems in the day-to-day dynamics.

At Tennessee Tech very similar comments were noted when interviewing students at the end of the course. Students were pleased with an approach where students have significant input. The presence of the framework that promotes professionalism in team work and that puts the student at the center stage to think about what s/he can bring to the team and make them responsible for such a decision was highlighted. The observation in the UOL is an aspect that will be available at a later time, since the approach was recently implemented at Tech.

Concluding Remarks

A novel team development strategy based on a functional approach has been described. The key aspects of such an approach have been identified and they depart considerably from other more traditional ones used in team formation and team member selection. It offers students a unique opportunity to develop (during college training) useful skills for the work/professional force. The methodology has been applied in three different engineering colleges and the general feedback from students and laboratory instructors have been very encouraging.

In general, feedback received by the students both during "exit interviews" or casual testimonials and in the UOL observations is very encouraging. They seem to believe that the approach helps introduce them to a "work force" style of performing. They also seem to favor the approach (after some initial skepticism) over the traditional ones since it gives an excellent opportunity to meet other fellow students and, in many cases, develop new friendship as is achieved in many professional organizations. Feedback from the instructors has been quite promising. Students seem to show a higher level of professionalism and readiness compared to others that have not been exposed to the approach.

References:

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Biographical information

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PEDRO E. ARCE

Pedro E. Arce is Professor and Chair of Chemical Engineering at Tennessee Tech. Dr. Arce is deeply committed to the development and enhancement of efficient learning methodologies in the engineering curricula where his focus is on *active and collaborative learning environments.* He has championed the use of the "Colloquial Approach," "The Principal Objects of Knowledge" the "Coach Model of Instruction," and more recently, "High Performance Learning Environment or Hi-PeLE".