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Motivating factors of MOOC completers: Comparing between university-affiliated students and general participants

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ABSTRACT

Massive open online courses (MOOCs) are a growing element in strategic decision-making in higher education. However, since only a small percentage of enrollees complete MOOCs, it is important to understand participants' preliminary expectations and motivations. This is particularly important for science and engineering MOOCs because they require professional knowledge, analytical skills, and the ability to handle abstract models of physical phenomena. Hence, the goal of this study was to examine the motivating factors of learners who successfully completed a MOOC in nanotechnology and nanosensors, while comparing between university-affiliated students (N = 114) and general participants (N = 194). Analysis of data, collected via an online survey, forum posts, and email messages, identified three motivational themes: career, personal, and educational. The findings indicated that participants from both groups were motivated by general interest, personal growth, and enrichment. However, while the university-affiliated students were oriented toward improving knowledge and receiving a certificate, the general participants were oriented toward research and professional advancement. Our findings suggest that the design of academic MOOCs should target at both promoting the understanding of new concepts and generating new skillsets.

1. Introduction

Massive open online courses (MOOCs) provide new learning opportunities that are available through online and open access. MOOCs offer a way for acquiring new professional knowledge and skills (e.g., Barak, Watted, & Haick, 2016; Barak & Watted, 2017; Breslow et al., 2013; Evans, Baker, & Dee, 2016; Hew & Cheung, 2014). In recent years, research has mainly focused on understanding the motivation of the MOOC enrollees, indicating reasons such as personal challenge, career development, and extending current knowledge (Barak et al., 2016; Hew & Cheung, 2014; Wang & Baker, 2015). MOOC participants' motivation to learn determine whether and how they engage with course materials (Halasek et al., 2014; Milligan & Littlejohn, 2017). Research has showed that learners' engagement in MOOCs is highly affected by their motivation (Barak et al., 2016; Yang, 2014). Although MOOC dropouts and completers are different in nature (Jordan, 2014), studies on MOOC motivation did not differentiate between the two populations (Kizilcec & Schneider, 2015; Littlejohn, Hood, Milligan, & Mustain, 2016; White, Davis, Dickens, Leon, & Sanchez Vera, 2015). In some cases, universities that produce MOOCs integrate them into the campus-based curricula (e.g., Barak et al., 2016; Milligan & Littlejohn, 2017; Swinnerton, Morris, Hotchkiss, & Pickering, 2017). This way, the university-affiliated students are more flexible in time and place of study and they have an opportunity to share ideas with people from around the world with similar interests (Barak et al., 2016; Barak & Watted, 2017; Breslow et al., 2013). A recent study on MOOC motivation identified differences between university students, and professional workers (Milligan & Littlejohn, 2017). Professionals were primarily motivated by current needs, while students used MOOCs to complement their learning. Milligan and Littlejohn's study, similar to most studies on motivations of MOOC learners, surveyed general participants, many of whom did not complete the course. Further research should focus on MOOC completers to better understand what motivates this special population. This is particularly important for MOOCs in science and engineering, since their completion rates are lower than average (Barak et al., 2016; Breslow et al., 2013).

Hence, the goal of this study was to examine the motivating factors of MOOC completers, while comparing two groups: university-affiliated students and general participants. This raised the following research questions:

1. What characterizes the expected benefits of participants who completed a MOOC?
2. What are the differences between university-affiliated students and

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general participants in their expected benefits?
3. What are the relationships between demographic background and MOOC completers' expected benefits?

2. Literature review

Understanding motivation to participate in a MOOC is gaining much interest among researchers (e.g. Barak et al., 2016; Littlejohn et al., 2016; Milligan & Littlejohn, 2017). The literature focuses on two main aspects: participants' motivation to enroll in a MOOC, and motivational factors that influence participants' engagement. The first aspect examines the initial incentives for taking a MOOC, while the second examines the motivation to continue learning.

2.1. Participants' motivation to enroll in a MOOC

Massive Open Online Courses (MOOCs) allow free access to high-level academic contents. Since they are open and free, the diversity of learners in a MOOC results in a range of motivations for participation (Kizilcec & Schneider, 2015; White et al., 2015; Zheng, Rosson, Shih, & Carroll, 2015). The literature indicates several reasons for enrolling in a MOOC. These reasons can be grouped into three themes: Personal benefits, Educational benefits, and Career benefits.

Personal benefits are conceptualized as reasons related to personal interest in the subject or in growth and enrichment. Personal benefits were selected as an important reason for joining a MOOC (Belanger & Thornton, 2013; Hew & Cheung, 2014; Zheng et al., 2015). Belanger and Thornton (2013) examined the enrollment motivation of more than three thousand respondents who participated in Duke University's first MOOC. They found that the majority of the participants indicated ‘fun and enjoyment’ as a primary reason for enrollment. Hew and Cheung (2014) conducted a meta-analysis of more than twenty articles that provided empirical evidence reporting on students' motivations for enrolling in a MOOC. They found that ‘personal challenge’ in terms of completing a challenging engineering course and ‘curiosity about MOOC’ were major motives for enrollment. Kizilcec and Schneider (2015) examined learners who participated in different MOOCs. They found that almost all the learners reported ‘general interest in the topic’ and a desire for ‘growth and enrichment’ as motivating forces. Similarly, Zheng et al. (2015) identified personal benefits for MOOC enrolment. Most of their interviewees were very curious about what MOOCs look like. The participants were motivated by the idea that they have access to valuable educational resources that they were always interested in but were difficult to pursue (Zheng et al., 2015).

Educational benefits, the second theme, can be conceptualized in terms of academic gains and earning a certificate (Kizilcec & Schneider, 2015; Milligan & Littlejohn, 2017). Breslow et al. (2013) examined the motivation of more than seven thousand responders from 194 countries for enrolling in a “Circuits and Electronics” MOOC. They found that over half of the participants reported that the primary reason for enrolling was the ‘knowledge and skills’ they would gain. Kizilcec and Schneider (2015) found that learners were motivated by academic reasons such as ‘the course was relevant to their school’ or ‘getting a certificate’. These results correspond with other studies, which show that MOOCs played an important supplementary role to learners' current formal educational opportunities (Belanger & Thorton, 2013; Schmid, Manturuk, Simpkins, Goldwasser, & Whitfield, 2015; Zheng et al., 2015).

Career benefits, the third theme, can be conceptualized in terms of knowledge and skills relevant to job or future employability (Dillahunt, Ng, Fiesta, & Wang, 2016; Littlejohn et al., 2016; Liu, Kang, & McKelroy, 2015; Zhenghao et al., 2015). Zhenghao et al. (2015) examined more than fifty thousand participants who had completed a Coursera MOOC prior to September 2014. They found that more than a half of the MOOC completers were primarily motivated by career benefits. More recently, Liu et al. (2015) argued that the majority of the participants taking a MOOC in Journalism were professionals who sought to get opportunities and resources for their career development. Dillahunt et al. (2016) surveyed more than four hundred learners who took MOOCs for reasons related to employment; they found that enhancing employability was a key reason why many learners enroll in MOOCs. They categorized ‘desired career advancement’ for MOOC learners into four types: transitioning into a new field; looking to be promoted in their current field/job; looking for new positions in current fields or jobs; and looking for a refresher course in their current area of work. Littlejohn et al. (2016) conducted in-depth interviews with more than thirty learners who participated in an “Introduction to Data Science” MOOC. They found that learners with a relevant professional context expressed motivations related to professional development, such as improving their skillset and gaining general content knowledge of data science that would support them in their current and future practices.

The three motivational aspects detailed above indicate a spectrum of expected benefits for MOOC enrollees. Some studies showed that personal aspects were the dominant motivation (Belanger & Thornton, 2013; Hew & Cheung, 2014); others showed that educational aspects were dominant (Breslow et al., 2013; Kizilcec & Schneider, 2015), while others underlined career advancement as the dominant motivating factor (Dillahunt et al., 2016; Liu et al., 2015; Zhenghao et al., 2015).

The differences regarding motivation for enrolling in a MOOC might be explained by differences in course topics. It can also be explained by differences in students' cultural background (Macleod, Haywood, Woodgate, & Alkhatnai, 2015; Stich & Reeves, 2017; Zhenghao et al., 2015). For example, Macleod et al. (2015) showed that MOOC participants with high socioeconomic status and higher levels of education were more likely to report career benefits. Conversely, Zhenghao et al. (2015) found that participants with lower socioeconomic status were more likely to report educational benefits (Zhenghao et al., 2015). Their study showed that participants from developing countries, where advanced studies were unavailable, were more interested in obtaining a certificate. In a recent study, Stich and Reeves (2017) indicated similar results. They examined more than two thousand U.S. MOOCers who participated in at least four hundred different MOOCs. They found that underrepresented populations such as Blacks/African Americans and participants from low-income backgrounds were most likely to hold educational advancement motivations for taking MOOCs.

2.2. The motivational factors that influence participants' engagement in MOOCs

Research has showed that learners' engagement in MOOCs is highly affected by their motivation (Barak et al., 2016; Halasek et al., 2014; Yang, 2014). Halasek et al. (2014) found that MOOC participants' interests and personal motivation determined whether and how they engaged with course materials. In their study, those with low motivation observed the course as educators interested in MOOCs, but did not assume the role of student; others read or watched the course materials with no intention of completing the course assignments. Those who completed the course assignments and selected individualized sets of enrichment materials showed higher motivation for advancement (Halasek et al., 2014). Barak et al. (2016) found that regardless the language of instruction, MOOC participants were driven to learn by similar goals, emphasizing *intrinsic motivation* and *self-determination* as the leading motivational constructs. The researchers found a positive relationship between motivation gain, the number of messages posted to the online forums, and the number of members in the online study groups. Five types of MOOC completers were identified: problem-solvers, networkers, benefactors, innovation-seekers, and complementary-learners (Barak et al., 2016).

Conversely, Yang (2014) found that there was no relationship between students' intrinsic motivation – the inherent satisfaction to be engaged in activity for its own sake – and their participation in the discussion forums at the initial stage of the course. However, the relationship between the intrinsic motivation and participation became stronger and significant as the course progressed over time. Similar results were reported by Barak et al. (2016), indicating that participants who were highly involved in the discussion forums showed high gains in motivation. These results correspond with other studies, showing that lack of motivation may result in attrition and dropout (e.g., Hew & Cheung, 2014; Wang & Baker, 2015).

The importance of peer support and discussion forums for learning in MOOCs is describe in recent studies (Barak et al., 2016; Wise, Cui, Jin, & Vytasek, 2017). However, little is known about the motivations that led participants to complete a MOOC. This study is unique in examining MOOC completers' motivations according to their academic and demographic background.

3. Methodology

The study was conducted during the first iteration of the MOOC entitled: Nanotechnology and Nanosensors. The MOOC followed the same syllabus as that of the face to face course delivered on campus. The course served as a case study for a science and engineering MOOC as it requires professional knowledge, analytical skills, and the ability to handle abstract models of natural phenomena. The case study approach was used since the study examined a contemporary phenomenon within real-life context, and there was little control over intervening variables. In the current study, the Nanotechnology and Nanosensors MOOC was delivered by Prof. Hossam Haick from the Technion - Israel Institute of Technology, via Coursera platform (www.coursera.org). It was designed to present innovative content and advanced approaches for the fabrication of nanosensors in diverse science and engineering fields. It introduced nanotechnology principles and the vital role of nanomaterials in novel sensing applications. The ten-week course included discussions over broad interdisciplinary areas that encompassed chemistry, physics, biology, material science, and electrical engineering. The learning materials consisted of video lectures, articles, and an e-book. The course included three types of graded assignments: ten weekly quizzes, two essay questions and a final project. In order to receive a “Statement of Accomplishment” (general participants) or a Certificate (university-affiliated participants) students were required to receive an overall course grade of 70% or higher.

3.1. Participants

The study was conducted during the first iteration of the Nanotechnology and Nanosensors MOOC. The total number of completers was 377 out of 11,210 participants who started the course (3.4%). Since participation in the study was voluntary and participants could withdraw at any given point, our sample included 308 participants who signed the informed consent form.

The participants (n = 308) were distributed as follows: 114 university-affiliated students and 194 general participants. The general participants included two special groups: Regular track (free) participants (N = 67) and Signature track (paid) participants (N = 127). Joining a signature track allowed participants to securely link their coursework to their identity so that they could receive a Verified Certificate issued by the MOOC provider (Coursera in this case) and the participating university. The university-affiliated students were accepted to the Technion according to their high achievements in the matriculation and psychometric examinations. They came from different engineering departments, with similar pre-requisite courses that were delivered face to face, where some of them meet. They took the Nanotechnology and Nanosensors MOOC for credit, answering the same quizzes and working on the same assignments as the general MOOC participants. The MOOC requirements were aligned with the university assessment regulations. The participants' demographic and academic backgrounds are presented in Table 1.

Table 1
Participant demographics and academic backgrounds by research group.

Demographics and academic background		% General participants (N = 194)	% University-affiliated students (N = 114)
Gender	Male	72	54
	Female	28	46
Age	25 and younger	34	47
	26–35	34	51
	36 or older	32	2
Level of education	Undergraduate	15	67
	Graduates	85	33
Academic field	Engineering/ Business	43	89
	Science/Medicine	57	11
Occupation status	Students	45	94
	Industry workers	29	6
	Researchers	26	–

Chi-Square test indicated statistically significant differences between the research groups in respect to Gender distribution – most of the participants in the general participant group were males, while the distribution was equal between males and females in the university-affiliated students group (χ^2 (1) = 10.06, p = .00); Age - the university-affiliated students were younger than the general participants (χ^2 (2) = 37.22, p = .00); Level of education - the percentage of graduates among the university-affiliated students was lower (χ^2 (1) = 88.00, p = .000); Academic field - most of the university-affiliated participants studied engineering, while the distribution between engineering and sciences among the general participants was almost equal (χ^2 (1) = 61.42, p = .000); Occupation status - only a few university students worked part time in the industry (χ^2 (2) = 73.47, p = .000).

3.2. Method and data analysis

In this study, we employed a sequential mixed-methods design, in which an exploratory qualitative study leads to a quantitative analysis process (Creswell, 2014). The qualitative data analysis followed the phenomenological approach, underlining the insights, beliefs, and epistemic views of the participants (Willig, 2013). Then, for the qualitative analysis process, the emerging categories were encoded, counted, and compared in order to examine the differences between the research groups.

The current study purposefully applies the comparison method. As a method strategy, comparison plays an important part in social sciences (Azarian, 2011). Through comparison, methodological problems such as controlling for intervening variables or establishing equivalent measures stand clearer. Comparisons may serve the identification of problems and issues, which would not be seen without them. Comparative methods in educational research undertakes to explore, understand, and explain differences across similar learning environments (Barak et al., 2016). Given the fact that no social phenomenon or process recurs in the same form, comparative analysis helps researchers make sense of the observed phenomenon by identifying the principles of both similarities and differences (Azarian, 2011; Smelser, 1976). Comparative analysis is often adopted for the purpose of better grasping participants' curiosity and motivations (Barak et al., 2016; Azarian, 2011).

Data was collected via an open online survey, forum posts, and email messages; altogether. *The online survey* was administered in order to examine the expected benefits for taking the MOOC. It included two parts: (1) demographic data: gender, age, level of education, academic field, and occupation status, (2) an open-ended question "Why are you taking the MOOC in Nanotechnology and Nanosensors"? The online survey was distributed through the course message system to learners who enrolled in the Nanotechnology and Nanosensors MOOC, prior to the start date.

In addition to the survey, we analyzed 116 forum posts and 45 email messages that referred explicitly or implicitly to participants' motivation to learn. Among them, 44 forum posts and 17 email messages were written by university students, and 72 forum posts and 28 email messages were written by the general participants. The additional information was used to triangulate the categories that emerged from the online survey (Denzin, 1978). Triangulation was used to corroborate the emerging categories found in the analysis of the survey. It was conducted to increase the study trustworthiness, objectivity, and validity through the convergence of information from different sources.

Participants' answers to the survey, their forum posts and email messages were analyzed qualitatively via a deductive and inductive analysis (Willig, 2013). The researchers found eleven categories that indicated online learning enrollment intentions. The deductive and inductive analysis included five main steps: 1. The participants' statements were compiled into one coherent file; 2. Three independent researchers read it rigorously and marked relevant text segments indicated, explicitly or implicitly participants' expected benefits to enroll to a MOOC; 3. The marked text segments were assigned to categories based on online learning enrollment intentions presented in Kizilcec and Schneider (2015); 4. The segments that did not fall under the categories developed by Kizilcec and Schneider (2015) were assigned to new categories; 5. Associated categories were grouped into three major themes: (career benefits, personal benefits and educational benefits); 6. Inter-coder reliability was calculated for all of the data. Coding disagreements were discussed until agreement on 90% of the scores was reached (Hayes & Krippendorff, 2007).

In order to conduct a quantitative analysis, for each participant, we summarized the number of relevant categories for each theme. For example, a participant might have provided two categories under "personal benefits," one under "educational benefits" and one under "career benefits." The quantitative data analysis was conducted using IBM Statistical Program for the Social Sciences (SPSS), version 22.0 (IBM, 2013). Due to the ordinal nature of the data, non-parametric approaches to statistical analysis were used. The statistical analysis involved two main tests, a Mann–Whitney U test to compare two independent groups and the Kruskal–Wallis H-test to compare more than two groups.

4. Findings

This section includes three parts; each provides data for one of the research questions. First, we characterize the expected benefits of MOOC completers. Second, we examine the differences between general participants and university-affiliated students in their expected benefits, and finally we discuss the influence of demographic factors on MOOC completers' expected benefits.

4.1. Characterizing the expected benefits of MOOC completers

The content analysis of the open survey, forum posts, and email messages revealed 469 statements related to the expected benefits of MOOC completers. The number of statements exceeds the number of participants because some participants expressed more than one reason to enroll in a MOOC. We identified nine emerging categories, which were grouped into three main themes: Career, Personal, and Educational benefits. The theme - *Career benefits* includes four categories: professional competence, product development, research relevance, and career change. The theme - *Personal benefits* includes two categories: general interest, and growth and enrichment. The theme - *Educational benefits* includes three categories: school relevance, certificate, and online learning experience. The following paragraphs include examples for participants' statements for each of the three themes by category.

4.1.1. Career benefits: professional competence

A common expected benefit for participants to take a practical MOOC is to acquire professional competence. Professional competence refers to the knowledge and skills relevant to a job. It also refers to the ability to communicate effectively with professionals. The following quotes provide selected examples of participants' statements.

For example, K.L. an Engineer from Belgium stated: *It's important for me to know what possibilities technology can give to best solve certain engineering/design problems I might encounter. I hope to gain further insight of where nanotechnology can help solve problems particularly in the field of medical practice, medical devices for patients, agriculture, and even education.* [K.L., an Industrial Design Engineer, Belgium].

Another example: *I'd like to learn about Nanotechnology and its various electronic and mechanical applications in aerospace industries. I think that this course could be useful to help me to strengthen my professional skills.* [S.O., an Aerospace Engineer, U.S.A].

4.1.2. Career benefits: product development

Another expected benefit of MOOC completers was product development. This expected benefit was more typical of professionals, entrepreneurs, and research and development (R&D) engineers, who were seeking innovative ideas, new techniques, or new technologies. Knowledge on product development processes can help them design and generate new tools or products. The following quotes provide selected examples of participants' statements.

For example, G.L. an Engineer from Brazil stated: *We work with electrochemistry to build our sensors using polymers; currently we are starting to use nanomaterials in our system. I'm taking this class to learn more about new techniques, comprehend chemical mechanisms of production and characterization of materials such as, gold nanoparticles, graphene, and carbon nanotubes.* [G.L., a R&D Engineer, Brazil].

Another example: *We work in the field of ocean energy development, specifically the development of tidal and hydrokinetic technology including cross flow turbines. We seek to identify and integrate innovative technologies to improve overall system performance with respect to coatings, electronics as well as environmental and performance sensors.* [S.P., an Industrial Management Engineer, Colombia].

4.1.3. Career benefits: research relevance

Many MOOC completers, especially scientists who work in research centers, had registered for the course to meet their current research needs, including learning about new tools and new research methodologies. This expected benefit was typical for academic researchers, including PhD students, laboratory researchers and research centers employees. The following quotes provide selected examples of participants' statements.

For example, a biochemical researcher stated: *I'm starting a research with nanosensors to identify oxidative stress molecules as a marker of diabetic nephropathy development. The aim of this study is use nanosensors as an important tool to predict renal injuries induced by diabetes mellitus. I think this course will meet my research needs.* [R.K., a Scientist, Brazil].

Another example is a doctoral student who stated: *I'm working on human augmentation in my PhD thesis, looking for a combination of different fields of science to reach my purpose. I think my research will be nothing if it cannot use nanosensors, and I'm completely unfamiliar with them, so I took this course to enrich my research.* [N.F., a PhD student, Spain].

4.1.4. Career benefits: career change

Many MOOC completers enrolled in the course to enhance their future employment. These individuals had strong determination to complete the course, because this would advance their resume and open new doors for careers opportunities. The following quotes provide selected examples of participants' statements. The following quotes provide selected examples of participants' statements.

For example, an industry worker from Russia stated: I plan a career change in the following year and nanotechnology is a possible opportunity *for a new field of work. I would like to open my mind for new areas, and maybe, together with my previous knowledge, I'll find new opportunities in this subject area.* [P.G., an Industry worker, Russia].

Another example: *I believe there are many improvements that we can do with the nanotechnology. At the moment I'm unemployed; I believe that with the course I can improve my curriculum vitae and find a good job.* [O.L., a Graduate student, Israel).

Overall, with respect to career benefits, the MOOC completers expected to improve their skillset and engineering knowledge. According to their assertions, obtaining professional skills will allow them to carry out their job responsibilities in a more professional way. It seems that professionals, entrepreneurs, and research engineers, enrolled to the MOOC with the expectation to gain innovative ideas and learn about new engineering techniques. With a focus on product development, they expect to be able to better design and develop new nano-devices. Completers with a scientific background expected the MOOC to meet their current research needs, including learning about new research methods and tools. Others had strong determination to complete the course, as they believed that this might promote their chances to better employment.

4.1.5. Personal benefits: general interest

One common motivation to take a particular MOOC was related to personal benefits. Many participants indicated curiosity and general interest in the nanotechnology. They were inquisitive about the field of nanoparticles and the use of nanosensors. The following quotes provide examples of participants' statements.

For example, a scientist working in a research lab stated: *Interesting topic, not directly related with my job but curious about what is going on in this field. To get some ideas of the new possibilities, indirectly affecting my field.* [W.Y., a scientist, Germany].

Another example: *I am very interested in nanotechnology in general. Because nanomaterials and nanostructures integrated with CMOS Chips lead to path breaking and exotic technologies, which were not possible earlier.* [P.M., a graduate student, Israel].

4.1.6. Personal benefits: growth and enrichment

Growth and enrichment is another personal benefit for MOOC completers. They wanted to be updated with the new scientific and technological developments in the field of nanotechnology not only for applying new ideas in work, but also for personal growth. The following quotes provide selected examples of participants' statements.

For example, an academic researcher stated: *I wish to keep myself updated with the latest technology and trends, and keep an eye on modern technics for my enrichment.* [S.Y., a chemist, Germany].

Another example: *I like to track the development of the nanotechnology field and see its future directions.* [E.B., a graduate student, Israel].

Overall, with respect to personal benefits, the MOOC completers were drawn into learning nanotechnology since the topic of nanosensors and their applications in various devices stimulated their interest. The participants were interested in understanding what is new in the field and they were fascinated about the rapid developments.

4.1.7. Educational benefits: school relevance

It is not surprising that many graduate students took the course because it was part of their graduate study requirements, or the course addressed topics relevant to their field of study. The following quotes provide selected examples of participants' statements. For example, an undergraduate student from Israel stated: *It's one of the required courses in my syllabus in the field of pharmacy…it helps me understand scientific and engineering concepts.* [E.B., an undergraduate student, Israel].

Another example given by an undergraduate student from Romania: *I am studying micro and nanotechnologies. Although my college program covered the basics, this course will give me the opportunity to learn much more about the practical use of nanosensors and the ways of their fabrication. The basics that I know allow me only to understand the basic quantum principles but I am having difficulties trying to implement that basis to real life engineering. I think this course will be a perfect chance for me to fully understand how the quantum world evolves and get to know more about its uses.* [H.K., an undergraduate student, Romania].

4.1.8. Educational benefits: certificate

As an expected, many MOOC participants took the course to receive a valuable and recognized certificate, as an evidence for their learning achievement in the nanotechnology field. A scientist from Brazil stated: *I learned nanotechnology by attending the local nanotech lab as an undergraduate research assistant. I intend to take this course as a means to append a valuable and recognized certificate to my major diploma, as a means to clearly state my background in nanotechnology.* [O.W., a assistant, Brazil].

Another example: *I need to add one more course to my academic curriculum in order to close all my academic assignments in undergraduate studies. This course is approved by the faculty administration.* [L.P., an undergraduate student, Israel].

4.1.9. Educational benefits: experience of online course

Experience of online course was an expected benefit for MOOC participants, especially among lifelong learners and hobbyists. For example: *I want to discover what MOOCs are, and how people do MOOCs.* [Q.D., a hobbyist, India]. Another example: *I am taking an online course. This allows me to adapt my learning to my time constraints, as I am now working and cannot attend a face to face course on a regular basis.* [H.D., an engineer, Brazil].

Overall, with respect to educational benefits, the MOOC completers, especially undergraduate and graduate students who enrolled to the course expected it to addressed topics that are significant to their area of interest. Some expected to acquire a certificate from a well-known university while others studied the course to experience online learning.

The distribution of participants' expected benefits for taking a MOOC, by themes and categories is presented in Fig. 1.

General interest was the most frequent category (33%, of the statements). Next was Professional competence (16%) and the least frequent category was Experience of online course (2%). The 'Personal benefit' theme and its two categories: General interest and Growth and enrichment, was the most popular theme, representing 44% of the statements. The 'Career benefits' theme and its four categories: Professional competence, Product development, Research relevance, and Career change, represented 37% of the statements. The 'Educational benefit' theme and its three categories: School relevance, Certificate and Experience of online course, represented only 19% of the statements.

4.2. Differences between university-affiliated students and general participants in their expected benefits

This section presents the differences in expected benefits between two groups: University-affiliated students and general participants. Data indicated that more than half of the university-affiliated students' statements (55%) referred to Personal benefits; more than a third (36%) referred to Educational benefits; and only a few (9%) referred to Career benefits. The analysis of the general participants' statements showed a different pattern. Half of their statements (51%) referred to Career benefits; more than a third (38%) referred to Personal benefits; and only a few (11%) referred to Educational benefits.

A Mann–Whitney test indicated statistically significant differences between the two groups. The university-affiliated students wrote more statements related to Personal benefits ($U = 9343.50$, $p = .01$, $r = -.14$), and Educational benefits ($U = 7662.0$, $p = .00$, $r = -.32$), while the general participants wrote more statements related to Career benefits ($U = 4731.00$, $p = .00$, $r = -.53$). In order to examine the source of these differences, further analysis showed that less than a half

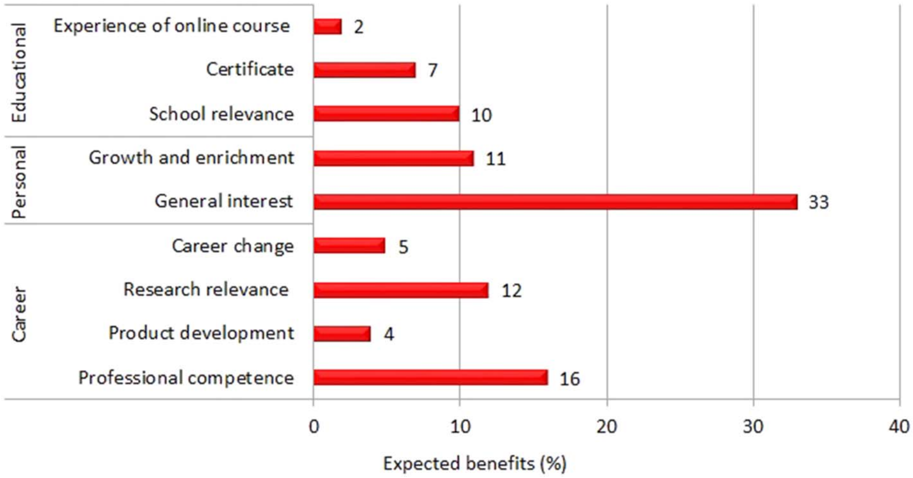

Fig. 1. The distribution of participants' expected benefits for taking a MOOC.

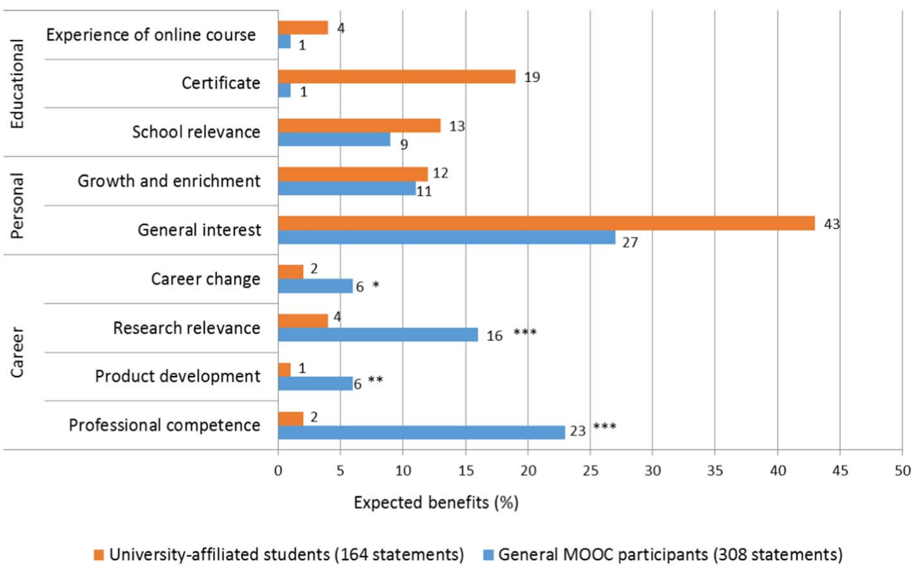

Fig. 2. The distribution of participants' expected benefits for taking a MOOC, by research group. *$p < .05$, **$p < .01$, ***$p < .001$.

of university-affiliated students' statements (43%, 69/161) referred to General interest in the subject matter. About fifth of the statements (19%, 30/161) referred to Certificate. About sixth of the statements (13%, 21/161) referred to School relevance. Other incentives were Personal growth and enrichment (12%, 20/161), Experience of online course (4%), Research relevance (4%), Professional competence (2%), Career change (2%) and Product development (1%). The analysis of general participants' statements showed that less than a third of the statements (27%, 84/308) referred to General interest in the subject matter. About a quarter (23%, 70/308) referred to Professional competence, less than a fifth of the statements (16%, 49/308) referred to Research relevance. Other incentives were Growth and enrichment (11%, 34/308), School relevance (9%, 27/308), Product development (6%, 18/308) and Career change (6%, 19/308). Only a few statements indicated the incentive for learning related to Certificate (1%) and Experience of online course (1%). The distribution of participants' expected benefits for taking a MOOC, by research group, is presented in Fig. 2.

Statistically significant differences between the two groups were indicated for all the 'Career benefits' categories: Professional competence ($U = 7416.00$, $p = .000$, $r = -.37$), Product development ($U = 10{,}226.00$, $p = .009$, $r = -.15$), Research relevance ($U = 8847.00$, $p = .000$, $r = -.25$), and Career change ($U = 10{,}266.00$, $p = .020$, $r = -.13$). Statistically significant differences were also indicated for General interest ($U = 9153.00$, $p = .000$, $r = -.17$) and Certificate ($U = 8319.00$, $p = .000$, $r = -.39$). The U measurement indicated high results because of the relatively large sample size.

Overall, university-affiliated students' enrollments were Personal and Educational centered whereas, general participants' enrollment intentions were Career and Personal centered. This difference raised a question regarding the role of taking the signature track in their expected benefits, that is, did general participants who enrolled through the signature track have similar benefit expectations to the university-affiliated students? A Kruskal–Wallis test was used to examine differences between three groups: General participants with signature track, general participants with regular track and university-affiliated students. Table 2 presents the Kruskal-Wallis of expected benefits by

Table 2
A Kruskal-Wallis analysis of expected benefits by categories and research groups.

Expected benefits	General participants		University-affiliated students (N = 114)	df	χ^2	p
	Signature track (N = 127)	Regular track (N = 67)				
Career	201.87	179.33	99.00	2	92.49	.00
Personal	125.2	156.46	169.54	2	13.23	.00
Educational	134.26	138.44	184.29	2	33.26	.00

categories and research groups.

Table 2 shows significant differences among the three groups in their statements related to Career, Personal and Educational benefits. A Mann Whitney U test was used to examine the source of these differences. A Bonferroni correction was applied and so all effects are reported at a 0.017 level of significance.

The university-affiliated students indicated significantly more statements related to Educational benefits compared to the signature track MOOCers and regular track MOOCers ($U = 2587$, $p = .00$, $r = -.32$; $U = 5075.00$, $p = .00$, $r = -.32$; respectively). They indicated significantly fewer Career benefit statements compared to the signature track MOOCers and regular track MOOCers ($U = 1304.00$, $p = .00$, $r = -.65$; $U = 3427.00$, $p = .00$, $r = -.61$; respectively). Whereas the signature track MOOCers indicated fewer Personal benefit statements compared to the regular track MOOCers and university-affiliated students ($U = 3388.50$, $p = .01$, $r = -.19$; $U = 2722.00$, $p = .00$, $r = -.27$; respectively).

Further analysis examined the relationships among expected benefits categories within each group. Among university-affiliated students, results showed a moderate negative correlation between two thematic categories: Personal benefits and Educational benefits (rs (114) $= -.57$, $p = .00$). Further analysis revealed a negative correlation between “General interest in the subject” (a Personal benefit category) and “Certificate” (an Educational benefit category) (rs (114) $= -.37$, $p = .00$). These findings suggest that the university –affiliated students who intended to take the MOOC to get a certificate were less motivated by general interest in the subject.

Among general participants, results revealed a moderate negative correlation between two thematic categories: Career benefits and Personal benefits (rs (194) $= -.47$, $p = .00$). Further analysis revealed a negative correlation between Professional competence (a Career benefit category) and two Personal benefit categories: General interest and Growth and enrichment (rs (194) $= -.17$, $p = .02$; rs (194) $= -.31$, $p = .00$; respectively). Another negative correlation was indicated between Research relevance and the two same categories indicated previously: General interest and Growth and enrichment (rs (308) $= -.17$, $p = .02$. rs (194) $= -.21$, $p = .00$; respectively). These findings suggest that general participants who are mostly professional workers and/or academic researchers (such as engineers, medical doctors, laboratory researchers and PhD students) were motivated by knowledge and skills relevant to their job or registered for a MOOC to meet their current professional research needs. They were less motivated to take the MOOC for general interest or enrichment.

4.3. Demographic factor influence on MOOC completers' expected benefits

This section provides an answer to the third research question. Data were collected to examine the differences in expected benefits within each group according to the following demographic trends: level of education, age and occupation. The analysis showed statistically significant differences for level of education within the university-affiliated students and for age and occupation within the general participants.

Related to expected benefits by level of education, the analysis shows that within the university affiliated- student group, the undergraduate students indicated fewer Career benefit statements compared to the graduate students. This difference was statistically significant ($U = 1113.50$, $p = .01$, $r = -.31$). No statistical differences were found between the two groups in their statements about Personal and Educational benefits. Within the general participants, the analysis showed no statistically significant differences for level of education. This can be explained based on the fact that within the general participants, most (85%) were graduates and only 15% were undergraduates.

Related to expected benefits by age, the general participants indicated statistically significant differences (Table 3).

Table 3
A Kruskal-Wallis test of expected benefits by age for general participants.

Expected benefits	25 and younger (N = 66)	26–35 (N = 66)	36 or order (N = 58)	df	χ^2	p
Career	91.45	107.04	86.97	2	5.91	.05
Personal	92.61	83.98	111.91	2	10.34	.01
Educational	107.89	91.89	85.52	2	12.86	.00

Table 3 shows the Kruskal-Wallis findings for age within general participants. Findings illustrate that there is no statistically significant difference between the three groups in their statements related to Career benefits. However, there is significant difference in their statements related to Personal and Educational benefits. A Mann Whitney test was used to examine the source of these differences. A Bonferroni correction was applied and so all effects are reported at a 0.017 level of significance.

General participants who were 36 years or older indicated more Personal benefit statements compared to participants who were 26–35 year old. In addition, they indicated fewer Educational benefit statements compared to the participants who were 25 and younger. These differences were statistically significant ($U = 1360.50$, $p = .00$, $r = -.28$; $U = 1464.00$, $p = .00$, $r = -.30$; respectively). However, the analysis showed no statistically significant differences for age within the university-affiliated students. This can be explained based on the fact that within the university-affiliated students almost half were 25 and younger the other half was 26–35 years old.

Related to expected benefits by occupation, the general participants indicated statistically significant differences (Table 4).

Table 4 shows the Kruskal–Wallis findings by occupation. Findings illustrate significant differences between the three groups in statements related to Career, Personal and Educational benefits. A Mann Whitney U test was used to examine the source of these differences. A Bonferroni correction was applied and so all effects are reported at a 0.017 level of significance.

The industry workers indicated fewer Career benefit statements compared to the students and researchers ($U = 1760.00$, $p = .00$, $r = -.22$; $U = 957.50$, $p = .00$, $r = -.23$; respectively). The industry workers indicated more Personal benefit statements compared to the students and researchers ($U = 1798.00$, $p = .00$, $r = -.21$; $U = 992.50$, $p = .00$, $r = -.20$; respectively). The students indicated more Educational benefit statements compared to the industry workers and researchers ($U = 1835.50$, $p = .00$, $r = -.25$; $U = 1755.00$, $p = .00$, $r = -.22$; respectively). This can be explained by the fact that most of the industry workers were veteran employees who took the MOOC for interest and enrichment; whereas researchers are those who work in laboratories in the academy or in industry in research and development centers. Deeper analysis indicated that most of the industry workers (71%) were 36 years old and older, 17% were 25–36 years old and only 12% were 25 and younger. In contrast, most of the scientists (60%) were 25–36 years old, 32% were 36 and older and only 8% were 25 and younger. Most of the students (64%) were 25 and younger, a third (31%) were 25–36 years old and only 5% were 36 and older. Within the university-affiliated students, the analysis showed

Table 4
A Kruskal-Wallis test of expected benefits by occupation for general participants.

Expected benefits	Student (N = 88)	Industry worker (N = 55)	Researcher (N = 51)	df	χ^2	p
Career	104.1	44.41	107.77	2	12.64	.00
Personal	91.92	116.26	86.89	2	11.00	.00
Educational	109.70	86.26	88.57	2	18.04	.00

no statistically significant differences for occupation. This can be explained based on the fact that within the university-affiliated students most (94%) were full-time students and only (6%) were industry workers.

5. Discussion and conclusions

The goal of this study was to examine the motivating factors of MOOC completers according to their expected benefits, while comparing two groups: university-affiliated students and general participants in the context of science and engineering education. Studies on motivation to learn in MOOC environments are not new (e.g., Dillahunt et al., 2016; Hew & Cheung, 2014; Littlejohn et al., 2016; Milligan & Littlejohn, 2017; White et al., 2015); however, these studies based their findings on enrollees, while the current study purposefully examined MOOC completers. Our main findings are summarized and discussed in the following paragraphs.

5.1. The characterization of MOOC completers according to their expected benefits

Completing a MOOC in science and engineering is a great challenge as it involves the understanding of complex contents, high self-efficacy, and internal motivation (Barak et al., 2016; Breslow et al., 2013; Shapiro et al., 2017). Prior literature has pointed out that MOOC participants vary in their backgrounds and personal objectives, leading to differences in learning incentives (Kizilcec & Schneider, 2015; Shapiro et al., 2017). In this study, the participants' motivating factors were grouped into three themes: Career benefits, Personal benefits, and Educational benefits.

Overall, the general interest category, under the personal benefit theme, was the major motivating factor of the MOOC completers. This was also indicated in other studies, suggesting that curiosity and being inquisitive about the learning subject, is a strong incentive among MOOC learners (e.g., Kizilcec & Schneider, 2015; Liu et al., 2015). Zheng et al. (2015) suggested that completion is just one outcome of MOOC participation, with key motivations related to satisfying curiosity, preparing for the future, fulfilling current needs, and connecting with people (Zheng et al., 2015). Notably, Social benefits, such as meeting new people or participating in discussion forums, were less articulated in this study, as opposed to other studies (e.g. Barak et al., 2016; Kizilcec & Schneider, 2015; Wise et al., 2017; Zheng et al., 2015).

Professional competence was also highly articulated among our participants. This reflects the new trend in online learning in which MOOCs have become more career oriented. Today, many science and engineering MOOCs are shifting from academic education to professional training (Pickering & Swinnerton, 2017; Wan & Hsu, 2016). For example, a MOOC entitled Exploring Anatomy: The Human Abdomen was specifically developed for healthcare professionals (Pickering & Swinnerton, 2017). Another example is the Special Topics in Clinical Pharmacy MOOC that was developed as a continue education program for professional pharmacists (Wan & Hsu, 2016). The need for updated competences and work-related skills is in high-demand worldwide. Adaptive, transferable and work-related competencies are necessary for professionals to address global challenges. Accordingly, the MOOC completers in this study voiced their expectations to improve their skillset and engineering knowledge. Their motivation to complete the course was based on the need to obtain professional skills that will allow them to gain innovative ideas and learn about new engineering techniques.

While professional competence was one of the popular incentives for learning a MOOC, acquiring a certificate was less popular. This shows that many completers enrolled to the MOOC with the intention of career advancement, and less for receiving credentials. This finding is encouraging since it suggests that the participants were interested in advancing their nanotechnology understanding and skills rather that learning only for an official document.

5.2. Differences between university-affiliated students and general participants in their expected benefits

This study examined two groups of MOOC completers: university-affiliated students and general participants. The two groups were similar in that their motivation was based on personal benefits – general interest along with growth and enrichment. However, the two groups differed in other parameters. While the enrollment motivation of the university-affiliated students indicated strong affiliation to educational aspects, the general participants' motivations were career based. This result, in part, supports research that identified educational advancement as the motivating factor for university students who take a MOOC (Stich & Reeves, 2017). It also supports a study that identified career advancement as the motivation factor for MOOC learners with a relevant professional context (Littlejohn et al., 2016; Milligan & Littlejohn, 2017). These differences, in turn, shape how learners conceptualize the purpose of the MOOC. Along with growth and enrichment, the general participants were interested in acquiring knowledge and skills relevant to their workplace, while the university-affiliated students were interested in learning contents that are relevant to their academic degree.

Among the university-affiliated students, results showed a negative relationship between personal benefits and educational benefits, indicating that those who took the MOOC for general interest were less concerned about earning a certificate. Similarly, among the general participants, results showed that those who took the MOOC for growth and enrichment were less concerned about professional competence and research relevance.

Although the differences in motivations, both university-affiliated students and professionals indicated personal-related motivations. Zheng et al. (2015) argue that because different MOOC participants have different motivations, they may benefit from different services. They propose two styles of MOOC modules: one is learning-driven and the other is certificate-driven. Contrary to this, we claim that there are many benefits of having university students and working professionals in the same learning environment. The students devote most of their time to learning. They have a strong incentive to complete the required tasks in the most successful way. They are acquainted with new ways of learning and their knowledge is updated. They can provide support to other learners and encourage MOOC completion. The professionals have experience in solving real-world problems since they work in companies, in factories, or in research centers. They bring a practical viewpoint to the learning process. Some have experience in working in collaboration with national and international peers. The professionals can emphasize career benefits, including work opportunities to the university students.

Guided by our findings, we believe that MOOCs should be developed to attract and support diverse populations, as each population can contribute to the knowledge and experience of the other population. The interactions between participants from diverse backgrounds, can be enhanced by encouraging participants to work in small groups on joint projects (Barak et al., 2016; Spoelstra, Van Rosmalen, & Sloep, 2014). We suggest that MOOC developers incorporate project-based learning to provide opportunities for idea exchange (Barak & Watted, 2017; Spoelstra et al., 2014). Project-based MOOCs can provide an empowering experience to all participants.

5.3. Demographic factor influence on MOOC completers' expected benefits

Demographic background of MOOC completers, especially the age factor, had a significant role regarding their expected benefits and enrollment motivation. Among the general participants, those who were 25 years and younger were mostly motivated by Educational aspects; those who were 26 to 35 years old were mostly motivated by Career aspects, while those who were 36 years and older were mostly motivated by Personal aspects. This result, in part, supports research that found that as MOOC participants' age increased, their desire to obtain certification or improve career prospects was less dominant (Macleod et al., 2015). Other research found that learners who reported enrolling due to educational aspects such as Relevance to school or their degree program were three years younger on average than those who did not report this intention (Kizilcec & Schneider, 2015). No differences were indicated for age within the university-affiliated student group since most of them were younger than 35 years.

Personal aspects were also the dominant motivational factor among the general participants who were industry workers. This might be explained by the fact that most of the industry workers were 36 and older. They were veteran employees or experienced workers who took the MOOC for growth and enrichment. On the other hand, researchers, who were scientists who worked in higher education laboratories or research institutions, took the MOOC mostly for career aspects, as most of them were 25 to 36 years old.

Among the university affiliated-students, the enrollment motivation of graduate students (26 to 36 years old) was based on career aspects, while the undergraduates (younger than 26) were motivated by educational aspects. Again, this might be explained due to age differences, as indicated above (Kizilcec & Schneider, 2015). The researchers also found that learners who held a college degree or a more advanced degree more frequently reported enrolling due to relevance to their job than those with some college or less schooling (Kizilcec & Schneider, 2015).

Our study is unique in showing that motivational factor of MOOC participants are related to their affiliation. The study identified two new categories that were not presented in the literature before: 'product development' and 'professional competence' for explaining MOOCers' expected benefits. This may suggest that MOOC completers and dropouts have different motivations. Further research is needed to examine this assertion in an empirical manner. Overall, building a deep understanding of participants' preliminary motivations and their needs is crucial for the development and evolution of future MOOCs. Signature track and the participants' age were found to be dominant factors for explaining enrollment motivation of MOOC completers.

6. Limitations and future directions

The current paper presents a detailed picture of the preliminary motivations of MOOC completers according to their expected benefits. Yet, some limitations should be acknowledged. First, the study was conducted in the setting of one MOOC in nanotechnology and nanosensors. This might limit the generalization of the results; nevertheless, the findings provide an in-depth perspective and important insights into participants' expected benefits, particularly of scientists and engineers. Second, our focus was on MOOC completers as a unique group of learners; therefore, the study included a relatively small sample size. This represent the existent state of MOOCs as studies show that MOOCs suffer from significant attrition rates, and only a small proportion eventually complete the MOOCs (Breslow et al., 2013; Evans et al., 2016). While the study contributes to the literature on enrollment motivations of MOOC completers in science and engineering, further research might compare the expected benefits and the actual benefits of MOOC completers.

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