"Educate the Educators:" An International Initiative on Geosynthetics Education

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ABSTRACT: The International Geosynthetics Society (IGS) has introduced an international educational initiative to facilitate the exposure of geosynthetics, a comparatively new topic within geotechnical engineering education, to undergraduate civil engineering students. A significant hurdle to teaching geosynthetics in university curricula is that geotechnical engineering professors themselves may not have been exposed to the basics of geosynthetics. Consequently, as part of this program, participating civil engineering professors receive fellowships covering their expenses to participate in a workshop consisting of practical demonstrations, pedagogical material and technical documents. Key to the successful implementation of this program has been the participation of and coordination among the International Society, its national chapters and industry leaders who provide the global expertise, local educational framework and practical geotechnical input, respectively.

Keywords: Geosynthetics, Experiential Learning, Instructor Training, Undergraduate Education

1 Introduction

Facing ever increasing technical challenges and a vastly expanded technical base, civil engineering programs are confronted with a dilemma posed by the need to limit the range of material that can be covered while simultaneously meeting the needs of young engineers who should be able to integrate an often fragmented accumulation of analytical tools before confronting real projects as practicing engineers. This dilemma does not mean that new course materials cannot be incorporated into the curriculum. Indeed, new materials can and often must be included to ensure courses remain relevant and are effective. Geosynthetics constitute a comparatively new technology within civil engineering, and it has become essential that geosynthetic education be introduced at the undergraduate level and made broadly available to practicing civil engineers.

This paper documents and evaluates an international training program, "Educate the Educators (EtE)," aimed at providing Geotechnical Engineering university professors with the content and pedagogical tools needed to offer undergraduate civil engineering students ample exposure to geosynthetics. The goal of the EtE program, initiated in 2012 under the umbrella of the International Geosynthetics Society (IGS), is seemingly straightforward: To offer undergraduate civil engineering students a one hour-long exposure class on geosynthetics. Yet the goal, in its reach, is extremely ambitious: To offer this exposure class in fundamental, mandatory courses. The ultimate plan is that by the time she/he graduates, every civil engineering undergraduate student would have received basic exposure to geosynthetics.

As part of this program, civil engineering professors receive fellowships that cover their expenses to participate in a two-day workshop. Practical demonstrations, pedagogical material and instructional documents are provided to participating professors. Beyond covering the one hour-long exposure class

on geosynthetics, the EtE program also includes more advanced modules addressing the design of geosynthetics in geotechnical systems, such as retaining walls, embankments, roadways and waste containment. Educational outcomes of programs offered at present are being compiled and indicate a high rate of success in achieving the program goals.

2 Background

Over a half century has passed since geosynthetics were introduced; more than four decades since geosynthetics were widely adopted in separation, stabilization, drainage, wastewater and landfill applications (cushions and liners); and over three decades since the creation of the International Geosynthetics Society (IGS) on 20 November 1983 (Zornberg, 2013) and the publication of the first edition of the landmark textbook *Designing with Geosynthetics* (Koerner, 1986). A variety of geosynthetic products from dozens of manufacturers are available, as exemplified in the annual *Geosynthetics Specifiers Guide* (Industrial Fabrics Association International, 2019). Nonetheless, geosynthetics continue to be regarded as new products by many in the civil engineering industry, and familiarity with geosynthetics or geosynthetic-centric systems and their benefits continues to be limited.

This situation persists, despite (a) the decreased construction costs, the environmental benefits, and the schedule advantages facilitated by geosynthetics and (b) the availability of a wide range of products and a growing number of established design methodologies. The state of geosynthetic education is incongruous with its long history; the development of quality assurance test procedures, and ASTM International, CEN, ISO and other standards; availability of design manuals and training courses; and evidence provided by thousands of successful and varied geosynthetic-inclusive projects.

Why? One answer is education. And how should education on geosynthetics be delivered to capitalize on the benefits and cost savings that could be realized through increased geosynthetic use? The geosynthetics industry includes manufacturers, suppliers, contractors, designers, researchers and academics. However, there is consensus that the focus of the geosynthetics discipline should be on the academics that educate the next generation of engineers.

In its May 2010 meeting, the IGS Council concluded that considerable focus should be placed on geosynthetics at the undergraduate level. It was at this time that the objectives of what became the “Educate the Educators” program were established. The program’s overall goal is to “educate the educator” on how to introduce geosynthetics into undergraduate curricula as the comparatively new, promising technology they represent within civil engineering.

The inaugural “Educate the Educators” program was held in May 2013 in Carlos Paz, Cordoba Province, Argentina (Montoro, 2013). This first event was organized by the Argentinian chapter of the IGS, with the support of the International Geosynthetics Society and in cooperation with the Argentinian Society of Geotechnical Engineering. The event brought together 40 professors from 18 different Argentinian universities, representing 19 different cities across the country, and received sponsorship from industry to cover attendees’ travel costs. Participants were chosen from an initial list of 70 professors interested in the course. The selection criteria involved a professor’s age, experience, maximum academic degree reached and geographic diversity. In this way, middle-aged professors with an MSc or PhD degree were preferred and at least one professor was selected from each university represented in the applicant pool to facilitate the geographic spread of the course.

Since the inaugural program in 2013, 15 subsequent EtE programs have been conducted to date (October 2019) and at least four additional EtE programs are scheduled in the next 12 months. Figure 1 shows the locations of EtE programs completed to date and those planned in the immediate future. As the figure illustrates, 16 EtE programs have already been held in 14 countries across six continents (grouped in four IGS regional committees) and demand for the program has continued increasing. The evolution of the EtE program has been well-balanced geographically, which illustrates the significant interest in geosynthetics education worldwide and the motivation of the IGS chapters.

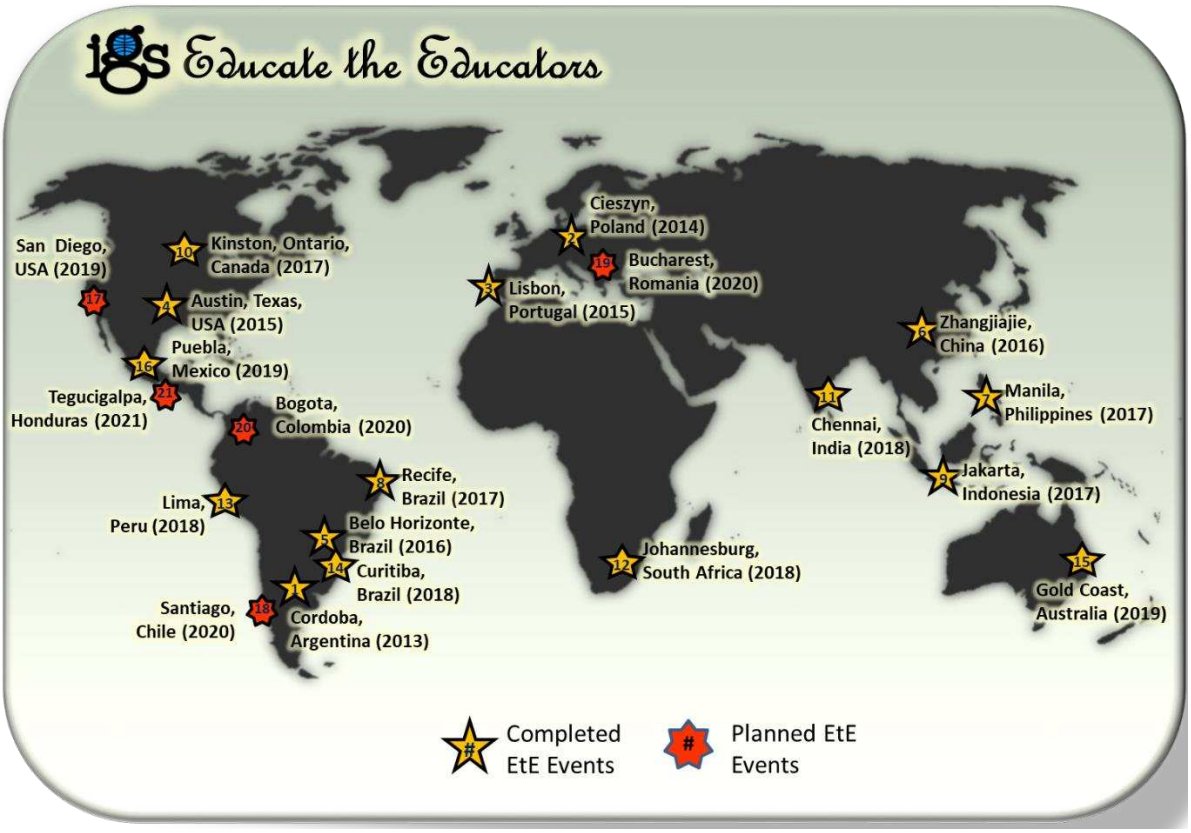

Figure 1. Geographic distribution of "Educate the Educators" programs conducted to date (October 2019) and planned within a 12-month period

3 Structure of the Educate the Educator Program

3.1 Objectives

A growing consensus within the geotechnical community is that focus on education should entail offering basic information on geosynthetics, even if just a single one-hour class within a four-year program, to *all undergraduate* civil engineering students. As a result, all future geotechnical, structural, environmental, transportation, construction and hydraulic engineers will, at the very least, have heard the term "geosynthetics" before they graduate. Providing basic exposure to geosynthetics for all civil engineering undergraduate students is an especially challenging task. Civil engineering programs, facing increasing technical challenges and a vastly expanded technical base, are confronted with a dilemma posed by the need to limit the range of material that can be covered while simultaneously meeting the needs of young engineers. Civil engineering students should be able to integrate an often fragmented accumulation of analytical tools prior to confronting real projects as practicing engineers.

While the overall objective of the EtE program is to "provide basic exposure to geosynthetics for all civil engineering undergraduate students" and focuses on students as the ultimate beneficiaries of the program, the specific objectives of each EtE event focus on the university professor as an attendee of the program. The specific objectives of each EtE event are as follows:

- Provide material for immediate implementation in at least one class on geosynthetics offered to all civil engineering students at the undergraduate level;
- Offer additional information on applications of geosynthetics for implementation in upper level undergraduate courses;
- Offer information that can also be used for advanced classes or graduate courses;
- Assess ways to implement the provided educational material in the classroom;
- Outline the foundation for curricular changes that include the teaching of geosynthetics.

3.2 Philosophy and Logistics

The philosophy of the EtE program is to facilitate the appropriate use of geosynthetics by significantly increasing geosynthetic education and exposure at the undergraduate level. Key to the success of the EtE program has been the framework offered by the IGS as the international learned society, which has not only provided the curriculum, but also facilitated a context for local participation. As previously mentioned, each EtE event involves a partnership between the international society and its national chapter, the local geosynthetics industry and national associations of civil engineering professors.

While significant emphasis has been placed on the development of educational material, equally significant emphasis is placed on its delivery, which should be conducted in-person (i.e. not virtually) to participating university professors. This is an important aspect, as, though it has been tempting to offer the EtE educational material via online platforms, the philosophy of the program is to offer it only in face-to-face forums that facilitate the experiential nature of the technical content. Doing so has allowed EtE educators to engage with learners (i.e. professors) in direct experience and focused reflection to increase knowledge, clarify values and facilitate discussion on curricular issues that often go beyond incorporating geosynthetics content.

In terms of logistics, the IGS provides funding to cover the travel expenses of the program instructors (typically three instructors). The responsibilities of the local IGS Chapter are to coordinate the activities and funding related to the event venue, compilation of educational material (e.g. geosynthetic specimens), promotion of the event, and conception and execution of the application process and selection of professors participating in the event. Lastly, funding for all local travel expenses for participating university professors are provided by the local IGS Chapter along with industry sponsors.

3.3 Educational Content

At the heart of the EtE program is the delivery of an educational program by geotechnical engineering experts to peer geotechnical engineering professors, the core of which was developed by the IGS using significant contributions from experts on each geosynthetic technical area. The actual content of each EtE program is tailored to fit the needs of the local chapter and capitalize as much as possible on the expertise of the geosynthetic experts delivering the program.

The length of previous EtE programs has usually been two days, with at least 16 hours of instructor contact.

The program of an “Educate the Educators” event conducted in Austin, Texas (USA) in 2015 is presented in Figure 2. A review of the program provided in Figure 2 reveals that the main objective of the entire event was to facilitate the incorporation of ONE class (at least) on geosynthetics. This one class was the focus of the entire first quarter of the two-day program offered during this EtE event. The remaining three quarters of the program aimed at providing additional geosynthetics background and motivation to engineering professors, many of whom were exposed to a formal training on geosynthetics technology for the first time at this event. While the remaining modules have varied among different EtE events based on local needs, a typical program includes four modules, which consider four typical undergraduate CE courses, as follows:

- Module 1: A typical “Geotechnical Engineering I” core class
- Module 2: A typical “Geotechnical Design” technical elective class
- Module 3: A typical “Pavement Design” technical elective class
- Module 4: A typical “Environmental Design” technical elective class

The introductory topics (Topics 1, 3, 6 and 9 in Figure 2) are delivered with a focus on didactics and are expected to illustrate the didactics and level of detail anticipated in undergraduate civil engineering courses. The topics identified as ‘advanced’ (Topics 2, 4, 5, 7, 8, 10 and 11 in Figure 2) are delivered at a higher level with a focus on technical content and are expected to illustrate the level of complexity that designers of systems using geosynthetics should achieve. The advanced topics are intended to highlight a few advanced aspects on geosynthetic design in each of the four modules and are not expected to provide a comprehensive treatise on geosynthetics. The discussions shown in Figure 2 are centered on the content, delivery and possible implementation of basic and advanced topics in undergraduate

curriculum. Finally, support activities, such as a workshop on identification of geosynthetic products and case histories, are included in the different modules of the program provided by EtE industry sponsors.

SCHEDULE: Tuesday, 28 July	
TIME	**ACTIVITY**
8:30 – 8:45	**Opening:** Welcome and Introductions
8:45 – 9:00	**Discussion:** Teaching geosynthetics in undergraduate classes. Objectives and philosophy of the "Educating the Educators" program
9:00 – 10:00	**Topic 1:** Introductory class on types and functions of geosynthetic materials
10:00 – 10:15	**Discussion:** Incorporating introductory GS class in UG courses
10:15 – 10:30	**Coffee Break**
10:30 – 11:30	**Workshop:** Recognizing different geosynthetic materials
11:30 – 12:30	**Topic 2:** Fundamental properties and related tests on geosynthetic materials
12:30 – 14:00	**Lunch:** Working lunch with group breakouts, networking and sponsor displays
14:00 – 15:00	**Topic 3:** Introductory class on geosynthetics for soil reinforcement applications
15:00 – 15:30	**Discussion:** Incorporating introductory GS class in UG courses
15:30 – 15:50	**Case Histories:** Presented by ETE sponsors
15:50 – 16:10	**Coffee Break**
16:10 – 17:00	**Topic 4:** Advanced topics on geosynthetic-reinforced soil walls
17:00 – 17:50	**Topic 5:** Geosynthetic-reinforced steep slopes
17:50 – 18:00	**Discussion:** Incorporating advanced GS topics in CE curriculum
18:00 – 21:30	**Technical Tour:** A teaching laboratory tour at the TRI facilities followed by dinner at Tres Amigos restaurant

SCHEDULE: Wednesday, 29 July	
TIME	**ACTIVITY**
8:30 – 9:30	**Topic 6:** Introductory class on geosynthetics in roadway systems
9:30 – 10:00	**Discussion:** Incorporating introductory GS class in UG course
10:00 – 10:20	**Case Histories:** Presented by ETE sponsors
10:20 – 10:40	**Coffee Break**
10:40 – 11:30	**Topic 7:** Geosynthetics for stabilization of unpaved roads
11:30 – 12:20	**Topic 8:** Geosynthetics for stabilization of paved roads
12:20 – 12:30	**Discussion:** Incorporating advanced GS topics in CE curriculum
12:30 – 14:00	**Lunch:** Working lunch with group breakouts, networking and sponsor displays
14:00 – 15:00	**Topic 9:** Introductory class on geosynthetics for environmental protection
15:00 – 15:30	**Discussion:** Incorporating introductory GS class in UG courses
15:30 – 15:50	**Case Histories:** Presented by ETE sponsors
15:50 – 16:10	**Coffee Break**
16:10 – 17:00	**Topic 10:** Calculating and minimizing leakage through composite geosynthetic liners
17:00 – 17:50	**Topic 11:** Factors affecting the service life of geosynthetic liners
17:50 – 18:00	**Discussion:** Incorporating advanced GS topics in CE curriculum

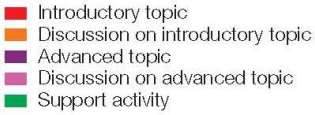

Figure 2. Example of an "Educate the Educators" program, with a focus on introducing geosynthetics in undergraduate civil engineering programs (source: EtE Austin, USA, 2015)

For each topic covered in the program, participating university professors receive course-ready notes (in print and PDF formats), PowerPoint slides, a binder of geosynthetic samples and supporting technical literature/references for each lecture. The lectures are provided in PowerPoint format, and attendees are allowed to use them as initially developed in their own classes or modify them as needed. However, the PowerPoint slides may not be circulated in electronic format to anyone (i.e. their use is exclusively for EtE attendees), nor may they be posted in this format for student access (posting in PDF format is acceptable, though).

4 Importance of the Framework Offered by a Learned Society

4.1 IGS Goals

The IGS is a learned society dedicated to the scientific and engineering development of geotextiles, geomembranes, related products and associated technologies. The core purpose of the IGS is to provide an understanding and promote the appropriate use of geosynthetic technology throughout the world. The vision of the IGS is that geosynthetics be recognized as fundamental to sustainable development by providing technological and engineering solutions to societal and environmental challenges. With this vision, the IGS can make a real contribution to a number of issues currently of concern around the world.

Key to the success of the EtE program has been the framework offered by the IGS, as the international learned society, which has not only provided the curriculum but also facilitated a context for local participation. Accordingly, each EtE event results from a local chapter initiative, which triggers the subsequent involvement of the IGS. The partnership involving the IGS, the local IGS chapter, the local geosynthetics industry, and national associations of civil engineering professors evolves with a clear understanding of the responsibilities of each group.

As previously emphasized, involvement of the local chapter is crucial as it is essential that the EtE course addresses local concerns and needs regarding local applications of geosynthetics as well as local specifications and regulations.

4.2 Against Environmental Injustice

According to the Lancet Commission on Pollution and Health (2017), pollution and pollution-related disease are often reflections of environmental injustice, which is the inequitable exposure of poor, minority, and disenfranchised populations to toxic chemicals, contaminated air and water, unsafe workplaces, and other forms of pollution, and the concomitant disproportionate affliction of these populations by pollution-related diseases, often in violation of their human rights. A core principle of environmental justice is that all people and communities are entitled to equal protection by environmental and public health laws and regulations. In most instances, the poorest people in the world, with the fewest institutional, cultural, governmental, or philanthropic resources to help them, are the most vulnerable to rapidly changing environmental conditions. This is why sharing knowledge through education is fundamental to preventing environmental injustice.

The geosynthetics community continually searches for ways to educate engineering students about geosynthetics and increase their awareness of the usefulness of geosynthetics. In relation to flood prevention and mitigation, Brandl (2010) states that an essential prerequisite for successful mitigation of flood effects is the comprehensive education and training of task forces comprising authorities, organizations, professional groups, and volunteers. Continuing education of clients and construction professionals is also critically important if the benefits of geosynthetics are to be widely dispersed (Dixon et al., 2017). The IGS' chosen approach of teaching educators who will in turn teach students is deemed the most rapid way to spread basics on the appropriate use of geosynthetic technologies. To ensure that environmental justice is achieved and consequently make the knowledge available to all, the IGS provides equal support, including financial support, to all chapters organizing an EtE event. Furthermore, supplemental IGS educational material is made available, for example in the form of a sustainability video, technical leaflets and a glossary of geosynthetics terminology. A series of videos and webinars will also be made available in the future.

5 Case Study – EtE Programs in Brazil

5.1 General Description

As the graphic in Figure 1 illustrates, three EtE courses were delivered in Brazil in 2016, 2017 and 2018. This group of events is described in this paper as a case study to explain the metrics collected on the participants and outcomes of the EtE programs. Figure 3 presents a map of Brazil and the origins of the participants in the three events held in this country. In 2016, the EtE event was held in the city of Belo Horizonte (southeastern region); the 2017 event was held in Recife (northeastern region); and the 2018 event was held in Curitiba (southern region). Despite the country's size and population distribution, a relatively diverse distribution in participants' origins can be observed, with a greater number of attendees coming from the southeastern and southern regions of Brazil. The organization of such courses has had a major impact on the dissemination of geosynthetics among undergraduate students in Brazil, as will be detailed below.

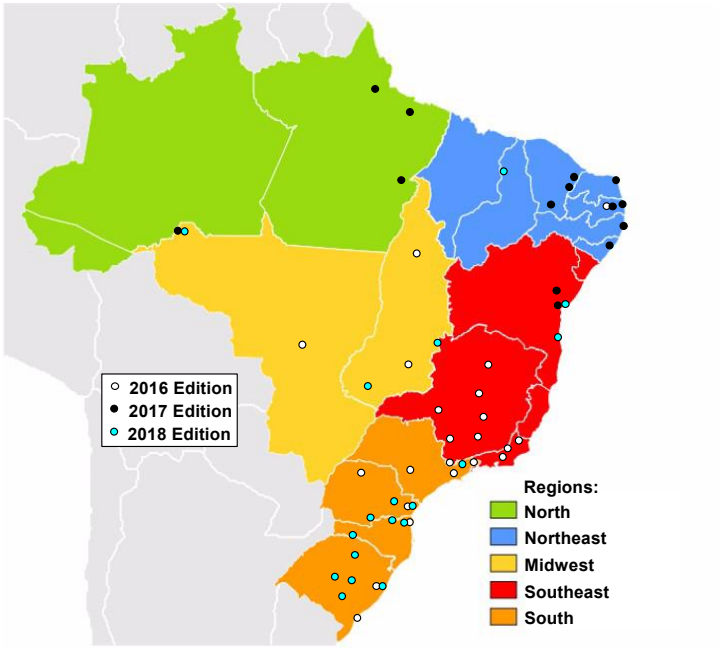

Figure 3. Origins of attendees of EtE courses in Brazil

Consistent with the technical content previously described for the EtE program as a whole, the EtE courses given in Brazil examined different aspects of geosynthetics applications in civil and environmental engineering works. Overall, the following topics were addressed:

- Introduction to the teaching of geosynthetics at the undergraduate level; objectives of the "Educating the Educators" program; course methodology.
- Types and functions of geosynthetics.
- Main applications, relevant properties of geosynthetics and testing.
- Geosynthetics in filtration and drainage.
- Geosynthetic-reinforced walls.
- Geosynthetic-reinforced steep slopes.
- Reinforced embankments on soft soils.
- Pavement reinforcement and restoration.
- Environmental applications of geosynthetics.
- Hydraulic applications of geosynthetics.

Sessions presenting case histories of engineering works involving geosynthetics were held between theoretical classes. Working examples and group activities were also utilized as part of the course.

5.2 Outcomes

An evaluation of the benefits derived from the course can be assessed by interviewing attendees at the end of the event and one year thereafter. Figures 4(a) and 4(b) show evaluations by the attendees of two events in 2016 (27 attendees) and 2018 (29 attendees) in which each item was assigned a grade between 0 and 5. The courses were evaluated very highly by the attendees in relation to quality of learning, quality of course content and overall satisfaction.

As previously stated, the main objective of the "Educating the Educators" program is to provide basic knowledge on geosynthetics to educators, and encourage them to deliver courses and organize activities related to geosynthetics at their academic institutions of origin. Participants were interviewed

one year after course completion to evaluate if the main course objectives were achieved. Of the 2016 and 2018 course attendees, 60% and 56%, respectively, responded to a questionnaire aiming at assessing how influential the course was in encouraging them to disseminate the knowledge acquired.

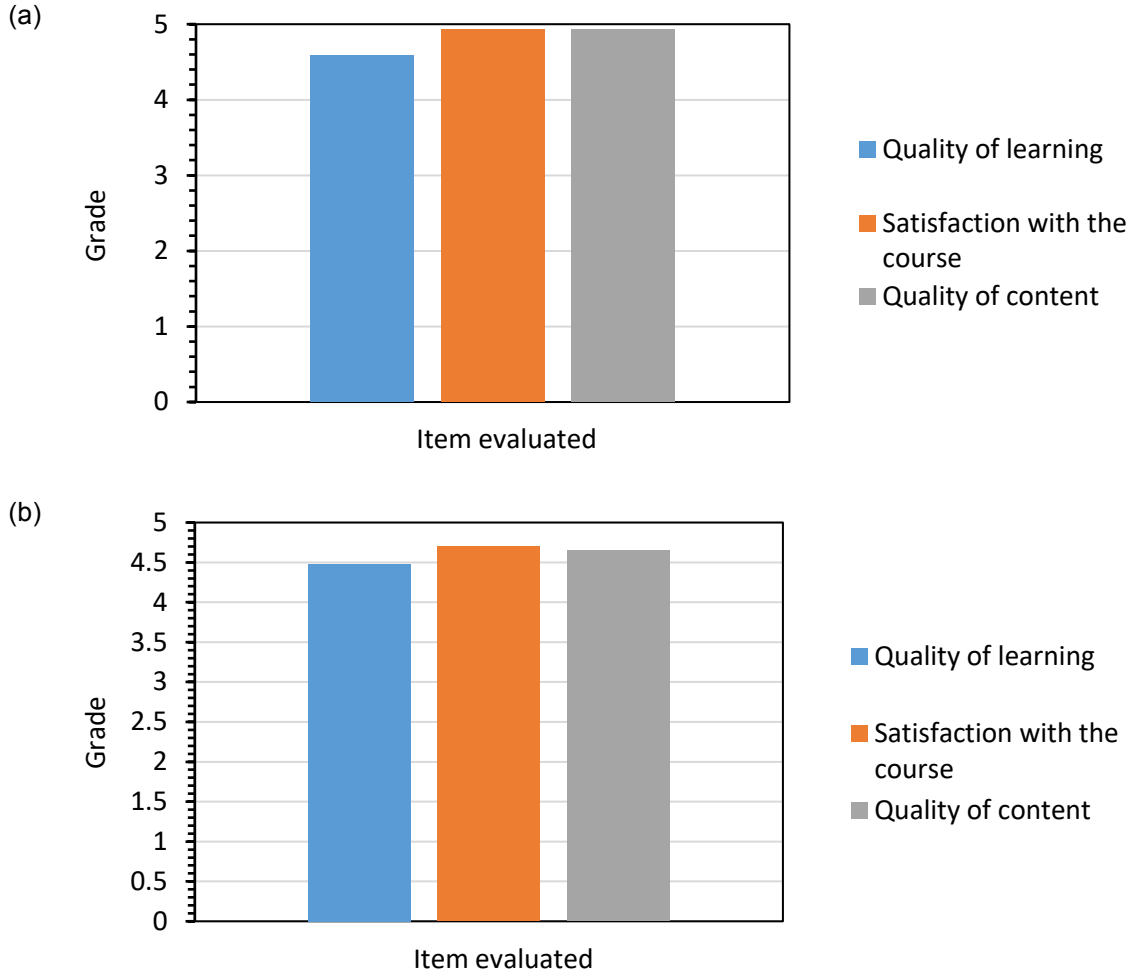

Figure 4. Evaluation of EtE course by attendees: (a) 2016 event; and (b) 2018 event

Figure 5(a) demonstrates that 62% of the 2016 course attendees included geosynthetics themes in existing disciplines in undergraduate courses; 15% created a new course (e.g. a technical elective course) on geosynthetics; 54% included geosynthetics in routine academic events at their institutions; 15% delivered keynote addresses; and 15% offered geosynthetics short-courses. In Figure 5(b), it can be seen that all 2018 course attendees stated that they included geosynthetics in existing disciplines; 33% included geosynthetics in academic events; 11% created a new course on geosynthetics; 11% delivered keynote addresses; and 6% offered geosynthetics short-courses.

Figures 6(a) and 6(b) depict the number of students who enrolled in courses either on or including geosynthetics that were delivered by 2016 and 2018 EtE course attendees at their institutions, respectively. For the 2016 course, 8% of lecturers reported five to 20 students per year; 31% reported 20 to 70 students per year; 23% reported 70 to 150 students per year; and 15% reported over 150 students per year. For the 2018 course, 6% of lecturers reported five to 20 students per year; 50% reported 21 to 70 students per year; 28% reported 71 to 150 students per year; and 17% reported over 150 students per year. Differences between the results of the two EtE courses are likely a consequence of differences in academic conditions, curricula and facilities of the host institutions in different regions of the country.

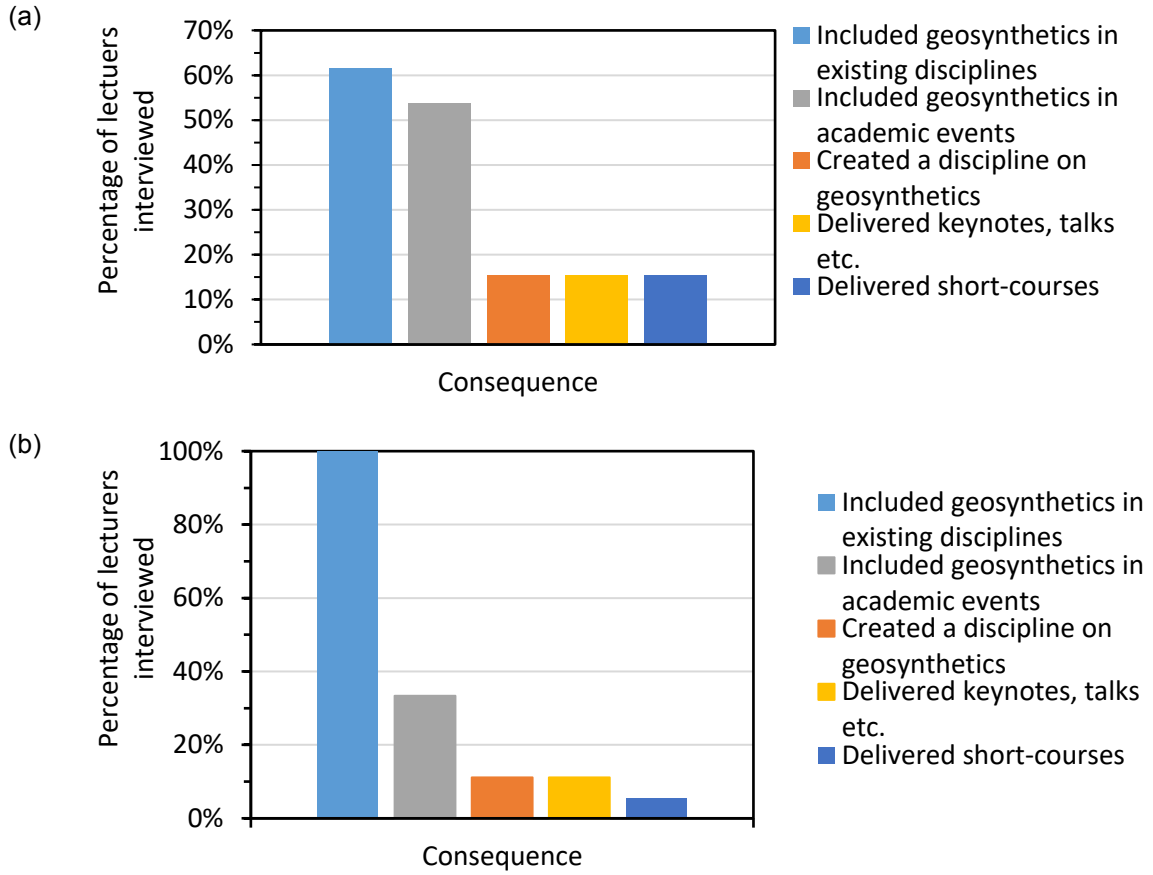

Figure 5. Outcomes of EtE programs conducted in Brazil: (a) 2016 course; and (b) 2018 course

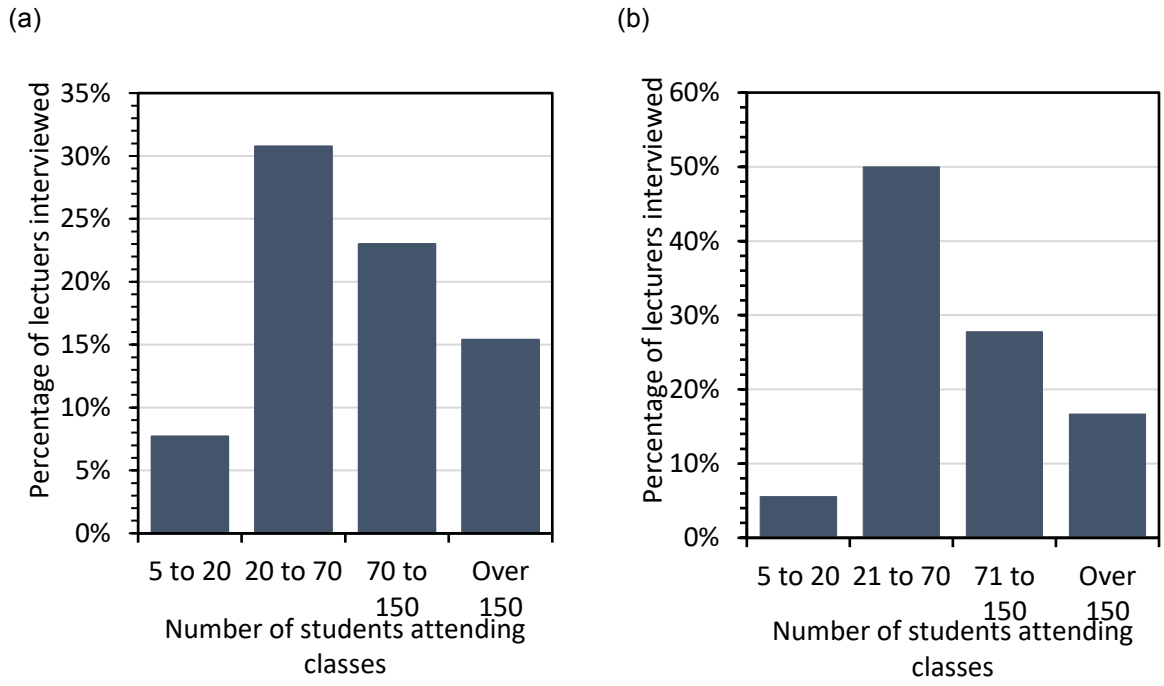

Figure 6. Number of students enrolled in classes delivered by EtE program attendees in Brazil: (a) 2016 course; and (b) 2018 course

The results obtained in the aforementioned surveys of past EtE course attendees in Brazil reveal the effectiveness of these programs in disseminating knowledge on geosynthetics among undergraduate students of civil engineering courses in different parts of Brazil.

6 Conclusions

A program was developed under the umbrella of the IGS to address the need to improve the information available and pedagogical dexterity of undergraduate geotechnical engineering in geosynthetics. With over 15 international "Educate the Educators" programs already completed and a number scheduled in the immediate future, the program has been determined a clear educational success. The results can be quantified as successful objectively, by individual EtE event, with outcomes being compiled over time to assess the implementation of geosynthetics materials at an attendee's home university, as well as subjectively, by the continued demand for EtE programs across the world.

Overall, the "Educate the Educators" program provides a good example that illustrates the benefits of establishing educational partnerships among relevant stakeholders of a given geotechnical theme to advance educational goals. In this particular case, EtE events have involved collaboration among the International Society, its national chapter, the local geosynthetics industry and national associations of civil engineering professors to successfully advance undergraduate education on geosynthetics.

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References

Brandl, H. (2010). Geosynthetics Application for the Mitigation of Natural Disasters. The 4th Giroud lecture. Proceedings 9th International Conference on Geosynthetics, Guaruja, Brazil, pp. 67-112.

Dixon, N., Fowmes, G., Frost, M. (2017). Global Challenges, Geosynthetic Solutions and Counting Carbon. Geosynthetics International, 24(5), pp. 451-464.

Industrial Fabrics Association International (2019). Geosynthetics 2019 Specifiers Guide, December 2018/January 2019, 31(6).

Koerner, R.M. (1986). Designing with Geosynthetics. Prentice-Hall, Upper Saddle River, NJ, USA.

Lancet Commission (2017). The Lancet Commission on Pollution and Health 2017. Published Online October 19, 2017, http://dx.doi.org/10.1016/S0140-6736(17)32345-0, 58 p.

Montoro, M. (2013). Educate the Educators on Geosynthetics in Argentina. IGSNews, (29)2, July, pp. 18-19.

Zornberg, J.G. (2013). The International Geosynthetics Society (IGS): No Borders for the Good Use of Geosynthetics. 25-Year Retrospectives on the Geosynthetic Industry and Glimpses into the Future, 25th Geosynthetic Research Institute Conference (GRI-25), April 01-02, Long Beach, California, pp. 342-357.

Authors' bios

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Prof. Zornberg has over 30 years' experience in practice and research in geotechnical and geosynthetics engineering. As an engineering consultant, he has been involved in the design of civil, transportation, mining and waste containment infrastructure. He has served as expert witness in numerous litigation and forensic cases. As a researcher, he focuses on transportation geotechnics, geosynthetics, unsaturated soils, expansive clays and environmental geotechnics. From 2010 to 2014, Prof. Zornberg served as president of the International Geosynthetics Society (IGS). He currently chairs the Geosynthetics Technical Committee of the Geo-Institute of ASCE. He has authored over 450 technical publications, edited a number of proceedings and book chapters, and been awarded three patents. Prof. Zornberg has been invited to deliver keynote lectures in over 30 countries around the world. He has also received many prestigious awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE) awarded by the President of the United States.

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