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PERFORMANCE AND FAILURE IN GEOTECHNICAL PRACTICE: A TEACHING TOOL IN CIVIL ENGINEERING

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ABSTRACT: This work introduces a novel teaching model that pairs graduate students with experts and engineers from both academia and the geotechnical industry. It was proposed to hold regular gatherings to talk about and share ideas regarding failures, malfunctions, and performance of structures found on difficult soils. Issues related to failure in the construction industry are frequently reported in practice. A three-to-five-hour sessions covering a specific problem or case study failures were suggested as a contact period to expose graduate students to the prevalent difficulties identified in geotechnical practice. A research unit created a geotechnical evening series, which is held once or twice a year. It is anticipated that exposure to real-world geotechnical issues and failures will heighten consciousness and instruct future engineers on how to prevent or address typical malfunctions and failures. Targeted objectives include the ability to predict failures related to materials and structures, the ability to evaluate the level of risk based on available data, and the development of good communication skills. A learning model is suggested to be developed as an educational civil engineering course based on typical gatherings. Direct and indirect assessment methods are proposed as guidance. Participant satisfaction score levels were reported as good to excellent.

Keywords: Geotechnical, Engineering practice, Graduate students, Failure, Education.

1. INTRODUCTION

Failures and sustainability in geotechnical engineering are currently emerging as an issue of concern in the construction industry. Studies of performance and lifetime span are linked closely to parameters defined and assessed by geotechnical engineers. Von der Tann [1] stated that the Norwegian Geotechnical Institute (NGI) posed the fundamental topic of how sustainability relates to geotechnical engineering to a group of geotechnical professionals. Based on the survey results, several viewpoints on sustainability in geotechnical engineering were analysed using the mixed-methods approach known as the Q-methodology. Wang [2] presented topics of relevance to geotechnical sustainability which included maximizing the bearing capacity of rock and masses and reducing the quantity of carbon-emitting building materials, like concrete and reinforcement [3, 4]. Driving the bearing capacity to its maximum is a challenge that is likely leading to failure. The current study is addressing a new learning approach targeting a better understanding of geotechnical performance and design.

Graduate or final year students need to be informed about the problems and failures that frequently occur in practice. Highlighting these threats to the students is an eye-opener on possible risks likely to occur when they are part of the workforce. They also need to be aware of the consequences of failure and/or malfunctions taking place from time to time. At present, many statistical tools can be used to introduce and evaluate the probability of failure and risk conditions. The engineer needs to be prepared to tackle such events when they occur, no matter how low the risk or how insignificant the probability of failure is. Utilizing professional experience in teaching has been performed for many years, but formal proposals based on modern teaching methods only appeared during the last decade of the twentieth century [5].

Kumar [6] developed a detailed proposal for a course related to geotechnical practice. This proposed course is aimed at training students and preparing them for practice. A 3-hour credit course is offered by Southern Illinois University at Carbondale (SIUC) to enable students to deal confidently with challenges in professional practices. He suggested the course format to be taught in groups, and projects carefully selected to reflect the complexity level for newly appointed engineers.

Shivashankar [7] stated that case histories in geotechnical engineering play a positive role in teaching the subject and enhancing practice. He selected several case histories to demonstrate a different way of teaching geotechnical engineering, unlike what he called the “chalk and talk” method of teaching. Akili [8] suggested that teaching case studies will provide a better understanding of engineering subjects.

A risk reduction strategy is always employed, particularly when the probability of failure is high. The use of extra conservative safety factors is not always a wise approach. The engineering control bodies tend to apply specifications and requirements in order to assure safe construction. In some cases, these requirements add huge unnecessary cost. High-quality concrete, normally specified for long-term strategic projects, is sometimes adopted by local bodies for temporary or routine construction or less critical structures. Using unnecessarily high safety factors can have a serious and negative impact on the overall cost for private and/or public funded projects to the point of making them economically unfeasible. Increasing the safety factor approach can allow for a safer design, but it will let the public funds suffer or go towards bankruptcy. Engineers need to be taught how to balance their decisions. If risk can be identified and estimated, it can then be controlled. In some cases, it may be possible to accept the risk rather than adopt an alternative, expensive choice. Awareness of how to identify and estimate risk issues is of great importance to practicing geotechnical engineers. It is difficult to figure out what can go wrong among numerous uncertainties in a particular project. Establishing methods and tools for decision making when important risks are determined is a proper approach for risk management.

Function and performance can be obtained at variable cost. Suitably selected safety factors against failure need to be considered to optimize the size and extent of engineering projects. A focus on damage caused by expansive soils has been noted in recent decades, and many publications and research work have been conducted within this area. Typical geotechnical failures are presented in Fig. 1, 2 and 3. Fig. 1 shows the failure of a boundary wall. This is typical for light structure placed on highly plastic soils. Fig. 2 shows failure of a building caused by uplift forces resulting from wetting expansive soils. Fig. 3 presents a typical form of distress in roads and pavements. The famous Shanghai building collapse shown in Fig. 4 shows a failure of a multi-story apartment building and is considered a good example to be used as an assignment for capstone projects. It is important for engineering students to study past failures, and research to document how this impacts their careers.

This article is focused on geotechnical engineering and a new style teaching model that expose students to practical experience as part of their curriculum. The main goal of this program is to enable students to understand failure problems related to geotechnical engineering. Targeted objectives include the ability to predict failures related to materials and structures, the ability to evaluate the level of risk based on available data and development of good communication skills with colleagues, instructors and senior engineers already in practice. This idea is suggested for the civil engineering discipline and can be utilized to support final year capstone projects. Seven geotechnical evenings were held during the period from 2011 to 2018. Instructors from academia and practice joined this trial and introduced valuable lectures and information. The idea attracted the attention of concerned engineers and became a recognized event. The subject of the event can vary with the nature of the speciality, the speakers and challenges related to a local practice. Failure case studies were the most relevant to this program. It is proposed to improve this education model by strengthening the students with back analysis procedures and lessons learned from failures. The professional risk management knowledge is also suggested as an efficient tool for better practice.

2. RESEARCH SIGNIFICANCE

This study presents an innovative proposal for a model course aimed at enhancing the understanding of geotechnical performance and failures for graduate students. By integrating industry practitioners, the course bridges academic learning with real-world experience, offering a rich, practical perspective through case studies. The suggested four learning outcomes are designed to be adaptable across various engineering programs, ensuring broad applicability. The teaching approach combines traditional lectures with interactive workshops and discussion groups, fostering deeper engagement and critical thinking. This novel approach not only equips students with essential technical knowledge but also emphasizes the importance of industry collaboration in shaping future professionals.

3. IMPACT OF FAILURE STUDIES AS A NEW TEACHING METHOD.

Wesley [9] is of an opinion that the conventional geotechnical engineering teaching is unsatisfactory and not developing enough concepts and principles. Moreover he observes that too much time is spent on methods and definitions which he considers to be a detriment to the student's education. Wesley wants students to be equipped with thinking tools when they are in the workplace. This can be achieved by learning and relearning aspects beyond the basic conceptual and theoretical backbone of the subject.

Kumar [6] went a step further in setting objectives of a course to be taught to undergraduate students. Measurable objectives included application of geotechnical engineering in a real-world setting with proper planning and quality management. The more important objective set by Kumar, which is relevant to this study proposal, is the application of professional liability, risk assessment and management, in addition to loss prevention.

Possible failure risk in geotechnical engineering field can be presented in two groups. The first one covers externally caused failures resulting from natural dynamic forces, flooding and loss of support and wind forces in addition to exposure to adverse environment. Exposure to temperature and rain and activities in close vicinity can all be classified as external factors. The second group is internally caused failures related to material and structural performance. This includes excessive settlement or heave, pull-out of foundations, shear failure and yielding of the substrata.

Back analysis procedures are often used in slopes and shear strength failures. It can help in estimating the soil mass properties along failing planes. Back calculation of shear strength provides reliable source of geotechnical parameters that can be used in validation of stability analysis [10]. The back analysis is not only limited to slopes and shear strength failures. Areas known of expansive soil problems can be surveyed for structures subjected to damage in order to establish the critical loads. Performance based analysis survey for Al Ghatt region conducted by Dafalla and Al-Shamrani [11] is an example. Survey of failures due to earthquakes can also provide valuable information on the structural frames suitable for specific earthquake magnitudes.

4. GEOTECHNICAL EVENINGS AS A TEACHING MODEL

A research unit in the civil engineering department of King Saud University suggested a new model of knowledge transfer which included graduate students and a few geotechnical researchers. This group meets in a formal setting with geotechnical engineers practicing in the private and public sector of Riyadh, the capital of Saudi Arabia to discuss failures and assessment of geotechnical malfunction in various projects. The term Geotechnical Evenings comes from the time this activity is normally held.

The evening topics were carefully selected to match problems of interest in Saudi Arabia and worldwide. It is designed such that invited speakers from the practice or academia present case studies related to failures or malfunctions or basic principles for safe and secure design. Table 1 shows attendance over seven cycles of the model. The attendance and contributions from public and private sectors was significant. Association with practice experts and academic staff and students is a key factor driving attendance. Networking and meetings are likely to introduce new opportunities for all participating.

The subjects involving real projects and challenges attracted the attention of students, researchers and practitioners. This typical setting is suitable to award continuous professional development hours known as CPD and normally required by the Saudi Engineering Council. These are aimed at improving knowledge and skills of registered engineers. This type of program also helps graduate students increase their self-confidence thus requiring less supervision when they join the workforce, as well as boosting their job satisfaction. Involving professionals with diverse backgrounds in the program is a source of strength where each party is eager to gain from the encounter and experience of other colleagues.

Expansive soil failures were among the dominant topics discussed. Light structures founded on moderately to highly plastic clay showed several types of failures/malfunctions ranging from vertical displacement and cracking to toppling. Repairs and maintenance costs due to expansive soil damage amount to millions of US dollars annually in Saudi Arabi alone [12]. Most failures related to expansive soils were presented by the author of this article. After serving two decades in practice and being involved in many strategic projects of Saudi Arabia, the author, joined academia as a research professor and published extensive studies related to expansive soils. Safety factors and design of retaining wall structures in restricted conditions were discussed by a faculty from a Jordan University who joined practice after spending a decade as a professor. A well-known visiting professor from the University of Texas at Arlington presented a talk on the yield of soil under plate loading tests. The studies on the behaviour of bentonite enhanced sand at different void ratios and stress partitioning is covered by a senior lecturer invited from the University of Leeds, United Kingdom. King Abdulaziz City for Science and Technology covered the topic of cavities and cavity detection using geophysical method. Two senior staff members surveyed the procedures of common geophysical methods. Graduate students presented their works and findings related to various topics including characterization and treatment of expansive soils using cutting edge instrumentation made available by King Saud University. Axis translation technique and soil water characterization curves and multi-dimensional testing of expansive soils are among the topics discussed. Practicing engineers presented on several articles and field situations. These are only examples of the subjects discussed. Fig.5 is a schematic presentation for association and joint program feeding and learning for the three groups involved in this experiment.

As graduate students were mainly targeted by this program, the methodology of their presentations is oriented towards evaluation of expansion mechanism and treatments of expansive soils to avoid failures/malfunctions. Expansive soils are the cause of severe damage to many buildings and infrastructure projects in Saudi Arabia.

The activities of each event included introduction of the invited speaker and brief information on the subject of talk. A detailed program prepared prior to the event specifies time slots for presentations and discussion. Short breaks between different sessions were allowed for free networking between attendees. The environment is similar to technical conference settings. A session chair is asked to run and control times for presentations, questions and comments. The chance was open for students to raise any issues to the invited guest or presenter. It can be very constructive in the future to set some outlines for speakers so that knowledge and skills are transferred in an educational context. Interactions and feedback procedures during learning will help in achieving goals and objectives of the course.

5. DEVELOPING THE ACTIVITY AS AN ELECTIVE COURSE

5.1 General

In order to develop a course that is of potential importance and significance to a program it is usually designed to include a course learning outcomes, teaching strategies and assessment methods. The current idea of converting an evening activity to a recognized course tailored to align with a specific engineering program is novel and can add real-life practical elements, case studies, and the expertise of local practitioners to the senior level graduate students.

Teaching strategies can be listed as lectures, workshop style events and groups discussion platforms.

Course learning outcomes can be stated in the specification to support knowledge, application and creative thinking. Examples of course learning outcomes can be:

CLO 1: Recognize the nature, in-situ subsurface conditions and classification systems showing issues affecting the function and design of the intended facility..

CLO 2: Assess engineering parameters used in the design of a facility or a project for integrity and stability.

CLO 3: Apply gathered information to design and develop creative solutions for the proposed facility.

CLO 4: Propose and design improvement techniques for better stability and analyze relevant parameters.

5.2 Indirect Assessment

A questionnaire can be designed and proposed for distribution to the event participants in order to provide an indirect assessment of the outcome and evaluate the program. Several bar diagrams can be presented to show the response of attendees. Participants are asked to select a number from 1 to 5 for each question of Table 2. Numbers are coded as weak(1), acceptable (2), good (3), very good (4) and excellent (5).

This is intended for checking satisfaction five areas. These areas included general evaluation, contacts with practice specialists, discussion, learning and skills development. Table 2 presents the typical questions need to be asked when establishing similar program. The questions need to be designed based on Table 2 outlines and can be mapped to the three main goals and objectives:

- The ability of students to understand failures.
- The ability to evaluate the level of risk based on the available data
- Development of good communication skills.

Set 2 questions (learning elements) are linked to the ability of the students to understand failures. These are:

- The program provides a suitable learning content easy to remember and understand.
- The program helps in developing critical thinking.
- The program involves problem solving cases.
- The program provides an application for general theories.

Set 3 questions are related to contacts with practice specialists. In set 4 a single question in (extra skills) is linked to the ability to evaluate the level of risk stating whether the program helps in handling problems, failures and case studies. In set 4 questions 1 and question 3 are linked to the third objective concerned with development of good communication skills. Set 5 all questions are related to discussion issues. Some questions are made to address secondary objectives.

The above are all related to the indirect assessment.

Table 1. Geotechnical evening’s attendance over seven cycles.

Attendees	Graduate Students	Acade-mia and Resear-chers	Private Sector Practice	Public Sector Practice
First GE	3	4	19	3
SecondGE	3	4	14	3
Third GE	3	5	13	1
FourthGE	5	6	18	2
Fifth GE	5	4	15	3
Sixth GE	3	5	14	1
Seventh GE	4	4	15	2

5.3 Direct Assessment

Direct assessment of this proposed teaching model can be performed for students involved based on the gain of knowledge and skills achieved.

Table 2 - Evaluation of Geotechnical Evening Series Program run by King Saud University, BRCES, Civil Engineering

Elements for General Evaluation 1. The subjects discussed in the evenings program is relevant to practice and industry 2. The level of subject is equal to or comparable to current geotechnical practice. 3. The attendees are from the right fields related to geotechnical and geological engineering 4. The time frame of 3 to 5 hours in the evening is appropriate.	**Learning Elements** 1. The program provides a suitable learning content easy to remember and understand. 2. The program helps in developing critical thinking. 3. The program involves problem solving cases. 4. The program provides an application for general theories.
Specialists. Contacts with Practice 1. The invited speakers are qualified enough. 2. The contents presented by the practice and industry are relevant. 3. Contributors are known in the industry. 4. The public sector contributions are satisfactory.	**Extra Skills** 1. The program provides opportunities to talk to senior staff. 2. The program helps in improving presentation skills. 3. The program strengthens communication skills. 4. The program helps in handling problems, failures and case studies.
Discussion of Topics 1. The time allocated for discussion is reasonable. 2. The time shares of discussion between academic and practice are well balanced. 3. The discussion level is appropriate to all attendees. 4. The student contribution in discussion is encouraged.	

Learning objectives were outlined in this proposed course. Assessment methods can take the form of allocating brief projects involving challenge and solutions. Quiz system approach may be followed to assess the application of knowledge and critical thinking. Like all other courses, this elective course can be monitored and improved over time using assessment results and survey feedback records. As the contributions of students were made in the form of presentations and discussion the assessment could be carried out for each individual to address their ability to predict possible failure and failure nature. The students also need to show the level of risk based on reasonable assumption or available data. Communication skills could be measured from oral presentation and response to questions asked. Other factors including clarity, language use and organization of ideas may be counted in the scoring system. Assignments can be added to the direct assessment methods. This can include presenting a report in a failure that took place in the real-life conditions.

6. COURSE CONTENT, CONTACT TIME AND ASSESSMENT SCORES

When designing a course based on this idea course content need to be clearly listed and must be related to the disciplines of relevant. Materials from geotechnical, structural and other engineering disciplines can be combined to form the list of topics that must be associated with any presentation. For example:

- Scope and applications of failure mechanics, Classification methods, Issues and problems related to failure mechanics.
- Presumptive capacity for a range of different material.
-General stability and issues of landslide, modes of failure, methods of analysis.
-Prevention and control of failure.
-Instrumentation for monitoring and maintenance.

The contact time need to be specified in terms of learning hours. The overall time need to assure a minimum of 45 to 60 hours including assignments. The assessment scores can be divided to consider contribution and discussion groups as 20% evaluation of the instructor as 20%, the assignment project as 60%. These figures are given as guidance and can be altered to suit the teaching strategy followed.

7. RESULTS AND DISCUSSION

The first trial conducted by King Saud University in Saudi Arabia included a series of events made together to combine acadamia with practitioners from different sectors of engineering profession. This included governmental bodies, private consulting and contracting firms. Invited speakers included international contributors from the United States of America and the United Kingdom in addition to instructors from King Saud University and local practice.

Delegates from the public sector included King Abdulla City for Science and Technology (KACST), Minstry of Education, Bugshan Research Chair in Expansive Soils and King Saud University. International firms included Saudi Arabian Dames and Moore (URS, Dames and Moore). Saudi Arabia firms included: Dar Alkhaleeg, Arab Centre for Engineering Services, Saudi Lab company, Riyadh geotechnical company (RGF), Nizar Kurdi Consulting Engineers, Omar Jazzar consulting engineers((OJZ), Geotechnical testing centre (GTC), SAFCO, Saudi Bin Laden Contracting Co. Fad Company.

Typical articles presented included variable topics. The followings are examples of the titles presented:

- Failures related to expansive soils: Characterization and Foundation Design Practice in Expansive soils (Anand Puppala). Prof. Puppala is a distinguished expert and scientist from Texas A&M University, United States. His research interests include sustainability in geotechnical engineering, expansive and unsaturated soils in addition to pavements geotechnics. Some of his relevant publications include [13, 14, 15, 16]. Prof. Puppala addressed the approach slab safe design and the collapse of pavements due to high sulfate content soils.
- Failures related to lateral Soil Resistance: Lateral Earth Pressure - Special Applications (Amgad Al-Barghothy). Dr. Al-Bargousthy is a practitioner in geotechnical engineering from Jordan and running a well-known firm operating in the Gulf and Middle East known as Arab Centre for Engineering Services.
- Failures Related to Expansive Soils: Design of stabilizers for expansive soils by inclusion of clay mineralogy aspects. (Prof .Anand Puppala).
- Innovative Scheme for Evaluation of Soil Induced Stresses in Settlement Computations (Mosleh Ali Al-Shamrani) Prof. Al-Shamrani is a professor in geotechnical engineering in King Saud University and the supervisor of the Bugshan Research Chair in Expansive Soils. Prof. Al-Shamrani conducted numerous studies that involve the bearing capacity and settlement of clays. His research of interest of soil-structure interaction and unsaturated soil behavior was found very relevant to the content of this event. Some of his publications include [17, 18, 19].
- Behavior of Bentonite Enhanced Sand (Dr. Terry Cousens) [20, 21].Dr. Cousens is a senior lecturer from the University of Leeds. United Kingdom.
- Assessment of ground: Geophysical Methods (Fouzan Al-Fouzan). Prof. Al-Fouzan is a lead researcher in King Abdulaziz city
- Geotechnical Awareness In KSA, Where Are We Now. (Ahmed Al-Qasabi). Dr. Al Qassabi is a Deputy CEO of Al-Qasabi Cont. Co. and very much involved in the practical assessment of damage related to subsurface ground conditions. Dr. Al-Qasabi obtained his PhD from University of Colorado at Boulder (USA)
- Collapsible Soils: Theory and State of Practice (Tamer Al-Kady). Dr. Elkady is from Bugshan Research Chair in Expansive Soils.
- Failure case studies from the Kingdom of Saudi Arabia (Muawia Dafalla). Prof. Dafalla works for Bugshan research Chair in Expansive Soil in King Saud University. Joined academia after 25 years as practioner and consultant in the geotechnical field. He is also the lead of the geotechnical evening events run by King Saud University.

Many other topics related to failures and collapse was presented by engineers, researchers and graduate students in addition to some invited speakers. Prof. Arif Moghal (NIW- India), Eng. Omer Jazzar (CEO Al-Jazzar). Eng. Khalid Al-Mutairy (KACST) Eng. Karman Shafeeq are among presenters.

Table 1 presents geotechnical evening's attendance over seven cycles showing the number of graduate students, academia and researchers, prive sector engineers and public sector engineers.

The outcome of the feedback from attendees was found to be very positive with regards to the goals and objectives set out for this particular learning model. At the end of the seventh event eighteen responses were categorized in three different groups representing graduate students, academia and practicing engineers. The response sorted as average is presented in bar diagrams with break down representing each group in Figures. 6, 7, 8, 9 and 10.

The results and feedback was very encouraging and the general satisfaction is observed from all participants. It can be noticed that the graduate student's scores were higher with regard to general evaluation, contacts and skills developments, indicating a higher level of satisfaction with these aspects of the program. However, graduate students were expecting this model to include more discussion and learning as problem solving and applications.

Very high support was observed for the subjects discussed and their level of competence. Participants ranging from geotechnical engineers to geologists, as well as from the private and public sectors were all well received. The score levels were greater than 3.5 for all questions in the first category group except for the time allocated for this activity. Academia and research staff scored less than 3.5, suggesting more time be allocated.

Invited speakers and content of talks presented by the practicing professionals were all well received. However, more contributions from the professionals outside academia were recommended, especially from the public sector. Good scores (in excess of 3) were reported for the time allocated for discussion and time shares of discussion between academic and practice groups. The discussion level was appropriate to all attendees and more student contributions in discussion were encouraged.

All participants agreed that the program learning content is easy to remember and understand and it helps in developing critical thinking. The program involvement in problem solving cases and applications of general theories were considered good. The average score for presentation skills and opportunities to talk to senior staff was between very good and excellent (4 to 5). The program strengthens communication skills and helps in handling problems, failures and case studies.

As this program is mainly aimed at preparing students, we can confirm that all participating students benefited from this program, as evidenced by the good scores from answers to the questionnaire survey for this new proposed model.

Direct assessment proposals can include queries from instructors at the end of each event to assess the percentage of knowledge attained and how this is linked to the overall program goals. The direct assessments shall cover all relevant CLOs and correctly mapped to the program PLOs. As this work is only a trial no direct assessment is performed for the seven events conducted. For the future assessment system a feedback is required at the end of each event and overall average can be computed to evaluate the proposed course. Number of events need to be set for the course completion. This can be worked out considering contact time, study time and time for projects and presenting the material.

Traditional teaching methods in geotechnical engineering lack the opportunity for hands-on learning and field experience. Courses geared for academic knowledge typically provide insufficient preparation for real-world challenges. The proposed present teaching model can facilitate the exchange of experiences with complicated geotechnical challenges and their solutions. Failures can teach useful lessons to both practice engineers and students. Failure cases can enable back analysis and adjustment of theoretical safety factors generally used in geotechnical computations. There are many local and international cases that might be of interest to investigate.

Fig. 1. Damage caused by expansive soil in the eastern province of Saudi Arabia.

Fig. 2. Damage caused by expansive soil in Tabuk Northern parts of Saudi Arabia.

Fig.3. Road damage caused by expansive soil in central Saudi Arabia.

Fig.4. Shanghai Building Collapse

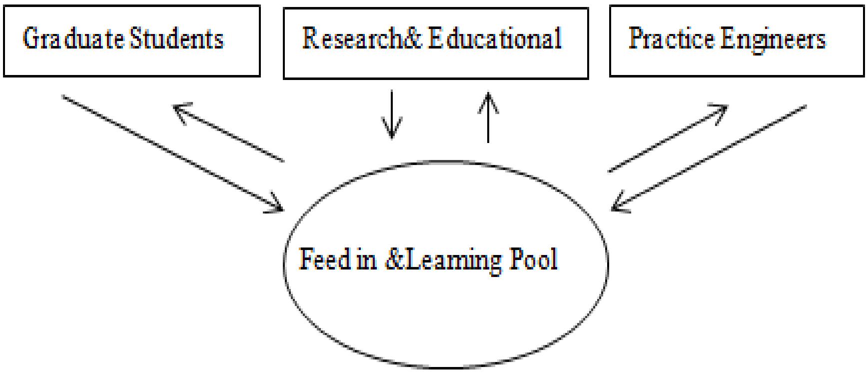

Fig. 5. Targeted Association

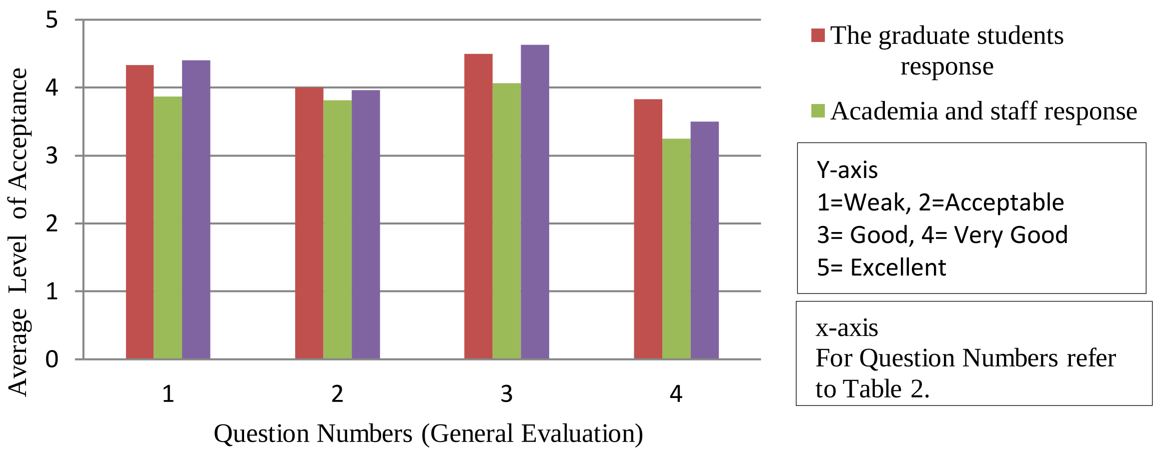

Fig. 6. General Evaluation

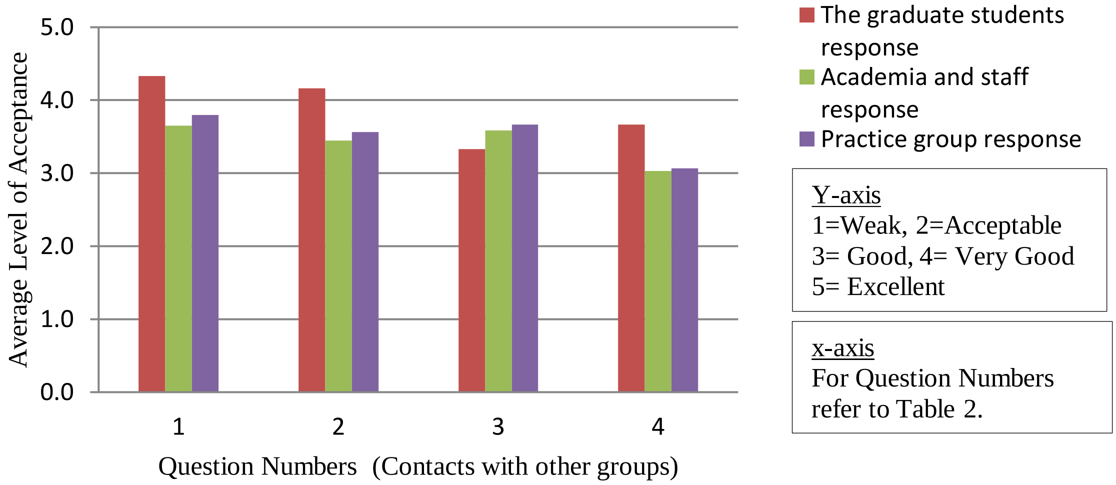

Fig.7 Contacts with practice specialists

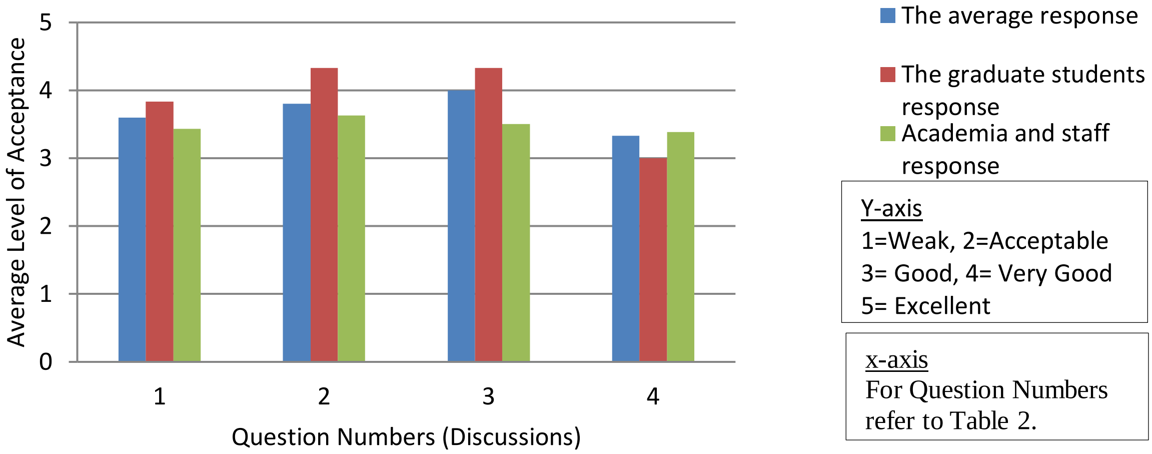

Fig. 8. Discussion of topics

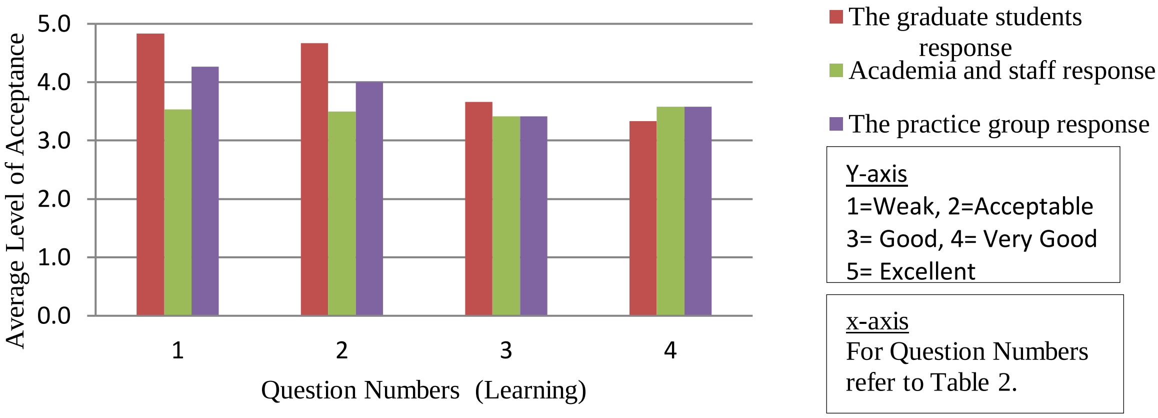

Fig. 9. Learning elements

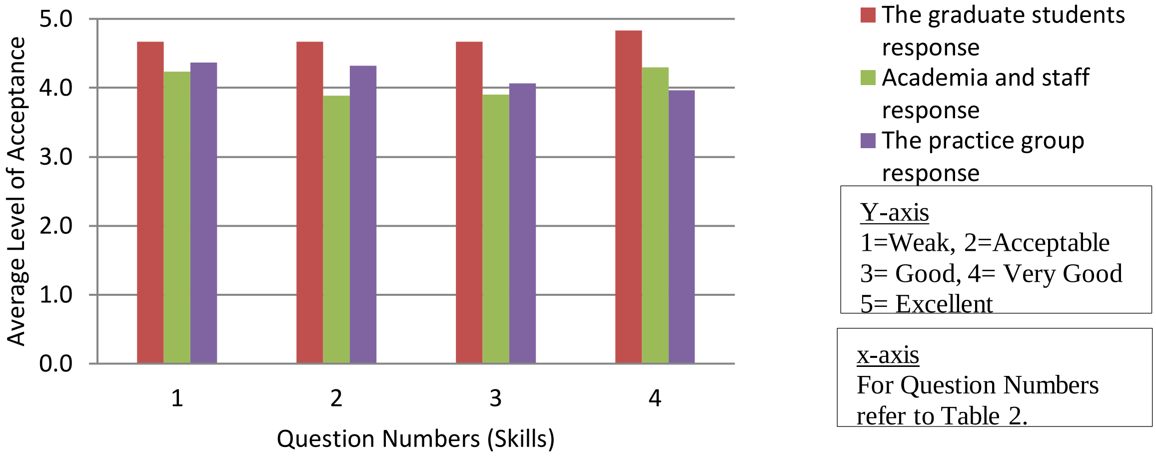

Fig. 10. Extra skills

8. CONCLUSION

A periodical event in which students utilize the knowledge of experts and practitioners was introduced as a new learning model.

For students approaching graduation in engineering, conventional teaching may not be efficient without considering an innovative tool for familiarizing and preparing them for engineering practice. Creative methods to involve students in serious topics include presenting courses that help them analyse, think and create links logically to arrive at well-built conclusions. Topics like failures, risks and consequences attracted attention of the students and encouraged them to increase awareness and avoid such unwanted situations. Students can learn how failure occurs and what forms of prevention or corrections can be made. This type of education was not aimed at gaining educational hours but introduced as elective or free practice learning in engineering. Participants gained good experience and developed professional networks that can help them in their career. A model presented in King Saud University demonstrated the benefits of this new learning tool, and resulted in satisfaction.

Feedback from students, practicing engineers and academic research staff resulted in good to excellent score levels (greater than 3.0 out of 5) for all questions in five different categories. These categories included; general evaluation, contacts with practice specialists, discussion, learning and skills development. It is recommended to look at the feedback and responses of different groups contributing to typical events with further details in repeated cycles in the future and this will enhance and improve the model. The potential limitation of adopting this course will be the availability of active practice and professionals within the vicinity of the academic institution.

9. ACKNOWLEDGMENTS

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