STEM Education Redefined

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Introduction

STEM education is typically defined as a curriculum that covers the academic areas of Science, Technology, Engineering and Mathematics. In 2006, a congressional research service report suggested that there is a growing concern that the USA is lacking in its preparation of students, teachers and practitioner in STEM related fields (Kuenzi, Matthews, & Mangan, 2006). A study by (Salzman, 2013), narrates how industry leaders and policy makers seem to be of the belief that the United States is in a high tech talent crisis and that there is a shortage of graduates in STEM fields. However, the study reveals that the Nation graduates more than two times as many STEM students each year in comparison to those who find jobs in STEM fields. Large investments on STEM education promotion are damaging to the engineering and science fields. Macilwan, suggests that large investments flood the market with STEM graduates, as it reduces the competition for their services and thereby reduces their wage rates (Macilwain, 2013). Therefore, the question to be answered is: how we find an appropriate balance between maintaining the high value and demand for STEM graduates, while also ensuring that STEM graduates are successful in finding employment. The authors of this paper conducted a preliminary qualitative study to identify some of the critical skills required and training investments for success in STEM related disciplines. Following the preliminary study, the authors have developed a hypothesis that STEM education should have a strategic focus in the enhancement and development of a redefined STEM: Soft Skills, Technical Skills, Experience and Managerial skills. Future studies should also be conducted to further explore and verify the validity of the factors of a redefined STEM education as proposed by this preliminary study. The authors therefore propose that the much needed balance for the demand of STEM graduates and ensuring their success in finding and succeeding at jobs, may be found in the rethinking of STEM education with a strategic focus on the redefinition of STEM education.

Literature Review

Ted Boscia, highlighted the importance of STEM education and that the future of the STEM industry would demand around 1 million STEM graduates (Boscia, 2013). Some other studies and reports supported this view, as observed in a labor review report with labor projections through 2024. The labor review report, suggested that growth in the economy will be driven by the construction industry and closely related industries (Statistics, 2015). The literature review seemed to indicate that there would be no drop in value and demand for STEM field graduates (Covers, Jones, & Watson, 2011). The industry employment and output projections report, seemed to highlight that the largest STEM occupations are related to computers with an average annual wage for STEM occupations being $77,880 in May of 2009. This average wage could be considered a motivating factor for students to pursue STEM related professions. While these studies indicate how STEM occupations are highly sought after because of varying factors such as higher paying jobs and political and industry promotions of the STEM field. They still fail to address or identify why there is a large population of STEM graduates who have not found jobs in STEM fields as highlighted by (Salzman, 2013).

Many studies showcase certain advanced skills such as spatial visualization that are specific and are observed most often in STEM graduates (Sharobeam, 2016). STEM students seem to have been targeted as a specific group with specific skills. The expectations in STEM fields and the

associated technical skillsets have also resulted in specialized high schools (Olszewski-Kubilius, 2009) and talent search programs serving as incubators during secondary education (Almarode et al., 2014), but even these programs do not indicate any focus or emphasis on the development of broader skills needed for the success of STEM students.

A research study that surveyed teachers and administrators perceptions, concluded that STEM education is not well understood and lacks clear vision among those who believe it is of vital importance (Brown, Brown, Reardon, & Merrill, 2011). This is further supported by Bybee who also highlights a lack of general understanding of what STEM education entails (Bybee, 2010a). In another study, we see that STEM is conceptualized differently from the different educational, political, societal and personal perspectives (Breiner, Harkness, Johnson, & Koehler, 2012), which is indicative of incongruence in the conceptualization and understanding of STEM. With a trend that seems to indicate a misunderstanding of what STEM education is and should be, it is important to understand that STEM education needs to be comprehensive in its approach in order to attract more students and retain them as observed in the Memphis STEP (STEM Talent Expansion Program) program (Windsor et al., 2015). Memphis STEP shows the nature of a comprehensive approach to engage students and retain them through various opportunities and resource provision. However, even the Memphis STEP program lacks the emphasis on skills that extend beyond the academic environment and into the industry. Another example of a step in the right direction of a comprehensive STEM education, can be seen in the "Integrative STEM education" as approached by Virginia Tech (Sanders, 2009) where STEM education is viewed beyond the confinement of traditional subject topics as affiliated with STEM and has shown improvements in interests, motivation and self-efficacy within the students. The integrative STEM education process is one that highlights student learning through student involvement in activities and the classroom (Bartholomew, 2017). This approach provokes an expansion of thinking beyond just Science and Math but also the encompassing of Technology and Engineering.

The literature review on industry perspectives and expectations from recent graduates have revealed that there is a great demand for STEM graduates to have a broader skill set. Bybee discusses what STEM education is and states the need for a broader and more coordinated strategy that expands on the diversity of STEM disciplines, while instilling deeper technical and personal skills (Bybee, 2010b). A study highlighted the importance for graduates to be confident communicators, good team players, critical thinkers, problem solvers and to be adaptive to new challenges (Salleh, Yusoff, Harun, & Memon, 2015). These skills can't always be taught in the classroom and may need to be acquired through opportunities such as internships and coop opportunities (Fisher, Fairweather, & Amey, 2001) and (Fairweather, 2008). Academic institutions are recognizing the value of experience through internships and coops but some studies seemed to indicate a lack in student preparation for an Internship or Coop environment (Fifolt & Linda, 2010).

Frank Badua, in a study connecting business education and STEM, highlighted the importance of business skills associated with Rhetoric, Orthography, Ontology and Teleology (ROOT) as being important to STEM education (Badua, 2015). This perspective further supports the necessity of a comprehensive approach towards STEM. An improved balance in soft skills, technical skills and experience could also help bring more value to the STEM graduates and therefore make them

more employable and marketable to potential employers, equipping the graduates with more knowledge, resources and tools to be more productive employees and explore newer and more creative ventures in their fields of expertise. The purpose of this study, is to serve as a preliminary study in identifying the importance placed by students and industry practitioners on the skills necessary for success in STEM. But, with an expanded view on identifying both Technical and Non-Technical skills as a stepping stone to redefine a comprehensive STEM education.

Methodology

The methodology of this study is a qualitative approach by means of interviews conducted either in person or over the phone with both industry representatives and students in the state of Georgia. The industry perspective was gathered from a carefully selected sample of experienced professionals who would be able to provide insight into the expectations from incoming STEM graduates. The student participants were selected from the student body of Georgia Southern University through invitation to registered student organizations that were indicated to have an affiliation with STEM related fields.

Separate interview questionnaires were designed for the two different samples. One set of interview questions consisting of 15 questions was designed for the industry perspective (appendix 1), and a similar yet differently targeted set of 15 questions were designed for the student's perspective (appendix 2).The responses to the interview questions were recorded and studied by the authors, and the findings of the study conducted are discussed in the data analysis and discussion sections below.

Data collection

Interviews were conducted with both students and STEM industry practitioners to identify the perceptions of skills and training required in order to be successful in a STEM work environment. The interviews were conducted as per the IRB (Institutional Review Board) approvals obtained for the study and were conducted either in-person or over the phone. For student data collection, student organizations were contacted by the researchers to field candidates for the interview. Selected students were then interviewed by the researchers. The researchers also found industry practitioners in the STEM field through personal networks and LinkedIn contacts. Interviews were arranged with the industry practitioners and were interviewed the same way as the students, either in-person or via phone interview.

Data Analysis – Student Perspective

For this preliminary study, the researchers approached 15 students from varied disciplines within the STEM field and ensured representative interviews with undergraduate students. The sample consisted of 6 underclassmen (freshman and sophomore students) and 9 upperclassmen (junior and senior students). The disciplines that were included in the student interviews covered 4 IT students, 2 nursing students, 2 chemistry students, 1 computer science student, 1 construction management student, 1 civil engineering student, 1 mechanical engineering student, 1 biology student, 1 exercise science student and 1 public health student. The STEM students interviewed

and categorized based on their academically defined disciplines have been represented in Table 1. The sample included 8 male participants and 7 female participants who were between the ages of 18 - 24. The students therefore encompass a relatively broad demographic within the STEM disciplines.

Table 1 – STEM student interview demographics

Discipline	Major – Number	Total Students
Science	Nursing Students – 2 Chemistry Students – 2 Biology Students – 1 Exercise Science Students – 1 Public Health Students - 1	7
Technology	IT Students – 4 Computer Science students - 1	5
Engineering	Construction Management Students – 1 Civil Engineering Students – 1 Mechanical Engineering students - 1	3
Total	15 Students	

The students were asked two questions that related to the required skills and resources for success in the STEM field and students replied with a variety of answers which could be summarized through the following list of nineteen items: technical knowledge, team work, analytical skills, communication, hand-on experience, internships, time management, knowledge retention, accuracy, discipline, creativity, networking, people skills, problem solving under pressure, willingness to learn, positive attitude, organization skills, efficiency and ethics.

When asked what the common weakness in STEM students were, the interviewees responded by highlighting communication, poor team players, reliance on perceived intelligence, lack of base or background knowledge, overly process oriented and limited focus on soft skills. One student was quoted as saying that communication was particularly hard because it felt as if "The brain seems to operate faster, than the ability to translate the idea and communicate it." When asked the opposite, the perceived common strengths were described as knowledgeable, technologically savvy and dedicated to improving processes, unafraid, creative, driven, determined, motivated, ability to apply technical skills, persistent and skilled problem solvers.

The students were asked about their involvement in student organizations and the involvements included advocacy organizations, technical organizations, community service organizations, leadership organizations, Greek organizations and campus ministries. The number of organizations ranged from 1 – 6 organizations and the average number of organizations per student in the sample was 2 organization.

The analysis of the data indicated that students who were more involved in student organizations seemed to have a higher understanding of the importance and value for soft skills. The value for soft skills were observed to be even higher if the students has participated in some form of internship or mentorship program. The students indicated that they had acquired knowledge of career opportunities and skills such as confidence in communication, managerial, leadership,

team work, professional skills, critical thinking, representation and self-expression. Students who were involved in a more diverse set of organizations had a tendency to feel like they had acquired a broader set of skills from their involvement in student organizations. For example, students who had more than the average number of organizations but only participated in academic or technical organizations, did not seem to discuss an acquisition of soft skills unless they held a position of leadership within the organization.

When asked about industry expectations, 14 out of 15 students indicated that they preferred to join an organization that invested in training. When asked if the training should be focused on technical skills or non-technical skills, a majority of the respondents indicated that they felt non-technical skills were important for training, but they expected a greater focus on technical skills. However, some respondents stated that a STEM field employer should expect the employee to have the required technical knowledge and therefore need not make any additional investment in training the employees with technical skills. To a question on student perceptions of training related investments; the student responses to how much they felt should be invested and allocated in time and money by their employers were added together and averaged out. Students expected an average annual training allocation of approximately $4,700 per employee with an average allocation of about 105 hours per employee, per year for training purposes. The range of annual training funds to be allocated were $0 - $12,000 while the range of hours to be allocated for training was 20 – 500 hours. There was a clear indication that STEM students preferred internal training mechanisms within companies, with the exception of a few who indicated that external training is better to ensure proficiency of the trainer. A majority also indicated that they expected training to improve and increase familiarity of the company and its processes while also ensuring that the expectations were clearly defined and communicated.

Data Analysis – Industry Perspective

The researchers approached 8 industry experts to be interviewed for this preliminary study on assessing industry perspective on incoming talent for STEM related fields. The experts from industry represented different company perspectives including management and supervisory roles from different industry perspectives encompassing Science, Technology and Engineering related fields. The age range of the participants were from 28 years to 68 years of age and the years of experience ranged between 2 – 45 years in the industry. 6 of the 8 or 75 percent of the interviewed industry professionals had more than 15 years of experience, which is indicative that the sample mostly consisted of professionals who have been able to observe the incoming talent over a period of time. Having a perspective shared by a more recent manager, has also helped with the perspective of a younger professional within the industry.

When asked as to what was considered most important for the success of STEM graduates, respondents indicated that it mostly depends on the job but highlighted a few important areas such as technical knowledge and proficiency, problem solving skills, communication, willingness to learn with a drive, motivation to do the job and experience through exposure. It was also shared that the success of STEM professionals could be enhanced with lessons in financial budgeting and training employees to see the big picture with all the working parts, including financial impacts and decision making. Focused efforts on enhancing collaboration and effectiveness along with the ability to scientifically study and analyze a situation in order to

identify and implement the best solution is positive for STEM professional as expressed by industry professionals. When asked what specific skills were important as a follow up question, the respondents highlighted that the most important skills could be identified as time management, work ethic, mathematical skills, business and accounting skills, team work, people skills and communication skills.

It was interesting to observe that the management level industry professionals credited the importance of the above STEM success necessities and skills to the interaction that is required either directly or indirectly with the customer / end consumer. While direct supervisors seemed to be more focused on the streamlining and efficiency aspects of the skills they associated with success in a STEM profession.

The biggest and most common weakness in STEM students / professionals were highlighted to be the lack of experience and real world exposure, lack of entrepreneurial and business acumen, commitment, inability to write scientifically and go through a process of research and investigation, methodically communicate and structure proposals for action and change. This perspective seemed to share a relationship with another weakness that was highlighted by participants, which was the weakness in written and spoken communication. Some of the supervisors highlighted that many STEM employees did not seem to show a strong desire to learn on the job as they seemed to perceive, that they already knew everything they need to know and also desired quick and unsubstantiated upward mobility in their careers. This desire for career advancement, shared similarities with another highlighted weakness, which was the lack of professional exposure and experience in terms of internships, coop opportunities and projects with professional work environment constraints. An interesting perspective shared from one of the more experienced professionals on the weakness of incoming talent, was in relation to an observed diminishing commitment to the job and tasks allocated for work.

The next question dealt with the common strengths of STEM students and were described as enthusiasm, empathy, flexibility, willingness to take on a challenge and try new things, care about finding solutions that have a positive impact and fearless in terms of trying new things and facing failure. Another description of a common strength was the STEM student's ability and understanding of the importance in collaboration when trying to find effective solutions.

When asked if student involvement in student organizations played an important role in the decision making of hiring STEM students, the industry professionals unanimously stated that it did play a role on hiring decisions. They highlighted that participation, the ability to balance and also showcase the pursuance of broader skills were of critical importance to being successful in the work environment. The industry professionals stated that the type of student organization did not play much of a role in the decision making and they did not show a preference for one type of organization over another. However, it was stated that organizations which pushed the members into industry exposure, service opportunities, managerial responsibilities and development of professional skills were preferred.

Training was also offered by every company/organization represented in the study and a variety of initiatives were taken in the work environments to provide training that assisted with knowledge enhancement and the development of both technical and soft skills. Facilitation in

relation to training was acquired from both external sources and internal sources depending on the type of training required and the certifications being provided. Some of the interviewed professionals also indicated that continuing education opportunities and partnered educational offerings were also provided to their employees.

The average investment costs on training in relation to direct cost and hours, were again added up and divided for the average as in the data analysis for the student perspective. It was approximated that the average direct cost / investment in training per individual employee was approximated to be around $1,100 with a range of direct investment on training being $300 to $2,500. The average number of hours dedicated to training was perceived to be approximately 126 hours and it was suggested that the number of hours dedicated annually was in the range of 10 to 200 Hours and the cost associated with the time allocation for training per employee was in the range of $450 to $5,200. This would mean that the average annual training allocation per employee in STEM related fields based on the sample interviewed was approximately $3,356.25. If both the average direct cost and time cost were added together, the average annual training investment from STEM companies in their employees would be $4,456.25.

All interview participants also indicated as additional advice that it was important that students seek opportunities for more professional exposure and networking through internship and coop opportunities. The interviewed industry professionals also strongly encouraged universities and academic programs to assist students through mentorship programs and other appropriate professional experience opportunities by advancing college and industry partnerships to offer more comprehensive industry exposure and experience to better prepare STEM industry focused students for the work environment.

Discussion

A list of skills highlighted from either the student, industry or both perspectives have been presented in Table 2. This table was developed by the analysis of qualitative data through interview responses and a verification through literature review. This list of skills below, identifies the independent skills that could be used for the next phase of this study, to validate the hypothesis of a redefined STEM (Soft Skills, Technical Skills, Experience and Managerial Skills).

The author has categorized the list of skills into the redefined STEM, and identified the redefined STEM areas within Table 2. The STEM areas are categorized based on the following: Soft Skills (S), Technical Skills (T), Experience (E) and Managerial Skills (M).

Table 2 – STEM Skills – Student and Industry Perspectives

Skill (STEM Area)	Students' Perspective	Practitioners' Perspective	Reference
Team Work (S)	X	X	"Good team players" (Salleh et al., 2015) "Collaboration" (Kappelman, Jones, Jonhnson, Mclean, & Boonme, 2016)

Communication (S)	X	X	“Confident communicators” (Salleh et al., 2015) “Communication” (Barker & Camarata, 1998) “Communication (Oral & Written)” (Kappelman et al., 2016)
Knowledge Retention (T)	X		“Knowledge Management” (Drewniak & Karaszewski, 2016) and (Lin, Chang, & Tsai, 2016)
Accuracy (E)	X		“Calculation Competence” (Coben & Weeks, 2014)
Empathy (S)	X	X	“Personal skills” (Bybee, 2010b) “People Management” (Kappelman et al., 2016), “Empathy” (Daily & Eugene, 2013), “Empathy” (Sadri, 2015)
Technical Writing (T)		X	“Professional Writing” (Kohn, 2015) “Technical Writing” (Bourelle, 2014) “Workplace writing” (H. Yu, 2008)
Efficiency (E)	X	X	“Efficiency” (Szymczak & Bosk, 2012) and (Griggs, 2013)
Analytical Skills (S)	X	X	“Critical Thinker” (Salleh et al., 2015) and (Ramsey & Baethe, 2013)
Organization Skills (M)	X		“Organizational Effectiveness” (Ravindranath, 2016)
Competency (T)	X	X	“Technical skills” (Bybee, 2010b) “Technical Knowledge” (Kappelman et al., 2016)
Time Management (M)	X	X	“Time Management” (Litchfield & Chater, 2007), (Ravindranath, 2016) and (Stelnicki, Nordstokke, & Saklofske, 2015)
Mathematical Skills (T)		X	“Math confidence” (Sax, Kanny, Riggers-Piehl, Whang, & Paulson, 2015) “Mathematical Competence” (Coben & Weeks, 2014)
Internships / Coops (E)	X	X	“Internships and Coops” (Fisher et al., 2001) and (Fairweather, 2008)
Exposure / Role Play (E)		X	“Simulation/Role-play” (Miller & Lauterbach, 2014) “Simulation” (Berk et al., 2014)
Finance / Accounting (M)		X	“Accounting” (Darwish & Dyk, 2016)

Problem solving (E)	X	X	"Problem solver" (Salleh et al., 2015) "Problem Solving" (Kappelman et al., 2016)
Continued Learning (S)	X	X	"Adaptive" (Salleh et al., 2015) "Learning Organization" (Barker & Camarata, 1998)
Work Ethic (S)	X	X	"Ethics" (Ramsey & Baethe, 2013) "Ethical Leadership" (Wang & Sung, 2016)
Decision Making (M)		X	"Decision Making" (P.-L. Yu, Fang, & Wang, 2016)
Business Acumen (M)		X	"ROOT and Business" (Badua, 2015) "Business Analysis" (Kappelman et al., 2016)

The data analysis in both the student perspective and industry perspective indicated alignment in most areas of industry expectations and student perception of skills required. The students from all disciplines, seemed to have a comprehension of the importance in soft skills as demanded by the work environment. This was also supported by their pursuance through involvement in student organizations and their perceived value of skills acquired through organizational involvement and exposure. While many students seemed to participate and be involved in organizations which were technical in nature, it seemed that the perception indicated lower soft skills development in technical student organizations, unless a leadership position was held. Students who had a wider range of variety in student organizations and specifically the inclusion of Greek organizations such as fraternities and sororities, seemed to show a broader set of skills and a larger value for the skills as acquired through fraternity and sorority affiliation. When examining the industry perspective, science and engineering field related professionals seemed to have a higher expectation for hands on work experience and technical skills for incoming talent, while the technology professionals seemed to place a higher level of importance on the soft skills. It is prudent to note that all disciplines still felt that it was important to refine and improve the soft skills, and exposure of the incoming talent. Industry practitioners recommended that students and colleges should do more to ensure student exposure to soft skill improvement and work experience.

When evaluating the training related questions of the study, it was identified that the students had a wider range of perceived direct cost training investment with an average of $4,687.00 when compared to the industry reporting of $1,100.00. The average number of hours from the student perspective was equal to 105 hours when compared to the 126 hours of annual average training time allocated as reported by the industry perspective. When considering the average cost for hours of training, it was estimated that the approximate cost for training is $26.58 per hour as reported by the industry professionals and the 105 hours of training per year as perceived by the students would thereby cost $2,791.34. This results in a total perceived training cost allocation of $7,478.34 as indicated by the students. There is a significant disparity in the student perception and numbers as indicated by the industry professionals which add up to a total cost of approximately $4,456.25 which is calculated to be approximately 59.6% of the students training cost expectations. It is recommended that future studies collect more data samples to identify if

the findings of this preliminary study are consistent when tested with a larger sample of students and industry practitioners.

It is noteworthy to mention that the study also indicated that the highest training investment including both direct cost and time allocation was from the Information Technology industry. This was closely followed by the Medical Sciences and lastly the Engineering industry. The interviews seemed to reveal that there was a higher expectation for work experience or on the job training in the engineering field when compared to the other sectors.

The results and discussion above, show the weightage of cost that students place on training and also the level of investment as made by companies in their employees. This study and the approach to training as assessed shows that it is a critical component of the student's success in their chosen STEM fields. It was also interesting to note that a majority of the training cost as invested by the companies/professionals was for the enhancement of technical skills and not so much the soft skills, which may indicate a larger degree of expectations from the students and colleges to ensure readiness with soft skills when entering the work environment.

Limitations and Future Recommendations

This study is not comprehensive and is only a preliminary study and as such is limited to the number of respondents that were available for interview, which includes 15 students and 8 industry professionals. The study was also limited to respondents in Georgia and mostly included respondents from South Georgia. It is recommended that future studies and research consider obtaining factual or more evidence based data on the training investment costs as investigated in this paper. The initial intention of this study was to have a mixed methodology approach to the data collection and thereby give a more comprehensive analysis of the perceptions. However, the study was only conducted with a qualitative approach and is therefore considered a preliminary or first part of a two part study. It is recommended that a quantitative study be conducted in the near future. A mixed method study would allow for a broader and clearer picture of the expectations of students and industry experts in relation to the importance of skills necessary in the work environment.

Conclusion

In conclusion, it is identified that the typical STEM (Science, Technology, Engineering and Mathematics) education would require an expanded and improved approach in an academic and collegiate environment. The student perceptions, industry expectations and literature, seemed to reveal a significant importance in having a comprehensive and balanced STEM education which covers both the technical and non-technical skills. The contribution of this study is a highlight of skills that are essential to the success of students and new talent entering the STEM work environment. This preliminary study indicates that improvements can be made to STEM education through the following approaches.

Soft skills – Could be enhanced and developed through the encouragement and participation in a broader scope of student organizations in academic and collegiate environments. It is also

possible for other programs to be designed and developed to expose students to a wider array of skills that will help them be more successful in a STEM work environment.

Technical Skills – Curriculum to be up to date and course design to be improved to ensure that students are receiving the most real-world educational experience with opportunities to test their technical skills and enhance them in the work environment. The addition and promotion of technical organizations, with an improved array of programs to help improve both technical knowledge exposure and soft skill exposure is recommended.

It is recommended that students, colleges and industry build stronger partnerships in improving communication and developing strategic approaches to ensure that STEM students are better prepared for the work environment. It is important that STEM student have a broader skill set than just the academic skills related to STEM, and are equipped in order to better contribute to the companies they work for. Students equipped with a more comprehensive and redefined STEM education, will feel a greater value in the education they have received and improve the productivity and return on investment made by their employers.

Finally, it is important that follow up studies be conducted to build on the preliminary listing of skills identified in this study. Future studies should be conducted to validate and verify the redefined STEM (Soft skills, Technical skills, Experience and Managerial skills) presented as a hypothesis in the introduction of this paper.

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Appendix 1: Industry Perspective – Interview Questions

1. What are the most important thing(s) for professionals working in the STEM field?
2. Why do you think those things are the most important?
3. What do you think are the most important skills, when working in the STEM field?
4. Why do you think the above skill(s) is (are) the most important skills?
5. If there is any, what is the biggest common weakness of STEM students/employees that you see?
6. If there is any, what is the biggest common strength of STEM students/employees that you see?
7. Do you feel that students' involvement in student organizations plays any role in your hiring/recruitment perception? If so why?
8. Does your company provide any training to employees in the things that you deem important?
    a. Knowledge
    b. Skills
        i. Non-Technical Skills (soft/technical/expressive language/managerial)
        ii. Technical Skills
9. If you company does provide training in those things (as listed in Item 7), could you provide more information about the training?
    a. Content
    b. Approach (External/Internal)

    c. Effectiveness/Feedback from Employees
    d. Cost
    e. Annual average hours of Training
    f. Others
10. What are the annual average hours of training for each employee?
    a. Knowledge
    b. Skills
        i. Non-Technical Skills (soft/technical/expressive language/managerial)
        ii. Technical Skills
11. Approximately how much money do you invest in providing training for employees (per capita)?
    a. Knowledge
    b. Skills
        i. Non-Technical Skills (soft/technical/expressive language/managerial)
        ii. Technical Skills
12. What will you suggest current STEM students to do to improve their competencies (Provide the following hint only when necessary: student organization, study abroad, dual degree, etc.)?
13. What will you suggest university/college/department to do to improve the quality and success of their students?
14. If you can go back to school, is there anything that you will do differently? If yes, what is it?
15. Anything else that you would like to share with us?

Appendix 2: Student Perspective – Interview Questions

1. What are the most important ***things*** for you to be successful in the STEM field?
2. Why do you think those things are the most important?
3. What do you think are some of the most important ***skills***, when working in the STEM field?
4. Why do you think those skills are the most important?
5. If there is any, what is the biggest common weakness of STEM students that you see?
6. If there is any, what is the biggest common strength of STEM students that you see?
7. Are you involved in any student organizations? If so,
    a. How many organizations?
    b. What are they / what type of organization?
8. If yes to the above question, do you believe you have acquired any anything through your affiliation?
    a. Knowledge
    b. Skills
        i. Non-Technical Skills (soft/technical/expressive language/managerial)
        ii. Technical Skills
9. Do you actively seek opportunities to acquire and improve on anything that you deem important? If you do – How?
    a. Knowledge

   b. Skills
      i. Non-Technical Skills (soft/technical/expressive language/managerial)
      ii. Technical Skills
10. For similar companies, will you be more interested in working for companies that offer training to their employees?
11. If yes to the above question, what training will you be interested?
   a. Knowledge
   b. Skills
      i. Non-Technical Skills (soft/technical/expressive language/managerial)
      ii. Technical Skills
12. Please describe an ideal training for you from the following perspective?
   a. Content
   b. Approach (External/Internal)
   c. Cost
   d. Annual average hours of Training per employee
   e. Others that are not listed above
13. What will you suggest university/college/department to do to improve the quality and success of their students?
14. Do you have any suggestions for future students of STEM field?
15. Anything else that you would like to share with us?