Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

ISSN 2307-7999
e-ISSN 2310-4635

RESEARCH ARTICLE

Challenges and Difficulties to Teaching Engineering to Generation Z: a case research

Desafíos y dificultades en la enseñanza de la ingeniería a la generación Z: Un caso de estudio

Suamit Correia Barreiro[1] & Daniel Fernando Bozutti[2*]

Universidade de Ribeirão Preto, Ribeirão Preto, Brasil

[1]Production Engineer.[2]Professor at Universidade de Ribeirão Preto (UNAERP) and Production Engineering Bachelor's Degree Course Coordination

Received: 6-07-17
Approved: 8-23-17
Online: 8-28-17

***Correspondence**

Email: dbozutti@unaerp.br

Cited as:

Correia, S. C., & Bozutti, D.F. (2017). Challenges and Difficulties to Teaching Engineering to Generation Z: a case research. *Propósitos y Representaciones*, *5*(2), 127 -183. doi: http://dx.doi.org/10.20511/pyr2017.v5n2.163

Summary

Many people from generation Z are at the beginning of their academic activities. This generation has peculiar characteristics that might be a challenge in the labor market. Thus, instructors have a great role in their preparation. However, professors might face difficulties dealing with their specific characteristics. The research aims to carry out a general survey to enable an understanding of the greater challenges and difficulties in teaching the subject of engineering to the students of Generation Z. The research method used was a case study at a University with 20 instructors from the Faculty of Engineering. The analysis revealed a great challenge in relating theoretical concepts with practical concepts. The research also showed a probable tendency of using more exhibition methods, and the low knowledge about generation Z by most instructors. This study seeks to contribute to the teaching-learning process of engineering.

Keywords: Generation Z, Teaching-learning in engineering, Instructors. Higher Education, Case Research.

Resumen:

Muchas personas que pertenecen a la Generación Z están iniciando sus actividades académicas. Esta generación tiene características particulares que podrían constituir un desafío en el mercado laboral. Por consiguiente, los profesores tienen un papel importante en la preparación de esta generación. Sin embargo, los profesores podrían enfrentar dificultades al lidiar con sus características. La investigación tiene como objetivo realizar una encuesta general para entender los mayores desafíos y dificultades que existen en la enseñanza de la ingeniería a los estudiantes de la Generación Z. El método que se utilizó fue un caso de estudio realizado en una universidad con 20 profesores de la Facultad de Ingeniería. El análisis reveló que existe un gran desafío para relacionar conceptos teóricos con conceptos prácticos, así

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

como una posible tendencia a utilizar más métodos de exposición y un bajo conocimiento acerca de la generación Z por parte de la mayoría de profesores. Este estudio busca contribuir en el proceso de enseñanza-aprendizaje de la ingeniería.

Palabras clave: Generación Z, enseñanza y aprendizaje en la ingeniería, profesores, educación superior, caso de estudio.

Introduction

Theme Introduction.

The term "generation" describes an average interval of time between the birth of parents and the birth of their children that range can be from 20 to 25 years (McCrindle, 2014). Generations have been studied and classified by their distinct characteristics. Recent generations include baby boomers, characterized by the postwar between years 1946 and 1964, generation X or gen X starting in mid-1960 until the beginning of 1980, generation Y known as the millennial generation, starting in 1980 until 1990 and the latest generation called generation Z or iGeneration, beginning in the mid-1990's.

The baby boomer generation is characterized by their discipline, competitive spirit, ability to work in teams, mental focus and level of commitment. Many people from this generation work at strategic levels and will be retiring in the coming years. As this generation of workers ends, another generation, called generation Z, begins with completely different attributes (Tolbize, 2008).

Generation Z was born at the apex of technology and internet, and it can be characterized as less sociable, extremely interactive, multitaskers, less focused and not adept to workplace hierarchies. This generation is also known as "the challenging generation" because of difficulties people will face to enter the labor market (Geck, 2006).

According to Gómez (2001), instructors have an important role in the teaching process, seeking to obtain an impact on the formation of their students, helping in the reconstruction of schemes of thought, feeling and behavior of everyone.

Knowing that teachers have an important role in preparing Generation Z for the labor market, what are the challenges faced by teachers and how important will be the use of pedagogical practices in the learning process of Generation Z students in the course of engineering?

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

Objective.

The work aims to carry out a general survey to understand the challenges and difficulties faced by teachers in teaching engineering students of Generation Z.

This work has the following secondary objectives:

- Analyze pedagogical practices adopted by professors of engineering currently in an institution of higher education;
- Check the understanding of professors in relation to their cohort from Generation Z;
- Bridge the knowledge of teachers about Generation Z with their adopted teaching practices.

Justification.

Nowadays, there is a problem of lecturers being experts in their own field, often with experiences that enrich their knowledge even further, but there is no significant concern with pedagogical methods in higher education (Darling-Hammonds & Young, 2002).

Through this research, it will be possible to verify the teaching-learning strategies used by instructors of engineering courses to deal with the peculiar characteristics of the students belonging to Generation Z. It will also be possible to check the need to carry out a restructuring in the teaching of engineering.

Theoretical Background

Generations.

The term generation is defined as a time interval between the birth of parents and their children, and it may have a gap of 20 to 25 years. Due to the rapid changes related to modern technology, this period has shortened. Two decades

is no longer sufficient to define the term. Sociologically, a generation refers to a group of people born in a certain time that share a similar age as well as stages of life related to their conditions (McCrindle, 2014). The most recent generations are the Baby Boomer generation, Generation X, Generation Y and Generation Z or iGeneration.

Baby Boomer Generation.

The Baby Boomer generation refers to people born between 1946 and 1964, during the postwar period. The name of this generation refers to the considerable increase in the birth index; about 17 million children were born in this period (O'Bannon, 2001). According to scientists, the probable cause for this boom was due to economic, social and psychological factors. During the years of 1946 and 1947, there was a peak of births due to the return of soldiers by the end of the war. In addition, feelings of joy and optimism at the end of the war, coupled with a positive expectation about the economy, led young couples decide to have more children (Macunovich, 2000).

People born at the time of economic growth saw a different world with new expectations, and because of that, they were considered to be motivators, optimistic and hard workers (Santos et al., 2011). With reference to the professional part, Conger (1998) states that baby boomers were the first who began to challenge the hierarchical system that existed in companies, starting the loss of credibility of the authority. People from this generation distinguish for liking to be part of a team, to be competitive and loyal to their employees. They seek to achieve goals, objectives and receive recognition for their performances. Finally, they have good relationships, aims to change possibilities and fight for their ideals. (Tolbize, 2008).

Many people from this generation today have important positions in the labor market. According to Roberts (2012), they are retiring with greater wealth, and higher pensions compared to previous generations. In 13 years,

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

all of this generation will be retired, leaving a legacy of knowledge and achievements of their time in the work force.

Generation X and Y.

Generation X refers to people who were born in the mid-1960s until around 1980. Many of this generation grew up in an era where it was required that both parents needed to work, allowing this generation to become independent in their youth. People belonging to this generation tend to be technically skilled, multicultural and global minded. Professional characteristics differ from baby boomers because they give greater emphasis to personal satisfaction rather than working in excess. They are more proactive, they can get an autonomy and flexibility in their lives and jobs, and have less need for leadership. Their main interests are leisure, family and lifestyles (Yu & Miller, 2005).

Generation Y refers to people who were born in the early 80s to mid-90s. These individuals grew during the period of economic expansion and advancement of media. They are confident, optimistic, competent and fun. They were born around technology, which have never known another way of life if not this (Lissitsa & Kol, 2016).

By dealing with the internet from an early age, they are very knowledgeable and tend to have no issues with technology. According to Oliveira (2011), they are "curious, hyperactive, usually little unbiased, communicative and almost always ambitious". They exert a self-confidence that make them to seem presumptuous; they crave professional growth in an organization quickly, and they have no attachment to the working environment.

Generation Z or iGeneration.

The generation Z, also called the iGeneration, consists of people who were born from mid-1990s onwards. Many of this generation are in school

and others have already started their activities in higher education. Some important events had influence on the behavior of this generation. In 1990, Tim Berners created the hyperlink system called the World Wide Web, a way to connect different documents through the internet. In 1993, the first graphic browser made possible the first navigation display to users (Geck, 2006). As the years went on these technologies were improved at a high speed, enabling access to information be made in seconds. These technological advances have produced a revolution in the world, affecting the lives of all people, especially those who were born during these events.

This generation grew up around laptops, Wi-Fi, video games, text messages, tablets and mobile phones. Through these technological advances, this generation has the possibility to be in constant contact with friends and family due to the internet, but this contact, most often, is digital thus resulting in being termed the "silent generation" by Kapil & Roy (2014). They are also exposed to a significant amount of information that can be accessed in seconds. Geck (2006) states that this will be the most avid of generations in their abilities to use various technological equipment at the same time. By being born in a digital era, they have high expectations. For example, they expect that books and articles are accessible online because it will allow them to access information in a very nice way, eating and watching TV at the same time. Fernández-Cruz & Fernández-Díaz (2016) summarize the characteristics of this generation as being experts and open to the use of technology; they are quick, impatient, resilient and interactive.

Although both generations Y and Z have been somewhat related due to the growth during technological advances, these generations have differences that may be beneficial to generation Z. Generation Y hates conflict, while generation Z grew up being pragmatic and conflicted by its parents belonging to generation X. People from generation X don't care too much in leading, leaving only the baby boomers, that no matter how much they insist on continuing working, they will retire soon. Therefore, there will

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

be a big gap of leaders, which will make generation Z filling this gap faster (Kapil & Roy, 2014).

People from this generation have already started or are on their way to start their professional careers and can leave a great contribution in the labor market, but they may face challenges because of their unique characteristics. Although they may be innovative, creative and technology experts, they are individualistic people with communication issues and lack problem solving skills (Half, 2015). This generation does not have capacity to focus and analyze difficult problems, not being able to work with long term goals (Chun et al., 2015). They prefer to work alone or in virtual groups and they present difficulties in vertical organizations (DeLaria et al., 2015). In order for these young people to enter the job market better prepared to face these challenges, academic development is essential.

Barnes & Noble College conducted a survey on high school students about their prospects related to higher education. Research shows that more than 89% of students pointed to the university education as very important. For them the academic experience is the ideal way to achieve a good job. This research also showed that they could make progress more quickly when they received challenges to be completely engaged in education.

Another important aspect shown by this research is that these students, regardless of work in groups or alone, prefer to learn by doing. More than half of those people said they learn best by being hands-on, while 38 percent said they prefer to learn visually. They also believe that discussions in class are a highlight for learning in the classroom. When asked about methods that teachers could use in the classroom environment to be more dynamic and interactive, the main responses were making more technology available, being more hands-on, and providing more individual attention (Malat, Vostok & Eveland, 2015).

Through this research, it is possible to see the needs related to the teaching-learning process that should be used in the educational environment, as well as making substantial and frequent the use of technology in the classroom.

Current reality of teaching in Brazil.

Instructor training is an important subject of study highlighted by several authors. According to Dantas (2014), in order to be able to teach, it is necessary that professionals specialize in a scientific area of their preference through graduation and post-graduation *strictu sensu*, as well as the development of scientific research related to the chosen area. It is expected from teachers to have scientific knowledge along with professional experiences that make them both knowledgeable and skilled in a specific area. According to Solís (2015), higher education teachers believe that small introduction courses or even continuous training are enough to fill the requirements of becoming an instructor. It is also expected that students have sufficient maturity to meet the demands of learning in higher education (Cunha, 2006). Because these requirements are scientific, the pedagogical part, which its goal is to improve the teaching-learning process, is understood as unnecessary (Darling-Hammond, Wei & Johnson, 2009).

This insouciance as the didactic-pedagogical issue in higher education presents challenges. Isaia (2006) argues that in the current scenario there is no understanding between teachers and educational institutions in relation to the preparation for performance in teaching. Consequently, even though instructors know of their formative function, they do not believe in any specific preparation to best perform it. They believe strongly that the years of studies obtained will be enough to enable them to perform a good job as teachers.

Educational institutions aim to train future professionals, but the training of teachers is not seen as important by them. If a teacher has a good degree with many scientific publications, the professional is accepted as a qualified

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

teacher, but this does not serve to guarantee a quality educational experience (Darling-Hammonds & Young, 2002). Other educational bodies such as the MEC (Ministry of education and culture) and CAPES (Higher education improvement corporation), do not provide any kind of improvement in didactic training in this area, hindering even more the process of training of instructors (Isaia, 2006).

The Role of Pedagogy in Higher Education.

Psychological perspectives of learning.

Current pedagogy and its methods are very useful for the teaching and learning of children and teenagers, but the teaching-learning process for adults still has some issues. It is worth pointing out that the pedagogical methods are different between children and adults due to their unique features. The adult is included in the world of work, and may use life experiences to acquire knowledge, while the child needs someone to guide how she or he learns; the adult can have greater autonomy in managing study time, while a child needs to be regulated. Adults have a perfect sense of what they do not know, so they look for something that will help them to make changes in their lives (Nascimento, Nascimento & Ferreira, 2007).

In order to provide an improvement and solutions to issues like this just quoted, psychological perspectives or theories of learning were created. Through these theories it is possible to check the reason why many people learn and others do not, or why many teachers have more success in teaching than others, or why there are disciplinary content that can be better applied than others (Carvalho, Porto & Belhot, 2001).

Among several theories on the matter, there is the constructivist theory from Jean Piaget, which talks about knowledge and its development. Piaget argues that the subject and object have no objection, but together form a whole in the construction of knowledge. Becker (2001) inspired by this theory,

called Relational Pedagogy, the design of knowledge through a relationship between subject and object to be exploited. This means that it is important that there is a relationship to the material to be explored and the student, providing answers to their own concerns. The classroom environment is based on this teaching method, which provides an interrelation between the teacher and the student in order to be an environment in which both are protagonists in the teaching-learning process.

According to Gúzman (2014), there are important principles in the teaching-learning process that are guides, and justify the instructor's actions. Those principles facilitate the learning process, and are grouped into four dimensions. The first dimension is called affective, which means that learning is the result of efforts and it is stimulated by an atmosphere of respect and support. Social and human development dimension is another group that explains about how learning is affected by human development factors and its influences by social and cultural factors. The third dimension is named as individual differences which states that learning is a personal and unique process. The last dimension is known as cognitive which exposes principles about learning from the past, learning based in achievements, and learning to construct knowledge.

In order to have the construction of knowledge, the teacher should provide means to assist in the intellectual process of students in various stages of schooling. In higher education, because they are adults, learning does not happen just by exposure to information. These students learn when their needs are being satisfied. Their learning needs to be constructed with their life experiences, in order to utilize the learning from real life (Nascimento, Nascimento & Ferreira, 2007).

Through this constructivist theory, another theory called the theory of meaningful learning arises. This theory applies concepts of constructivist theory in the process of formation of knowledge, which means understanding how individuals assimilate the information. Through the learning cycles, called as well as experiential learning, it is possible to understand how this process happens.

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

Learning Cycles or Experiential Learning.

The learning cycle is an important mechanism to teachers understand the learning process, it means, understanding how individuals receive information and how their intervention can happen. Carvalho, Porto & Belhot (2001) classify three types of learning cycles called respectively of Kolb cycle, cycle of Ginter and White and the learning cycle in the constructivist vision.

The Kolb cycle, shown in Figure 1, reflects the learning process as a cycle of four stages. First, the student will have to go through a real experience called a concrete experience. Then, they will have to go through step called reflective observation, where the student will analyze it and reflect about the observation. The individual will have to abstract the concept of this situation and turn on ideas that could be called abstract conceptualization. Then, the ideas will be tested in their experiences in the active trial. In this last step, the student will analyze if the fact occurred had importance, and then decide whether it will be part of their knowledge (Carvalho & Porto, 2003)

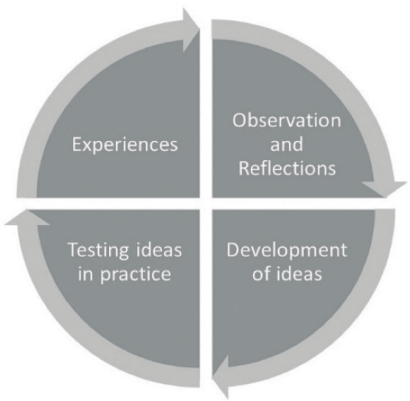

Figure 1. Kolb Cycle. Adapted from "O uso do ciclo de Kolb no planejamento de ensino de engenharia" by Carvalho, A., Porto, A. & Belhot, R. (2001).

The cycle of Ginter and White is a model in which individuals learn through observation of others who find themselves in a social situation as shown in Figure 2. Regardless of the actions of other people, the individual

might copy their actions, adding behavior through additional experience. In this method, the learning causes permanent and constant changes.

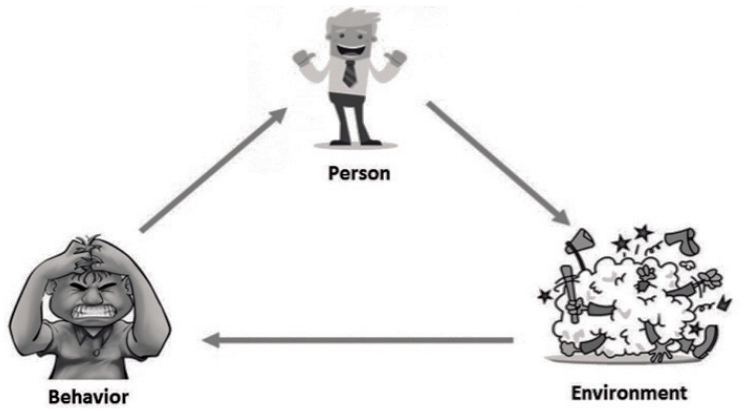

Figure 2. Cycle of Ginter and White. Adapted from "Aprendizagem Significativa no Ensino de Engenharia" by Carvalho, A., Porto, A. & Belhot, R. (2001).

The learning cycle in the constructivist vision is a model consisting of four stages as shown in Figure 3. The first stage is called Context and Justification. In this stage, students receive concepts that they should study, as well as the reasons for studying by applying the scenario of the student experience. Then, they are challenged or motivated to understand these concepts. In the second phase called Conceptualization, individuals are encouraged to make deductions and generate ideas; thereby individuals may have a connection with new concepts that had not yet been studied. After the second stage, they will have to apply the concepts previously studied by means of practical exercises, in this third stage is essential to stimulating development and creativity. Finally, the fourth stage described as new situations, the individual will have to apply the concepts in a scenario involving the reality. This model is widely used in engineering teaching due to the dimension and application in learning (Carvalho, Porto & Belhot, 2001).

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

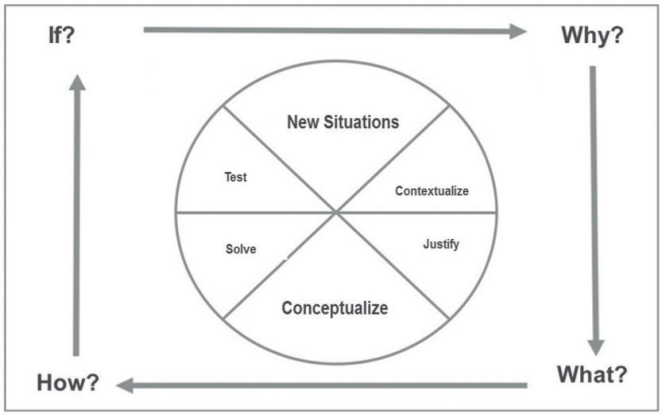

Figure 3. Learning cycle in the constructivist vision. Adapted from "Aprendizagem Significativa no Ensino de Engenharia" by Carvalho, A., Porto, A. & Belhot, R. (2001).

Teaching-Learning Destined to Generation Z in the Engineering Course.

With scientific and technological advances in recent years, engineering is experiencing a time of intense changes. Nowadays, it is required that professionals be more qualified and prepared to face the field. In relation to the current reality of teaching in Brazil, the problems in engineering programs are the same, but with greater intensity. Dantas (2014) states that there is a need to carry out a restructuring of engineering education in order to keep up with the social impacts of the current scenario.

These professionals need to prepare for the constant changes related to this field. They need to "learn to learn". In order to produce engineers, instructors need to prepare them to make decisions, how to obtain information and know where they will apply them. Once there is a closer relationship between student and instructor, there will be a beneficial contribution to both sides; the professor will become an educator and the student will thus be more valued (Carvalho, Porto & Belhot, 2001).

There is another factor that should be considered which is that most of the students from higher education are people belonging to Generation Z

with distinct characteristics that make the teaching-learning process even more difficult.

In order to obtain success in the teaching-learning process with the Generation Z, the instructor will need to know their strengths, weaknesses, challenges, and interests. According to Gúzman (2016), the teacher shall be responsible to create conditions for a successful teaching-learning process; the student must be the core in this process and no longer the teacher. Therefore, it will be necessary to study and use pedagogical methodologies, such as learning theories and its cycles, which are aimed at the understanding of the process of knowledge construction, as well as its interventions in order to meet their need of learning and make it more meaningful to students of this generation.

Methodology

The methodological strategy used for this research is the analysis of a case study, which according to Yin (2001), is a study that enables the investigation of contemporary events entered in the context of real life. It means that the boundaries between the events and the context are not defined clearly.

Through a case study, it becomes possible to develop new theories and expands knowledge about the real and current events (Miguel, 2012). However, many researchers have shown concerns because of faulty evidences and biased views that can occur due to a lack of rigor in research. Another concern is associated with limited basis to carry out a scientific generalization, which can be solved using the same technique in multiple case studies, with the requirement to repeat the phenomenon in different conditions (Yin, 2001).

This case study is explanatory because it aims to describe the reality and explain the relationships of cause and effect through theory. Its approach is to have a qualitative relationship between the real world and the subject, not worrying about the numerical representation (Goldenberg, 2004).

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

The case study was conducted at a University in the Engineering department of the institution. This department has students specializing in production, computing, and civil engineering and contains 42 professors. All research took place during the period of October to November 2016.

The instrument chosen to collect data was a survey. The survey was developed containing eighteen closed questions and three open questions by being seven questions to determine the profile of the interviewee and fourteen of them in order to see the relationship between Generation Z and the teaching-learning process in the engineering program.

The questionnaire was made in a virtual way with aid of JotForm, which is a website that enables the creation of forms free of charge, and the data can be collected online, with the benefit to ease in obtaining and processing of data. The website generated a link containing the questionnaire, which was sent via email to all respondents. Prior to send the questionnaire to the entire parcipant group, a group of five professors was randomly selected to answer a preliminary questionnaire. The answers of this preliminary questionnaire were analyzed and adjustments were done with the aim to obtain a representative result of the survey.

In order to standardize the information obtained through the questionnaire, it was used the technique of data tabulation and descriptive statistics in order to sort the results, making it easier to read and review.

Presentation of Findings

Educational institution studied.

The educational institution studied is a university located in the city of Ribeirao Preto – São Paulo – Brazil, and it is ranked among the 10 best private universities of Brazil. It occurred in the Department of Engineering, which has courses in computer, production and civil engineering, with 42 teachers.

To carry out the interviews, 20 teachers out of 42 responded to the questionnaire, which is about 48% of teachers of the Department of Engineering. In relation to the titration of respondents, 9 are doctors, 10 are masters and 1 is specialist. More than 50% of them teach in other institutions and 70% of them teach for over 5 years. In relation to the number of students in the classroom, 45% of the professors teach classes of 21 to 40 students and 45% of 41 to 60 students.

Findings.

Interviewees were questioned about pedagogical training courses were held, and 16 out of 20 responded that they had done it in the last 5 years. Figure 4 shows the results obtained.

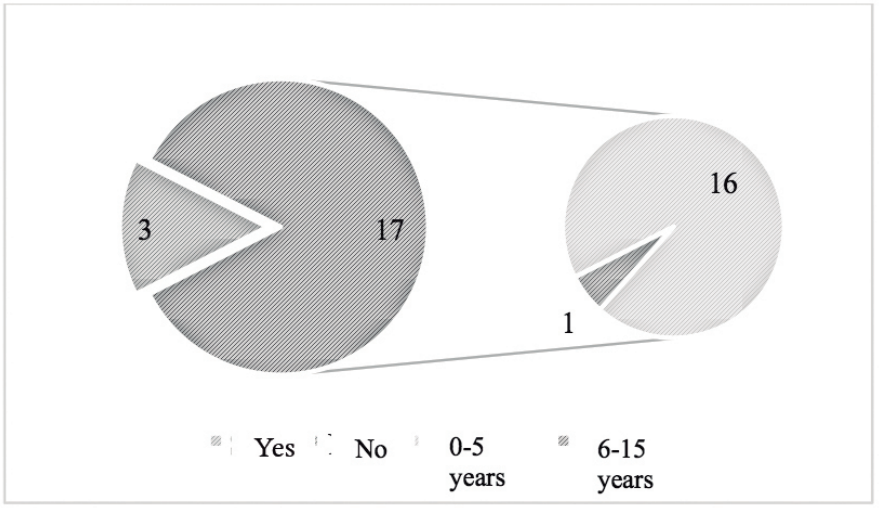

Figure 4. Pedagogical Training.

In order to better understand the contribution that the educational institution had in the pedagogical qualification of teachers, they were asked to rank on a scale from 1 to 5, 1 being no effect and 5 being the greatest effect. According to the findings, 55% have posted as being good and high, 35% have posted as average, and 10% responded that there was no effect at all.

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

Following the interview, 70% of respondents said that there is a need to carry out a restructuring of engineering education and they all declared that pedagogical practices in engineering education are important.

Respondents were asked with respect to the knowledge about the learning cycles, and 80% of them responded that they know these cycles. About teaching strategies adopted, most teachers said they use both exhibition and discussion-based classes, as illustrated in Figure 5.

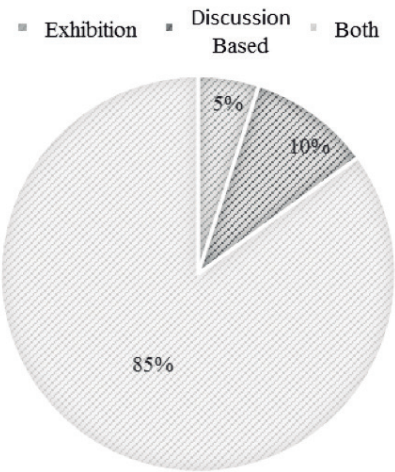

Figure 5. Pedagogical Training.

Respondents ranked on a scale from 1 to 5 their pedagogical contribution to generate learning processes. From the collected replies, 75% of respondents said being good and great contribution and 20% responded to be average. None of the teachers responded that their contribution was below average.

About the methods used in the classroom, it is possible to check their answers through Table 1. It is notable that the most used resources are chalkboard, projector and exercises, which are usually applied in lectures. In contrast, the least used are dynamic, seminars, case studies and computers, which are resources that can be applied in practical classes, where it aims to obtain a greater participation of the student.

Table 1.

Didactic Resources.

Didactic Resource	Frequency Low	Average	High
Blackboard	10%	35%	55%
Projector	15%	30%	55%
Exercises	5%	30%	65%
Projects	30%	35%	35%
Presentations	70%	15%	15%
Case studies	40%	45%	15%
Discussions	10%	50%	40%
Dynamics	50%	40%	10%
Computers	65%	10%	25%

Teachers were asked to list the greatest problems encountered in teaching engineering, as shown in Table 2. Among the most cited problems are the difficulty of associating theory with the actual practice of the discipline, low performance in high school, and the lack of commitment on the part of students.

Table 2.

Problems in the engineering teaching.

Problems in the enginnering teaching	Percentage of answers
Associate practice with theory	30%
Lack of commitment	26%
Low performance on high school	26%
Disinterest in the disciplines	9%
Low workload	4%
Less time to study	4%

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

Teachers were asked to opine about an ideal teaching methodology for engineering nowadays. Their opinions were listed and shown in Figure 6. It is possible to realize that many teachers believe that the appropriate methodology for engineering is conducting practices, followed by the frequent use of technological resources.

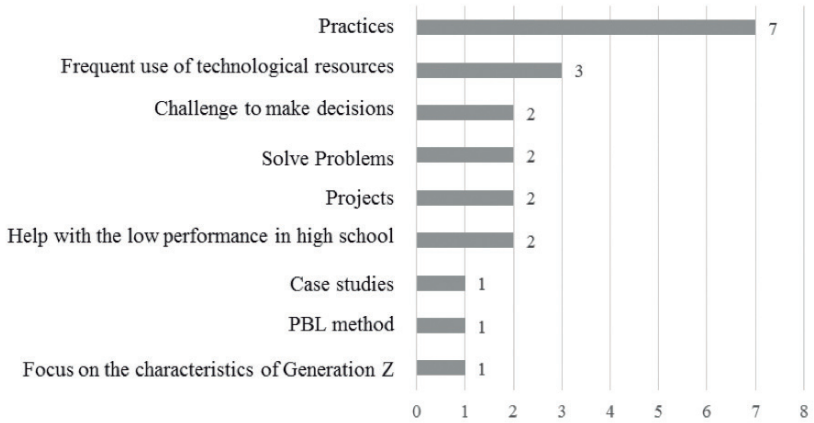

Figure 6. Methodology in Engineer Teaching.

In order to find out the understanding that teachers have of the Generation Z, they were asked to give their opinion regarding its students. They cited several features and through them it was possible to classify into 3 levels of understanding, such as are shown in Figure 7.

Through the graph, it is possible to see that most of the teachers have limited understanding about Generation Z. Two respondents declared not having knowledge of this generation, and others classified this generation with different features to what was studied. In relation to teachers who know about this generation, they cited characteristics such as impatience, lack of focus, creativity and immediacy.

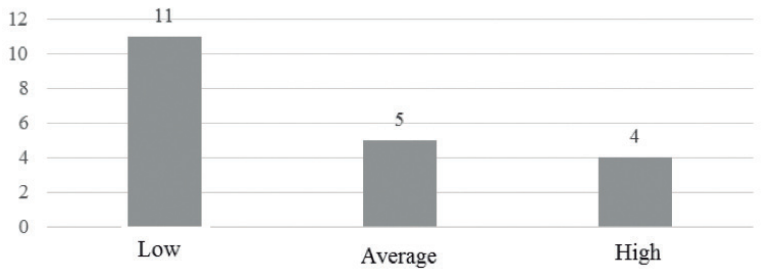

Figure 7. Level of knowledge about generation Z.

When asked if the characteristics of Generation Z are part of the pedagogical plan of engineering, 75% of them answered yes.

Critical Analysis.

Through the results, it is important to notice some relevant points. A considerable number of teachers have already carried out pedagogical training courses over the past 5 years and have knowledge about the learning cycles, which is great to be able to deal with Generation Z's characteristics.

As much as studies indicate that educational institutions tend not to worry about investing in pedagogical training, the vast majority of teachers responded as having received incentive from the studied university. Their opinions have also shown that they are in favor of undertaking a restructuring of engineering education.

During the analysis of findings, there was an aspect that was evidenced. When respondents were questioned about the major problems in engineering education, most of them answered that the difficulty was in linking theory with practice. When questioned about appropriate methodology in teaching engineering for generation Z, most of them answered that it was conducting practices to be able to retain the knowledge. However, when asked about the use of resources, the majority of resources cited were exactly those used in the theoretical/expository teaching by evidencing the low use of resources

Propósitos y Representaciones
Jul.-Dic. 2017, Vol. 5, N° 2: pp. 127 -183
http://dx.doi.org/10.20511/pyr2017.v5n2.163

for practical teaching. Even though teachers understand that there is a need to include practical content, there is still a certain difficulty in applying these types of practices in the classroom.

Another aspect to be highlighted is associated with the didactic method used in classrooms; most of them said they prefer to use exhibition and discussion-based methods. However, it may have a greater tendency to use lectures, compromising the learning outcomes of this generation. The use of other approaches may be necessary, so students can retain learning.

Most of the respondents answered that the pedagogical plan discusses the characteristics of Generation Z, but they still showed little knowledge about the generation Z. That is a case of social desirability bias which can explain some of the contradictory responses in this research.

Although it is notable that teachers are preparing for teaching, they still do not understand the characteristics of this new generation. Therefore, the learning process of these future engineers is compromised, making their preparation process to face the job market even more difficult.

Concluding Remarks

The objective of this study was to conduct a survey to understand the challenges and difficulties faced by teachers in teaching engineering students from Generation Z. To complete this survey, 20 professors were interviewed in the Faculty of Engineering Department of a University.

Through the interviews, it was possible to identify that there is a great difficulty in linking theory with the actual practice of engineering. In addition, teachers may be using more lectures than other methods, and the majority of those surveyed still have no knowledge of Generation Z. All aspects previously cited impact directly on learning of Generation Z. Instructors, also, have knowledge about the learning cycles, but they fail in applying them. Thus, it is possible to say that the objective of this work was achieved.

In relation to the improvements for this study were the number of faculty respondents, 52% of respondents did not reply to the questionnaire, and the study has been done in a single university. There is a certain difficulty about generalization, although 55% of lecturers of the university studied teach in other institutions, this behavior can be expanded to other universities.

For future studies, it is proposed to study the implementation of PBL method (Problem-based Learning) in engineering based on the characteristics of Generation Z. In the PBL method, students are agents in the process of learning, providing a practical experience of the problems. Additional studies should be performed in other universities for further analysis, including public universities where there are a greater number of teachers associated with scientific research. It is also proposed to analyze the difficulties of teacher in applying the learning cycles.

The contributions achieved by this study include exposing the difficulties and challenges facing teachers and students as well as highlight the need to improve engineering students from Generation Z's learning outcomes. With frequent use of professional experience in engineering classrooms, coupled with the use of different types of teaching methods, there will be greater success in the teaching-learning process.

References

Becker, F. (2011). *Educação e construção do conhecimento*. Porto Alegre: Artmed Editora.

Carvalho, A. & Porto, A. (2003). *O uso do ciclo de kolb no planejamento de ensino de engenharia*. Congresso Brasileiro de Educação em Engenharia, Joinville, SC.

Carvalho, A., Porto, A. & Belhot, R. (2001). Aprendizagem significativa no ensino de engenharia. *Revista produção*, *11*(1), 81–90. https://doi.org/10.1590/S0103-65132001000100006

Chun, C. et al. (2015). *Teaching Generation Z at the University of Hawai'i.* University of Hawaii, Hawaii.

Conger, P. J. (1998). Quem é a geração x ?. *Hsm management*, 11, 128–138.

Cunha, M. I. D. (2006). Diferentes olhares sobre as práticas pedagógicas no ensino superior: a docência e sua formação. *Educação*, *27*(3), 525–536. Recuperado de: http://revistaseletronicas.pucrs.br/ojs/index.php/faced/article/view/397

Dalapria, N. et al. (2015). *A inserção da geração z no mercado de trabalho e o impacto causado nas organizações*. Congresso internacional de administração, Ponta Grossa, PN.

Dantas, C. M. M. (2014). Docentes engenheiros e sua preparação didático-pedagógica. *Revista de ensino de engenharia*, *33*(2), 45–52. https://doi.org/10.15552/2236-0158/abenge.v33n2p45-52

Darling-Hammond, L., Wei, R. C., with Johnson, C. M. (2009). Teacher Preparation and Teacher Learning: A Changing Policy Landscape. In G. Sykes, B. L. Schneider, and D. N. Plank (Eds.), *Handbook of Education Policy Research (pp. 613- 636)*. New York: American Educational Research Association and Routledge.

Darling-Hammond, L, & Young, P. (2002) Defining "High Qualified teachers" What does ·scientifically-bases- research" actually tell us? *Educational researcher, 31*(9) pp. 13-25. https://doi.org/10.3102/0013189X031009013

Fernández-Cruz, F. J. & Fernández-Díaz, M. J. (2016). Generation z's teachers and their digital skills. *Comunicar*, *24*(46), 97–105. https://doi.org/10.3916/C46-2016-10

Geck, C. (2006). The generation z connection: Teaching information literacy to the newest net generation. *Teacher librarian*, *33*(3), 19–23. Recuperado de http://www.redorbit.com/news/technology/397034/the_generation_z_connection_teaching_information_literacy_to_the_newest

Goldenberg, M. (2004). *A arte de pesquisar*. Rio de Janeiro: Editora Record.

Gómez, P. A. (2001). *A cultura escolar na sociedade neoliberal*. Porto alegre: Artmed Editora

Gúzman, J. C. (2014). *Los principios de la enseãnza centrada em el aprendizaje (ECA)*. Universidad Nacional *Autónoma de México, Ciudad de México*.

Gúzman, J. C. *(2016)*. ¿Qué y cómo evaluar el desempeño docente? Una propuesta basada en los factores que favorecen el aprendizaje. *Propósitos y Representaciones, 4*(1), 285-358. https://doi.org/10.20511/pyr2016.v4n2.124

Half, R. (2015). Get ready for generation Z. *Enactus*, 1, 1-44, 2015.

Isaia, S. M. A. (2014). Desafios à docência superior: pressupostos a considerar. Inep, 5, 63–84.

Kapil, Y. & Roy, A. (2014). A critical evaluation of generation z at workplaces. *International Journal of Social Relevance & Concern*, *2*(1), 10–14.

Lissitsa, S. & Kol, O. (2016). Generation x vs. Generation y - a decade of online shopping. J*ournal of Retailing and Consumer Services*, 31, 304–312. https://doi.org/10.1016/j.jretconser.2016.04.015

Macunovich, D. (2000). The baby boomers. *Macmillan Encyclopedia of Aging*, *77*, 14.

Malat, l., Vostok, T., & Eveland, A. (2015). Getting to know Gen Z. *Barnes & Noble College*, 1, 2–8.

McCrindle, M. (2014). *The abc of xyz: Understanding the global generations*. Sydney: UNSW Press.

Miguel, P. (2012). *Metodologia de pesquisa em engenharia de produção e gestão de operações*. Rio de Janeiro: Elsevier Editora Ltda.

Nascimento, E., Nascimento, S. & Ferreira, S. P. A. (2007). *Ensino universitário : estratégias e metodologias para a aprendizagem*. Universidade Federal de Pernambuco, Recife.

Oliveira, S. (2011). *Geração Y : ser potencial ou ser talento? Faça por merecer*. São Paulo: Integrare Editora e Livraria Ltda..

Roberts, K. (2012). The end of the long Baby-Boomer Generation. *Journal of youth studies*,*15*(4), 479–498. https://doi.org/10.1080/13676261.2012.663900

Santos, C. F. et al. (2011). *O processo evolutivo entre as gerações x, y e baby boomers. Seminários em administração*. Santa Maria, RS.

Sólis, C. A. *(2015). C*reencias sobre enseñanza y aprendizaje en docentes universitarios: Revisión de algunos estudios. *Propósitos y Representaciones, 3*(2), 227-260. http://dx.doi.org/10.20511/pyr2015.v3n2.83

Tolbize, A. (2008). *Generational differences in the workplace*. University of Minnesota, Minneapolis.

Yin, R. K. (2001). *Estudo de caso: planejamento e método*. São Paulo: Artmed Editora.

Yu, H. & Miller, P. (2005). Leadership style: The X generation and baby boomers compared in different cultural contexts. Conger, P. J. (1998). Quem é a geração x ?, *26*(1), 35–50, 2005. https://doi.org/10.1108/01437730510575570