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Diverse Cross Functional Student Teams: A Teaching Tool For Enhanced Learning

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Diverse Cross Functional Student Teams: A Teaching Tool For Enhanced Learning

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Cross-Functional Student Teams as a Teaching Tool for Enhanced Learning

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Abstract

Traditional engineering and science teaching methodology has been to train like-minded students within the discipline of their respective majors. Curriculum time constraints, however, limit the number and nature of out of discipline elective courses. As a result, students are well trained within their respective fields of study but lack the breadth of experience in interacting with other diverse disciplines. Industry, particularly technology-based companies, has observed that solutions to problems have a greater probability of success when all interested parties (purchasing, innovation, marketing, sales, manufacturing, etc.) have input in developing a plan to achieve a desired corporate outcome. It is through this collective action of diverse disciplines that unique solutions are conceived. Many times breakthroughs in innovation and product development occur not through the actions of companies in direct competition but through new entrant companies by modifying technology currently residing in different markets and applications. The breakthrough occurs because the new entrants are not bound by the technology paradigms constraining innovation in their particular market arena. Our goal is to take the diversity lessons gleaned from industry and incorporate them into coursework that creates diverse cross-functional teams such that students learn the benefits of cross-discipline diversity. The College of Business and Technology at ETSU is itself a diverse blend of disciplines (Engineering Technology, Entrepreneurship, Human Nutrition, Marketing, Digital Media, etc) and several graduate and undergraduate courses residing in different departments within the college have intentional programs that encourage cross-discipline enrollment. This action is further facilitated through dual course listings between departments for the same course. Examples of diverse discipline teams will be discussed with attention to outcomes and challenges. Through this diverse cooperative program, students from the technology, business, applied human sciences and digital media disciplines gain a perspective for each other's expertise and learn to develop teams with diverse skills to meet the increasing challenges for managing business and technology.

Introduction

In industrial and service fields' cross-functional teams are recognized for their ability to bring configurationally synergistic enhancement to the final desired outcome [1]. The demonstrated ability to assimilate information from personnel with diverse backgrounds is recognized by human resource departments and students demonstrating this capability significantly increase their value in the job market. At East Tennessee State University, we have initiated programs and courses that demand interaction within cross-disciplinary teams. These programs have

provided us opportunities to observe and respond to challenges, both expected and unexpected, created by bringing individuals with differing educational, work history, experiential, and personality differences together.

This paper is designed to discuss these problems, propose some arenas for research, explore cross-functional team experiences from industry and their potential translation to educational experiences and offer some potential solutions. While this approach creates many distinctive challenges, it is imperative that we train students from all of our disciplines to interact efficiently and effectively to create a competitive advantage for themselves and the organizations that employ them[1].

Challenges of Team Assimilation

One of the first challenges that instructors and top management teams face as they seek to develop cross-disciplinary teams is the process of selecting team members in a manner such that the team establishes a social relationship conducive to learning, both at an individual and group level, and that the diversity of team members is both valued and leveraged[2, 3]. Participation in team problem solving exercises is in many cases a new experience for many upperclassmen and graduate students and allowing them to choose their own team members may not be the most efficient method for developing the team. Our experience indicates that the tendency of students is to select members that they have worked with in the past, are pursuing a similar major field of study or possess similar personality traits. We know, however, that supplementing the knowledge of team members with perspectives from other fields augments the individual's knowledge in both their own field and those of their team members. The establishment of teams trained in the same sub-discipline (accounting, finance, engineering, general management) allows for homogeneity among team members (foundation skill sets, proven methodology, familiarity), but misses the opportunity to maximize team synergy due to a lack of breadth in the teams' educational and experiential toolbox. On the other hand team members from the same discipline have knowledge of each other's expertise and can efficiently allocate work responsibilities. This socio-cognitive capability[4] has a learning curve advantage for those that are starting from scratch and leads to an outcome sooner, however, that outcome would likely be less encompassing than that of the cross-disciplinary team. However, numerous mistakes often made by professors can potentially be avoided by reading literature written to assist with the team dynamics[5].

One possible solution is to allow teams to select a group member from their discipline, but leaving the balance of the selection to the instructor, or insist upon selection of different sub-discipline categories. This problem is an issue primarily in the broad based disciplines such as business. In technological oriented projects, teams typically are comprised of those students that have expertise in and around the focal technology and while this may result in a rapid solution to the problem the solutions typically have a narrow focus and do not evaluate "out of the box" solution sets. Insertion of team members with diverse educational background and experience may result in solution sets that at first blush are nonsensical to technology oriented team members but these solution paths may generate unique options that technology/engineering students never would have been explored. Balance of diversity becomes an issue when assimilating team members. For example, it would probably be suboptimal to have three

accounting majors devising a marketing plan for a new nutritional supplement, however inclusion of the accounting skill set to the team, in addition to marketing, advertising and science based skill sets, creates an environment for a unique and broad based solution. In addition to discipline differences among team members, cultural differences are a growing concern for industry. The Hudson Institute in its' landmark study Workforce 2000: Work and Workers for the 21st Century[6] and Workforce 2020[7] concluded that the workforce is increasingly becoming a rainbow coalition. Therefore, the challenge is to determine how to manage. According to Sinclair, Laskowitz and Sinclair[8], "Simply informing members of today's organizations about cultural differences is an incomplete strategy for helping workmates bridge the gaps that impair cooperative work. To achieve maximum benefit, information should be supplemented with behaviorally specific skills or "tools" that equip trainees/students with practical techniques for solving classroom and workplace problems that derive from cultural-based differences. Awareness is the first step, but alone is insufficient."

Another potential issue relates to the commitment level of the students. While the traditional "grades" incentive is effective to a degree, it is far more beneficial to have some element of intrinsic reward for the students. This is more likely to occur if the students have an inherent interest in the project prior to the start of the teamwork. One method used by one of the authors was to have the technology/engineering students "pitch" their idea (in this case their senior projects) to the business students involved in their "strategic experience" class. These students (already broken into teams by business functional expertise) then voted on which project/s they would like to take on for their semester assignment. Upon this selection the technology/engineering student/s became members of the team. This provides some degree of buy in for the non-technological students. It also provides an opportunity for the technology students to think through the benefits/costs that are involved in their innovation.

Pedagogical Issues

There are several issues that make teaching in a multi-disciplinary course a challenge. First, the differences in background mean that instructors will need to clearly define the problem and the expected role that each team member (discipline) will play. In some situations where the diversity in team members is extensive, the instructor may be required to provide the students with some fundamental data necessary to provide a uniform background of understanding. This background may be needed to solve the problem or assist in the facilitation of incorporating diverse skill sets such that the students can develop a unique multi-disciplinary solution. It should be noted, however, that in industrial situations, team members are expected to bring their area of expertise to the table and contribute to the overall team directive. Non-technical team members are not brought up to speed on aspects of technology important to the project nor are technologists taught financial basics. In the industry setting, all of the team members are united in their common knowledge of corporate direction and the consequences of team success/failure. In the business world, team members are paid for their contribution to the overall project; this contribution is enhanced if the individual contributor finds mechanisms to develop synergy with the teams' diverse skill sets. In addition to enhanced student learning, the inclusion of course offerings that require multi-disciplinary teamwork and a team teaching format provides a structured forum for faculty interaction that potentially can foster new and unforeseen collaborative research platforms.

Another issue involved is that of asymmetric enhancement of capabilities accrued to the experience. While students from one discipline may be gaining skills that can be applied across a wide variety of projects, others may only be picking up knowledge that will be of use in this one idiosyncratic instance. It could, and should be argued that the exercise of learning is a useful tool that is being developed, and even though the specific knowledge gained during this project may be of little use in the future, the experience of learning and inclusion in cross-functional team dynamics will be. Once the basic knowledge is obtained through team interaction, the basis for social learning is in place and the likelihood of success is increased [9]. At this point the teams are ready to take advantage of the plethora of gains attributable to team decision-making.

Team dynamics become an important issue for the inclusion of all team members in providing input into the process that result in the final team output (report, recommendation, etc.)[10, 11]. More dominant team members may establish leadership roles and either consciously or subconsciously exclude team members or views in opposition to their own. Intentional inclusion of more timid or sub-discipline outlier team members may be accomplished through blind brainstorming sessions (either using note cards or electronic means) or through the use of a neutral team facilitator. It is critical, however, that all team members have an opportunity to present their thoughts and views and understand their contribution to the final team output in order for the formation of diverse cross-functional teams to have an impact on their learning experience.

Finally there are issues of assessment of the outcome. The easiest method is to give the entire team the same grade. This definitely is the method used by the markets! However, in the markets for labor there is differentiation. Excellence of individual effort is indeed rewarded despite overall team performance. Athletics are full of examples of these phenomena. Tracy McGrady is still renowned as one of the best pro players in the National Basketball Association, and indeed he is paid as such, however he plays for a team that consistently performs poorly (Orlando Magic). A more difficult assessment is the team member that makes only a few contributions, but the value of these contributions is essential to the success of the group. Once again, athletics provide a great example. Steve Kerr, a three-point shooting specialist provided the spark that the Chicago Bulls (led by Michael Jordan) needed to win the NBA title. He was a one-dimensional player that was perceived as a liability on defense, but within the proper context delivered the game winning difference in the final game of the championship (he also collected another championship with the San Antonio Spurs). It is a difficult challenge to reward a team member that contributes irregularly and asymmetrically, especially in the field of business where the value of the contribution is so significant.

Team member assessment of fellow members is also a process that provides potential problems. Oftentimes the students want to assess the level of effort without consideration for the skills called for in the project. Projects do not tend to call for symmetric levels of effort in every aspect. Normally, there is a focal issue that needs to be addressed and those team members with the greatest degree of expertise in that field will be called upon to contribute the most to the solution. Team members may perceive this to be "unfair" when it is really just a lesson in reality. It is entirely possible that the next project that is undertaken may have a focal point outside of their specialty and therefore a lesser workload would be required. Indeed it is even

feasible that temporal differences in effort may exist during the same project. The technology/engineering members may be required to provide detailed, but understandable analysis to their business team members. This information will provide a cornerstone from which the business students will build their analysis. During the gathering time the business students may well be "sitting on their hands" awaiting the input from their teammates. Alternatively, toward the end of the project there may be little need for technology/engineering inputs as the business elements of the team begin the final analysis. It should be emphasized, however, that students should participate to some extent in all phases of the project in order to experience and appreciate the dynamics of cross-functional teams. In the marketplace the ultimate product and return are the assessment mechanism, while in the organization individual excellence is rewarded by both tangible and intangible rewards. As noted by Kayes[12], "management learning" occurs in four basic agendas; Action[13], Cognition[14], Reflection[15], and Experience[16]. Each of these agendas are characterized by individual rewards and learning, group rewards and learning, or elements of each. It is imperative that we provide a similar experience in the classroom.

Lessons from Industry

Teamwork and participation in teams have become standard practice in industry as quality management (QM) and Deming's philosophy swept the world[17,18]. Industry saw value creation in the form of more efficient operations, less rework, reduction in waste and numerous other examples when teams comprised of managers and floor workers were forced to work together to solve problems under the banner of quality management. QM teams, having proven their worth, are now commonplace in industrial and service industries. Businesses began experimenting with teams within different corporate functions to determine their utility in creating more efficient and innovative organizations. One example relates to the Polymers Research and Development Department of Hoechst Celanese, a global chemical company. In discussions with their research department the first author learned of their use of Myers-Briggs type analysis in developing teams to identify research direction and program development. This organization populated teams with not only their best scientists but in addition intentionally tried to include most if not all of the Myers-Briggs types as team participants. If a particular personality type were excluded from the team, the team would take time to identify how that particular personality type would respond to the proposed output of the team. They found that by using this design, team decisions regarding direction and funding of research programs were met with greater buy-in, purpose of direction and less "meeting after the meeting" discussions. By intentionally selecting diversity many problems that may have been unforeseen were unearthed prior to program layout[19].

The first author observed similar positive results from team collaboration while managing a pharmaceutical intermediates manufacturing business. The business team of this organization was comprised not only of marketing and customer interface personnel but also with members from purchasing, research and development, human resources, manufacturing and process development. Teams comprised of such diverse disciplines are difficult to manage, however the efficient output of the business derived through a coordinated effort by all functions reaped synergistic rewards. Business goals, yearly key initiatives selection and quality standards were determined by the collective effort of the team, not only by the business managers. Because of

this collaborative effort, measures regarding goal achievement developed by the team had the complete buy-in from all involved functions. The scope of the business plan, goals and key initiatives would not have been as broad or achievable if only one function were responsible for the proposed business sales and earning goals. Diversity generated profitability through evaluating problems through different sets of cultural lenses.

The ability to recognize and adapt to competition is a trait exhibited by all successful technology organizations. Dr. Adrian Slywotzky, author of "The Profit Zone"[20], contends that competitors have traditionally been identified as "companies that do what we do", however he cautions that today's competitor should be classified as "one that shares your customers and/or your scope". The ability to look beyond the obvious market edge helps to identify where new threats are coming from and that tomorrow's key competitors may not even be on today's competitive radar screen. An often-cited example is Honda Motor Corporation[21]. The three major United States automobile manufactures did not consider Honda a threat because Honda was not in the automobile business; they were in the internal combustion engine business. The automobile manufacturers were blinded by their automobile paradigm and did not see the emerging threat as customers began seeking more fuel-efficient cars. Businesses that can adapt to the challenges of new technology and business methods do so by watching and evaluating the changing customer priorities and then adapting to the new business environment by transforming their business design. The ability to anticipate change and look beyond the edges forces corporations to embrace diversity and welcome the impact that the new technology or business process will have on the corporation and how it is configured and managed.

To further provide evidence as to why the study or multi-disciplinary teams is important, an additional example is provided. Here is a cross-functional team that lost its focus and failed to get all participants involved at a satisfactory level. The team started out asking a lot of questions before the actual work began. As team members worked on a project, the dynamics of the team began to change and the focus reverted to the dominant participation of one or two members. The remaining members struggled to identify their roles within the team and lost interest to a point where one member failed to conclude the project. Several years ago, the second author participated in a cross-functional team workshop, where the purpose and goal was to invite college professors from various disciplines from across the country to participate in cross-functional teams and learn to incorporate the skill sets of the various participants to solve a predetermined problem. Examples of disciplines represented were engineering, history, English, communication, art, psychology and the like. Initially, communication within the groups went very well. Much of the discussions focused on working as a team. However, when the problem was assigned (reverse engineering – making a better toaster), most of the groups began to rely on the technical representative within the groups. It was obvious that the technical individuals took on the role of leader and the other member waited for further instructions. As the teams worked, they began to compete in an attempt to see who could finish first. In doing so, there was very little interaction with the arts and sciences team members. Interestingly enough, time was a variable that individual groups super imposed on themselves and was not a criterion of the facilitators. With this variable in mind, a couple of teams, including the one that the author participated in fell in to the same trap. It was realized and discussed shortly after the completion of the workshop that several of the groups failed to enhance learning by not incorporating and maximizing the expertise of the non-technical participants.

Conclusions

Cross-functional teams are a challenge to manage whether in the classroom, military or industry, however the potential benefits of synergy are often measured by the team's output of unique and broad based solution sets. This paper deals with the challenges of assimilating, managing and mentoring teams with diverse educational backgrounds but today's teams are further confounded with the challenges of assimilating team members from different cultures, gender, nationalities, dialects, physical and social handicaps, religious affiliation and sexual orientation. The differences described in the preceding sentence represent new areas of research in optimizing team dynamics and will be evaluated by future research at East Tennessee State University. Companies and educational organizations that actively search for ways to optimize their human resource capital should benefit in the long-term through their broad-based approach to the marketplace and/or students.

A drawback to the use of diverse cross-functional teams relates to achieving speed to innovation. Cross-functional teams require time to go through their iterative process in order to develop outputs that are potential breakthroughs in current thinking. In order to be profitable and nimble however, industry and scholastic organizations need to find the proper balance between using highly focused mono-discipline teams and multi-discipline cross-functional teams in order to achieve both speed to innovation and the potential to define new industry paradigms through unique innovation.

Another particularly problematic issue is the perception of the participants that each team is an idiosyncratic experience; therefore the failure to succeed in one will be counterbalanced by another's success. This can lead to an attitude of "cutting our losses" in a particularly problematic project and focusing on one that appears to have a higher probability of success. This can lead to a tendency for firms to miss out on opportunities that have high payoff potential because their teams have not been trained, nurtured, and rewarded, to focus their attention on overcoming the obstacles encountered. By empowering these participants to pursue solutions to these problems, organizations can create an environment that truly requires a "fatal flaw" within the project to discontinue the pursuit. This empowerment can then create sustainable competitive advantage for the firm in the area of "socio-cognitive capability" as described by Ginsberg.[22] These capabilities are excellent examples of resource advantages in that they are rare, imperfectly imitable, valuable, and their profits tend to be appropriated by their organization.[23] The problem is that many organizations fail to provide these capabilities an opportunity to develop. The life-support is pulled from the team as soon as the obstacles are deemed too large to allow for an adequate risk/benefit ratio. This ratio rarely considers the development of socio-cognitive assets within the firm.

We hope that the concepts, practical information and experience shared in this manuscript will be of benefit for courses utilizing cross-functional teams. Educators interested in using cross-functional teams in their courses must pay close attention to assimilation of teams, team dynamics, intentional inclusion of all team members, mentoring of the team and feedback from

team members in regard to their inclusion in the team and their contribution to team value creation. Should you have any suggestions or would like to share your experiences with the authors; they would value your input.

[1] HILLS, H. 2001. Team-Based Learning, Gower Publishing, Ltd, Aldershot, Hampshire, England.
[2] WEISBORD, M.R. 1987. Productive Workplaces: Organizing and Managing for Dignity, Meaning, and Community. Jossey-Bass, San Francisco, CA.
[3] MARQUARDT, M.J. 1999. Action Learning in Action. Davies-Black, Palo Alta, CA.
[4] GINSBERG, A. 1994. Minding the competition: From mapping to mastery. Strategic Management Journal, Vol. 15:153-174.
[5] JUSTICE, T. 1999. The facilitator's fieldbook: step by step procedures, checklists and guidelines, samples and templates. AMACOM, New York, NY.
[6] JOHNSTON W. and A. PACKER. 1987. Workforce 2000: Work and Workers for the Twenty-First Century. Hudson Institute, IN.
[7] JUDY, R. and K. D'Amico (1997). Workforce 2020: Work and Workers in the 21st Century. Hudson Institute, IN
[8] SINCLAIR, G., K. LASKOWITZ, and J. SINCLAIR. 2000. Conduct differences in teams: recognizing the proper level of assertiveness. Journal Engineering Technology. Vol. 17.
[9] BRUFFEE, K. 1999. Collaborative Learning: Higher education, interdependence, and the authority of knowledge. 2nd Edition, John Hopkins University, MD.
[10] ARROW, H., J. McGRATH and J. BERDAHL. 2000. Small groups as complex systems: formation, coordination, development and adaptation. Sage Publication, Thousand Oaks, CA.
[11] DANIEL, L. 2001. Group dynamics for teams. Sage Publications, Thousand Oaks, CA.
[12] KAYES, D.C. 2002. Experiential Learning and its Critics: Preserving the role of experience in management learning and education. Academy of Management Learning and Education. Vol. 1(2):147-149.
[13] ARGVIS, C and D. SCHON. 1978. Organizational Learning, Addison-Wesley, Reading, MA.
[14] SENGE, P. 1990. The Fifth Discipline: The art and practice of the learning organization. Currency Doubleday New York, NY.
[15] MEZIROW, J. 1991. Transformative Dimensions of Adult Learning. Jossey-Bass, San Francisco, CA.
[16] KOLB, D. 1984. Experiential Learning: Experience as the source of learning and development. Prentice-Hall, Englewood Cliffs, NJ.
[17] ECKES, G. 2003. Six sigma team dynamics: the elusive key to project success. John Wiley, New York, NY.
[18] WALTON, M. 1986. The Deming management method. Dodd Mead, New York, NY.
[19] MAYERS, S. 2003. Using Myers-Briggs in the workplace. Psychiatry on Line. Vol. 1: Issue 5, paper 5. http://www.priory.com/mbwp.htm.
[20] SLYWOTZKY, A.J. and D.J. MORRISON. 1997. The profit zone: How strategic business design will lead you to tomorrow's profits. Times Business-Random House, New York, NY.
[21] PORTER, M.E. 1986. Competition in global industries. Harvard Business School Press, Boston, MA.
[22] GINSBERG, A. 1994. Minding the competition: From mapping to mastery. Strategic Management Journal, 15:153-174.
[23] BARNEY, J. 1997. Gaining and Sustaining Competitive Advantage, New York: Addison-Wesley.

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