The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2018

Volume 9, Pages 276 - 283

ICEMST 2018: International Conference on Education in Mathematics, Science and Technology

Impact of Internship Programme in Engineering Education

H. Ziya OZEK
Namik Kemal University

Abstract: A common opinion suggests that a distinction is somehow developed between the competence of engineering graduates and elemental requirements of the industry. Consequently, many universities in various countries have adapted internship programmes or industrial placement for some of their degree programs. This approach is also accepted and supported by many potential employers in different fields. Internships and placements are a kind of work experience obtained during the undergraduate years. Thanks to internship, the practical knowledge and understanding of students are greatly improved, especially in engineering education. It provides students with an opportunity to gain valuable working experience in their specific field and to enhance their prospects for future employment and engineering career before their graduation. This study is an attempt to evaluate the impact of such programmes on the basis of benefits and challenges. The evolution of internship programmes, alternative methods and basic principles are discussed. On the basis of the experience of Namik Kemal University, it is clear that this programme provides certain advantages for all sides but also many challenges. The students are introduced with the work life before graduation and has the chances of better preparation for the professional life. From the company point of view, they can make a very realistic assessment prior to the employment. The success of the programme depends on the level of co-operation and commitment displayed by internship students, partner companies and university academic staff. The involvement and commitment of students, support and capabilities of the factories outstands as important success criteria.

Keywords: Internship programme, Engineering, Engineering education, Training

Introduction

Various universities in several countries have already adapted internship programs or industrial placement for undergraduate programs. This approach is also accepted and supported by many potential employers in various disciplines. An internship is a kind of work experience which is achieved in the major field of student for one or two semester. In consideration of the fact that a distinction is somehow developed between the competence of engineering graduates and elemental requirements of the industry, Internships are extremely valuable for engineering students. Typically students participate in projects as they work alongside practicing industrial professionals as they tackle special day-to day challenges. Thanks to the internship program, the practical knowledge and understanding of students are greatly improved especially in engineering education. Internship programme in engineering provides students with an opportunity to gain valuable work experience in their specific field, and to enhance their prospects for future employment and engineering career before their graduation.

A certain period of practical training is integrated into engineering curriculums in many universities. The internship training may be optional or obligatory depending on the program concept. The internship is expected to focus on the relevant engineering discipline. It is believed to have positive impacts on all stakeholders with exception. On the other hand, interns on the field training may face some serious challenges. These are varied such as time limitation for the courses, unsupportive behaviour of companies, exaggerated enterprise privacy or cases with no pocket money or payment. The present study seeks to determine impacts of the internship means in engineering and attempts to raise questions to establish an ideal internship layout. A typical example of this method has been running at the department of textile engineering of the Namik Kemal University in Turkey since 2011. All final year students are required to take the internship procedure called as Sector Integrated

Education (SIE) for the last two semesters. Students are placed to several partner companies and take part in the program as intern engineers by attending three days per week for the entire semester.

Concept of Internship Programs

Previous works cited in the literature appear to be in agreement on the basic definition of internship. McMahon and Quinn (1995) state that internships are supervised work experiences whereby students leave their institutions and get engaged in work related programmes, during which period they are closely supervised by experienced job holders. According to Furco (1996), internships are defined as programmes engaging students in service activities primarily for the purpose of providing them with hands-on experience that enhances their learning or understanding of issues relevant to a particular area of study. In a relatively newer study, Tackett *et al* (2001), reported that internships have taken on an increasingly important role in education over the past decade since they provide students with many advantages, ranging from gaining experience and obtaining career-related direction to networking with other students from various institutions during the period of internship. The National Commission for Cooperative Education defined cooperative education as "a structured educational strategy integrating classroom studies with learning through productive work experiences in a field related to a student's academic or career goals." (Groenewald, 2004). Internships are therefore any carefully monitored piece of work or service experience in which an individual has intentional learning goals and reflects actively on what she or he is learning throughout the experience or duration of attachment. Internships takes place during different times of the year: summer, winter or spring. These may be part-time or full time internships over different durations. Typical internships are entry-level, educational jobs that can be paid or unpaid and usually give one specific course credit for the work done.

Internship programs are believed to be developed as practical part of the Cooperative education which is a structured method of combining classroom-based education with practical work experience. Sovilla & Varty (2004) reported that a cooperative education experience, commonly known as a "co-op", provides academic credit for structured job experience and it started in the USA. The first cooperative education program in the USA was launched in 1906 at the University of Cincinnati with an enrolment of 27 students. This first program was in part inspired by the sandwich programs which may have existed in the United Kingdom since 1840 (Haddara & Skanes, 2007). About 50 years later than America, the first Canadian cooperative education program started at the University of Waterloo. The introduction of cooperative education programs in North America was mainly motivated by the needs of industry for better prepared engineers. The initial framework of cooperative education was defined by Herman Schneider who was engineer, architect, and educator (ceiainc.org n.d.). His approach concluded that the traditional learning space or classroom was insufficient for technical students. After trials in some technical colleges, Schneider devised the idea of cooperative education and it was launched at the University of Cincinati and became an immediate success. This approach gradually gained popularity in the North American Universities and was spread out to many countries.

The first experience of such a scheme in Turkey was implemented by the TOBB Economy and Technology University in 2004 (Dogdu, 2010). A cooperative training period which takes place 3 trimesters in commercial or industrial workplaces was mandatory for all students, In 2008, Namik Kemal University launched a similar scheme for all Vocational High Schools students as a workplace training two days per week (Ozek, 2010). This program was revised for the engineering students in 2011 as Sector Integrated Education. Bahcesehir University started co-op education program in 2009 and Gaziantep University launched a similar program as intern engineering in 2012. Since then the interest and remodelling cases for industry oriented training for engineering students have been gradually increased. On the basis of internet searches, Çukurova, Sakarya, Toros, Selçuk, Türk Hava Kurumu, Celal Bayar and K.Maraş Sütçü İmam Universities have already adapted internship programs for engineering curriculum.

Although internships and coop employment are similar, they are not the same thing, even if people use these terms interchangeably. The basic differences between the co-op and internship schemes are the period of training, the extent of involvement in workplace and terms of payment. The co-op programmes are longer in period as 2-3 semesters, students are more involved in company routines and employer and always get paid as a trainee for the whole training period.

Assessment of Internship Programs

A number of surveys were designed to measure the "benefits incurred by the student interns". The result of a survey shows a strong indication that the students find the internship experience is "worthwhile and valuable" (Sovilla & Varty, 2004). In 1990's, Mengoni (1998) described the collaborative work leading to the establishment of 3-year Diploma degree between the university and industry in Milan, Italy. A survey was carried out for the large number of companies A critical point of survey disclosed the concerned availability of the companies for active participation in the teaching and training activities-with interventions that range from hosting training internships to providing access to laboratories, from equipment loan or donation to involvement of company personnel as active teachers.

In another survey, the level of satisfaction of mechanical engineering students at the University of Kettering was assessed by Nasr, Pennington and Andres (2004). It was stated that over 90% seemed to be satisfied with the level of supervision and the work environment, and over 90% believed that the assignments they were given during their work terms contributed to their professional development, while 87% of the respondents were satisfied with their work experience. Similar other surveys discuss the possible benefits for employers and institution. The results approves that the internship programs provide a source of pre professional staffing," and is used "as a postgraduate recruitment device by many companies.

A recent survey carried out by Ozek (2016), among all the partners of a similar program, called Sector Integrated Education (SIE), in the Namik Kemal University proved that the implementation of the SIE procedure appears to be highly important from many aspects for all parties. The assessment of collective questions confirmed that partner companies have produced the highest average score (as 3,714 / 5) while the average scores of the SIE students, graduates and academics varied between 3,464 and 3,272. The survey confirms all parties have almost agreed on the high impact of the SIE on engineering education, and it also found that it has certain benefits for the NKU students. The ranking and total scores of possible benefits and

Table 1. Average ranking Scores for the assessment of NKU SIE survey for all parties (survey carried out among students, graduates, academics and companies, Ozek 2016)

QUESTIONS	STUDENTS	GRADUATES	ACADEMICS	COMPANIES	Total Score
Benefits and accomplishment of the SIE programme for students (rank between 1-5)					
Gaining practical experience	1 (24 %)	2 (22 %)	3 (21 %)	1 (29 %)	96%
Experiencing professional work life	3 (21 %)	1 (23 %)	2 (24 %)	3 (22 %)	90%
Professional field orientation	2 (22 %)	3 (20 %)	1 (25 %)	4 (15 %)	82%
Building up theoretical knowledge	4 (17 %)	4 (18 %)	4 (17 %)	2 (23 %)	75%
Improvement of engineering formation	5 (16 %)	5 (17 %)	5 (13 %)	5 (11 %)	57%
Benefits and accomplishment of the SIE programme for the partner company (rank between 1-5)					
Assistance in the completion routine operations	1 (26 %)	2 (22 %)	1 (27 %)	4 (18 %)	93%
Conduction of routine tasks and minor projects	2 (23 %)	1 (24 %)	2 (22 %)	3 (20 %)	89%
Recruiting as potential emloyee	3 (18 %)	3 (20 %)	5 (12 %)	1 (25 %)	75%
Improving the university and industry collaboration	5 (15 %)	4 (18 %)	3 (21 %)	2 (21 %)	75%
Considerable labour force assistance	3 (18 %)	5 (16 %)	4 (18 %)	5 (16 %)	68%
The impact of SIE on academic achievement of students					
Positive	59,0%	73,3%	66,6%	69,0%	67,0%
No consirable contribution	41,0%	26,7%	33,4%	31,0%	33,0%
Benefits and accomplishment of the SIE programme for the university (rank between 1-5)			ACADEMICS		
An opportunity of conducting industry based projects for students			1 (24 %)		
Industry & university collaboration for joint projects			2 (22 %)		
Improving the recognition of the department			3 (19 %)		
Enhanced and Industry oriented textile engineering education opportunity			4 (18 %)		
Understanding current state and basic aspects of text. companies			5 (17 %)		

Accomplishment of the SIE programme at the NKU Textile Engineering Departments is given in Table 1. The highest ranked outcomes are; Gaining practical experience for students, Assistance in the completion of routine operations for partner companies and An opportunity of conducting industry based projects for students from the university. It is also found that all partners have agreed that the impact of the SIE on academic achievement of students is positive which was rated as 67% in average.

An assessment of the practical training that was developed in the Electrical Engineering Department of the Technical University of Delft is made by Rompelman (2002). The work confirms that program was proven to meet the predefined educational objectives to a large extent. Another study by Smith & Monk (2005) reports a survey of the progress of participants in a year in industry scheme for A' level graduates in the UK typically aged 18/19. The scheme involves spending a supervised year in industry prior to a degree programme in engineering. The evidence shows that the year in industry: has a beneficial effect on the degree classification of the academically weaker participants, but little effect on the stronger. It also encourages all participants to take up further study; provides participants with a more positive picture of industry and engineering; but does not provide greater motivation to enter industry. These results can be interpreted in terms of the way young people weigh the benefits of different career paths. From this survey and the analysis presented, it is stated that ''the year in Industry is a worthwhile investment''. Although there are specific benefits, like improved degree results amongst weaker participants, and there are also disappointments. Internship scheme gives students real world experience in a professional job setting, networking opportunities that significantly increase their ability to get jobs after graduation, and explore potential careers. The outcome of a study by Baytieyeh & Naja, (2012) concludes that employers seek engineering students with related job experience and use their internship programs to recruit entry-level talent.

The benefits and challenges faced by student interns at the Zimbabwe Open University are discussed in a paper [Bukaliya, 2012). The study focussed on Faculty of Science and technology and Faculty of Applied Social Sciences. The results showed that the majority of the students preferred the attachment programme because it exposed them to the real expectations of the world of work. However, a number of challenges such as the reluctance of some fulltime employees to disclose important information appeared to have negative effect on the effectiveness of the program.

Galvan and his collegues (2013) examined whether students' performance as interns and the number of internships they completed are significant in determining their employability in various labor-market conditions. The study analyzed the records of 1,184 graduates at a private Mexican university who had completed undergraduate degrees in business, design, and engineering as well as mandatory internships between 2006 and 2009. Variables found to have a positive impact and a strong significance on the probability of employment (in order of decreasing influence) were: an excellent performance as an intern, a high degree of social connections, and high admission score. Variables with a negative impact on employability and a strong significance on employment were the interaction between students having graduated from the engineering and technology majors and their performance as an intern. This study revealed that the performance as an intern played an important role on employment.

The Noel-Levitz Student Satisfaction Inventory (SSI) is one of the popular and valid instruments used to assess students' perception of teacher quality and other quality factors in institutions of higher education (Mazumder, 2013). These perceptions of quality and measures of student satisfaction are used to improve services in university surrounding. The Noel Levitz SSI is widely utilized in North America (Richardson, 2005). In the 2017 Annual Report (R.Noel Levitz, 2017) of the The Noel Levitz SSI, the question of "Internships or practical experiences are provided in my degree/certificate program." is rated as high importance for four year degree and technical college students. In a recent SSI assessment for Cincinnati University students (University of Cincinnati, 2017), the importance of the question is rated as 78% and the satisfaction rate appears to be slightly better in comparison with the students of National Community Colleges.

Impacts of Internship on Engineering Education

In order to evaluate possible impacts of an internship or co-op scheme on an engineering curriculum, the following issues should be analysed and discussed from the views of all stake holders; student interns, academics and partner companies.

- How do students benefit from the internship scheme?
- What are institutional benefits of internships in engineering?

- What are the benefits of companies employing engineering interns?
- What challenges are faced by the three parties in the process instituting internship scheme for Engineering curriculum?
- Are initiatives at the state and institutional levels promoting and even mandating that engineering students have an internship experience being designed with attention to the evidentiary base?
- What are possible benefits and drawbacks of the scheme experienced by graduates?
- How can the challenges faced by intern student be overcome in order to make the internship programme more effective and attractive?

O'Neill (2010) attempted to discuss the question "Are internships high-impact educational experiences?" It was expressed that this question should be answered by individual campuses and departments in accordance with their intentions and perspectives but also in recognition of international work world. From the students point of view, several impacts are listed as;

- They are effortful.
- They help students build substantive relationships.
- They help students engage across differences.
- They provide students with rich feedback.
- They help students apply and test what they are learning in new situations.
- They provide opportunities for students to reflect on the people they are becoming.

Particular impacts of an internship scheme for all the stakeholders, based on the practice at the NKU and findings of the relevant studies on the literature are given as follows:

On the Students :

- Increasing understanding of classroom theory through practical experience
- Having an early opportunity to select the most suitable sub area of the major engineering discipline
- Gaining major-related work experience prior to graduation
- An opportunity of building up self confidence in a working environment
- Increasing the chance of employability for the current employer just after graduation.
- Earning an industry oriented engineering diploma which is highly valued by potential employers.

On the University and academic staff :

- Establishment of a continuous relationship and contact with many companies
- Improved relations with the sector companies and technical experts
- Having an opportunity to conduct joint projects with industry
- Enhancement in the department curriculum and practical training
- Improved reputation of the department and the university
- Potential of increasing the quality and quantity of incoming students

On the partner Companies :

- Utilization of extra skilled labour force
- Having an opportunity to conduct joint projects with university
- Recruiting potential employees
- Improved relations with the university
- Collaboration in enhancing the qualifications of potential engineering graduates

Suggestions for Planning an Internship Scheme for Engineering Education

The transition from university to an engineering career is critically important and highly complex for engineering graduates. Succeeding in this transition is not only a matter of finding a job; it is also a matter of functioning intelligently in a world in which the culture, behaviors and rewards are new for them. As stated by Gower and Mulvaney (2012) in a systematic approach for students to make the most of their internship experience, the attitude of students are very critical. If students do not approach the internship experience thoughtfully, understanding communicating their personal and professional goals, and recognizing the needs and goals of the other parties involved, it is likely that they will be less than satisfied at the conclusion of the internship.

A very recent research report by Hora and colleagues (2017) on "What do we know about the impact of internships on student outcomes?" reviews the present literature work and current practices. The key findings of this work are listed in seven headings. These seven key issues are given as the lack of rigorous field studies on student outcomes; a detailed and standardized definition for what constitutes an "internship" experience does not exist, the evidence is mixed regarding the effects of internships on employability over the long-term and little research exists about the effects of internship experiences on wages; few studies examine the relationship between the design characteristics and student outcomes; the importance of careful planning, institutional support systems, coordination between academic programs and job-site mentors, a large "stable" of employers willing and able to host interns, and careful attention to legal and ethical issues; Scaling up of internship programs should ensure adequate staff, funding, and willing participants are in place before creating internship programs at scale; the field needs rigorous mixed methods longitudinal studies that examine the impacts of specific internship characteristics on a variety of student outcomes.

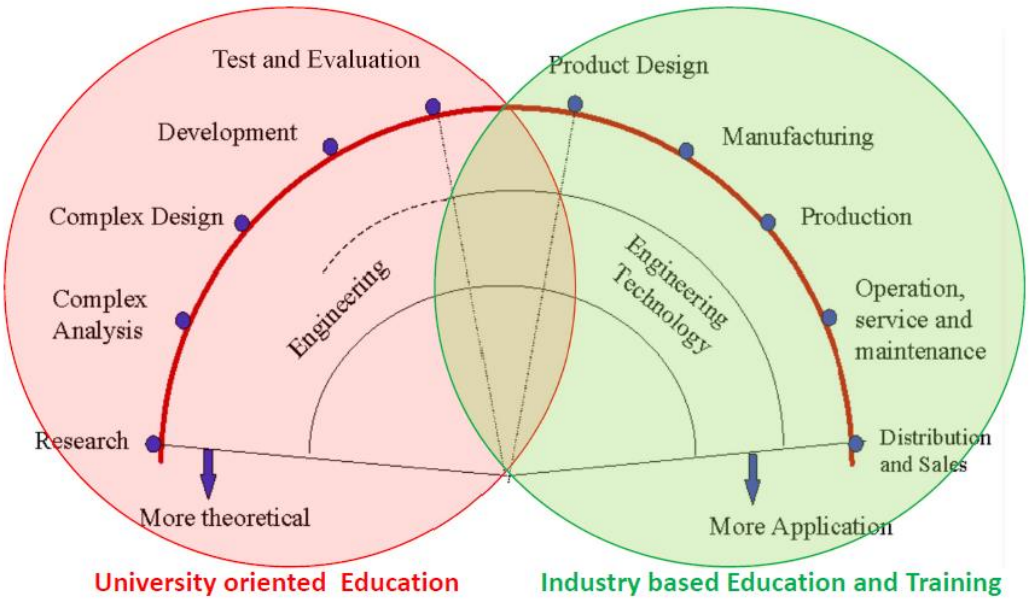

Figure 1. A comparison of the content of university and industry oriented education and training

Basic challenges and difficulties of the internship practice are usually dependent on the common understanding of the principles of the proposed scheme and the perception of specific role of each parties. These common challenges are as follows:

- Lack of specific framework to standardize the training activities
- Unfamiliarity with the SIE programme for many companies
- Wide variation between the partner companies
- Difficulty in planning and conducting of joint projects
- Reluctance of industrial supervisor and other technical staff to disclose technical information
- Less spare time for intern students
- Risk of extending the education period for poor students
- Limitation of the days allocated to the university class rooms (2 days per week) in the case of the NKU
- Hesitance of the companies to pay certain pocket money

Obviously, it is the responsibility of the university to assess whether the educational objectives are met. Internships should never be just an accumulation of periods working in companies. The prime educational objectives in planning of an internship or sector integrated education are :

- It must be intimately integrated with the academic components of curricula. As seen in Fig. 1, industry oriented training sessions should incorporate the practical aspects of the engineering discipline and technology.
- Internships terms, conditions and objectives must be linked to the skills already developed by the students, and accordingly, subsequent academic periods must take into account the internship outcomes,
- As a consequence, internships can be either searched by the university or by the student (as it is also something to be learnt) but, in the second case, the university must also verify the content and interest,

- The academic supervisor of students must be regularly informed about the internship progression so that he/she can help him to get more profit of the experience, and correct the eventual problems which may arise,
- Additionally, it should be utilized as an excellent opportunity in order to develop industry-academy relation.

Conclusion

The success of the program depends on the availability of a well designed internship or co-operative education program model. This was confirmed by a report prepared by the Turkish Universities Board (ÜAK, 2016). The report commented the shortcoming of the present models of internships as they were not based on a systematic project approach, while the importance of industrial training for engineering education is emphasized. The level of co-operation and commitment displayed by internship students, partner companies and university academic staff also appear as very important factors. The critical success factors are;

- existence of an appropriate framework for the internship scheme.
- assignment of responsibilities for student involvement,
- commitment of academic staff, and
- support and capabilities of the partnering companies.

The involvement and competency of students as well as the supportive behavior and capabilities of the partnering companies outstands as important success criteria for the internship program. In conclusion, the educational goals of the such schemes should be based on the following points:

- Accomplishment of acquiring insight into engineering profession and applied technology
- Enhancement of learning to apply as well as broadening technical knowledge and skills.
- Developing a common understanding and communication between all parties
- Social/psychological goals for student interns to learn surviving in a different culture and work environment.

References

Baytiyeh, H & Naja, M ; (2012), ‘’Identifying the challenging factors in the transition from colleges of engineering to employment, European Journal of Engineering Education, 37:1, pp.3-14.

Bukaliya, R, ‘’The Potential Benefits And Challenges Of Internship Programmes In An ODL Institution: A Case For The Zimbabwe Open University, International Journal on New Trends in Education and Their Implications, January, February, March 2012 Vol: 3 Issue: 1.

Cooperative Education & Internship Association, Inc. History of Cooperative Education and Internships
Available from: http://www.ceiainc.org/about/history/

Doğdu, E (2010), Ortak Eğitim TOBB Ekonomi ve Teknoloji Üniversitesi Uygulamalı Eğitim Modeli Sunumu, Available from: www.ua.gov.tr/docs/erasmus-/13-calistay-staj-egitimi_tobb_etu.pdf?sfvrsn=0

Furco, A, Service Learning and School-to-Work; Journal of Cooperative Education, Vol:1, 1996, pp. 7-14.

Galvan J, Fisher E, Casman E and Small M (2013), Assessing the impact of mandatory internships on employability of recent college graduates in Mexico, Proceedings of the 2013 Conference for Industry and Education Collaboration, Session ETD 435, American Society for Engineering Education

Gower, R K, Mulvaney, M A, (2012), Making The Most Of Your Internship, A Strategic Approach, Sagamore Publishing LLC, Urbana, USA.

Groenewald, T (2004). Towards a definition for cooperative education. In R.K. Coll &. Eames (Eds.), International handbook for cooperative education: An international perspective of the theory, research and practice of work-integrated learning (pp. 17-25). Boston: World Association for Cooperative Education.

Haddara, M, Skanes, H; “A reflection on cooperative education: from experience to experiential learning”, AsiaPacific Journal of Cooperative Education, 2007, 8(1), pp.67-76.

Hora, M T, Wolfgram M and Thompson, S, (2017) What do we know about the impact of internships on student outcomes? RESEARCH BRIEF #2 Centre for Research on College to Workforce Transitions (CCWT) and University of Wisconsin-Madison Wisconsin Center for Education Research.

Mazumder, Q. H. (2013), Student Satisfaction in Private and Public Universities in Bangladesh, *International Journal of Evaluation and Research in Education (IJERE)*, Vol.2, No.2, June 2013, pp. 78~84.

McMahon, U, & Quinn, U; (1995) Maximizing the hospitality management student work placement experience: A case study. Education and Training, Vol:37, p.13-17.

Mengoni, L & Sami, MG; (1998) Cooperation Between University and Industries in Organizing a 'Diploma Universitario' Curriculum: The Politecnico di Milano-Assolombarda Experience, European Journal of Engineering Education, 23:4, pp. 423-429.

Nasr, K.J., Pennington, J., & Andres, C. (2004). A study of students' assessment of cooperative education outcomes. Journal of Cooperative Education, 38(1), 13-21.

O'Neill, N, (2010) "Internships as a High-Impact Practice: Some Reflections on Quality", Peer Review, Association of American Colleges & Universities, Fall 2010, Vol. 12, No. 4.https://www.aacu.org/publications-research/periodicals/internships-high-impact-practice-some-reflections-quality

Ozek, H Z (2010), Çerkezköy'de Üniversite, Kent Ve Sanayi Etkileşimi, Çerkezköy Değerleri Sempozyumu Kitapçığı, 20 Ekim 2010, pp.100-116.

Ozek, H Z (2016), Benefits And Challenges Of Internship Programme In Textile Engineering : A Case For NKU, 16th AUTEX World Textile Conference, June 8–10, 2016, Ljubljana, SLOVENIA.

Richardson, J. T. E. (2005), Instruments for Obtaining Student Feedback: a Review of the Literature, *Assessment and Evaluation in Higher Education*, Vol. 30, 2005, pp. 387-415.

Rompelman, O & De Vries, J; (2002) Practical training and internships in engineering education: Educational goals and assessment, European Journal of Engineering Education, 27:2, pp.173-180.

Ruffalo Noel Levitz (2017), 2017 National Student Satisfaction and Priorities Report. Cedar Rapids, Iowa: Ruffalo Noel Levitz. Retrieve from RuffaloNL.com/Benchmark.

Smith, N & Monk, M; (2005), ''An evaluation of the impact of a Year in industry scheme', European Journal of Engineering Education, 30:2, 2005, pp. 181-190.

Sovilla, E S, & Varty, JW ; (2004) ''Cooperative education in the USA, past and present: Some lessons learne'', International handbook for cooperative education: An international perspective of the theory, research and practice of workintegrated learning R.K. Coll &. Eames (Eds.), Boston: World Association for Cooperative Education pp. 316.

Tackett, J, Wolf, F, Law, D ; (2001) Accounting interns and their employers: Conflicting perceptions. Ohio CPA Journal, 60, pp.54-56.

UAK (Üniversiteler Arası Kurul) (2016) Türkiye'de Mühendislik Eğitim-Öğretiminin Niteliğinin Geliştirilmesine Yönelik Öneriler, Analiz, Şubat 2016 Sayı:1.

University of Cincinnati (2017), Un. Of Cincinnati Clermont College - SSI - 05/2017 Ruffolo Noel Levitz Student Satisfaction Inventory. Available from: http://www.ucclermont.edu/content/dam/clermont/Institutional%20Research/University%20of%20Cincinnati-Clermont%20College%20-%20SSI%20-%2005-2017.html

Author Information

H. Ziya OZEK
Namik Kemal University, Corlu Faculty of Engineering
Silahtaraga Mah., Corlu, 59860 Tekirdag, Turkey
Contact e-mail: zozek@nku.edu.tr