Computers & Education 94 (2016) 49–60

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

# Motivation to learn in massive open online courses: Examining aspects of language and social engagement

Miri Barak [a, *], Abeer Watted [b], Hossam Haick [c]

[a] Head of the Science and Learning Technology Group, The Department of Education in Science and Technology, Technion-Israel Institute of Technology, Haifa, 320003, Israel

[b] The Department of Education in Science and Technology, Technion-Israel Institute of Technology, Haifa, 320003, Israel

[c] The Department of Chemical Engineering, Technion-Israel Institute of Technology, Haifa, 320003, Israel

ARTICLE INFO

*Article history:*
Received 11 May 2015
Received in revised form 9 November 2015
Accepted 21 November 2015
Available online 25 November 2015

*Keywords:*
Higher education
Language of instruction
Massive open online course
Motivation
Social engagement

ABSTRACT

Learning is mediated by language of instruction and social engagement. Both factors may play a significant role in understanding motivation to learn in massive open online courses (MOOCs). Therefore, the goal of this study was threefold: a. to compare motivation patterns of MOOC participants who study the same course but in a different language of instruction; b. to examine relationships between motivation gain and diverse modes of engagement; and c. to characterize MOOC completers according to their learning motivation. An exploratory case-study was conducted in the settings of a MOOC in *Nanotechnology and Nanosensors*, delivered in two languages: English and Arabic. The research sample included 325 participants from the English (N = 289) and Arabic (N = 36) MOOCs. The study applied the mixed methods approach, collecting data via pre- and post-questionnaires, forum posts, and email messages. Findings indicated that regardless the language of instruction, MOOC participants were driven to learn by similar goals, emphasizing *intrinsic motivation* and *self-determination*. Findings indicated 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.



## 1. Introduction

Massive open online courses (MOOCs) provide people from all over the world the opportunity to expand their education for free without any commitment or prior requirements. The growing number of MOOCs has given rise to a growing body of research that explores various aspects of online learning. Following this trend, recent studies analyzed attrition and dropout rates in MOOCs (Halawa, Greene, & Mitchell, 2014; Ho et al., 2015; Jordan, 2014; Sinha, 2014). Other studies examined social engagement (Ferguson & Clow, 2015; Li et al., 2014) and motivational patterns of MOOC enrollers (Kizilcec & Schneider, 2015). However, little is known about what motivates those who complete the online courses (Onah, Sinclair, & Boyatt, 2014). Given that MOOCs are becoming more and more popular worldwide, learners' motivation should be further studied from various aspects (Barak & Watted, 2015; Kizilcec & Schneider, 2015; Sinha, 2014). In light of the aforesaid, this papers addresses the

* Corresponding author.
*E-mail addresses:* bmiriam@technion.ac.il (M. Barak), abeerw@tx.technion.ac.il (A. Watted), hhossam@tx.technion.ac.il (H. Haick).

http://dx.doi.org/10.1016/j.compedu.2015.11.010

study of participants' motivation to learn by analyzing the impact of language and culture. The variables under study are the participants' motivation and their social engagement. The following literature review addresses the topics of motivation to learn in online learning environments and the impact of language and culture on motivation.

### 1.1. Motivation to learn

Motivation is perceived as a reason or a goal a person has for behaving in a given manner in a given situation. It is part of a person's objectives and beliefs about what is important or not (Ames, 1992). Motivation is conceptualized as an internal state that arouses, directs, and sustains goal-oriented behavior (Bandura, 2006). It is defined as "the process whereby goal-directed activity is instigated and sustained" (Schunk, Pintrich, & Meece, 2008, p. 4). It determines whether or not a person will have a certain interest or be engaged in a certain activity. In the context of learning, motivation is conceptualized as an internal source which enhances, maintains, or mediates cognitive development (Brophy, 2004; Slavin, 1987). It is also conceptualized as an integration of cognitive and affective components which result in intentional behavior (Slavin, 1987). Brophy (2004) defined 'motivation to learn' as the inclination to find relevant academic activities and obtain the intended benefits from them. Some researchers view motivation as a personality trait; however, this approach ignores the fact that learners can be motivated, depending on time or context (Schunk et al. 2008).

Glynn and colleagues indicated several motivational components that influence learning (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011). Among them: intrinsic and extrinsic motivation, personal relevance, self-efficacy, and self-determination. *Intrinsic* 'motivation to learn' involves an inherent gratification prompted by the feeling that learning is interesting and enjoyable (Duda & Nicholls, 1992; Glynn et al., 2011). On the other hand, *extrinsic motivation* involves external incentives for learning, such as obtaining a reward or avoiding punishment (Black & Deci, 2000; Glynn et al., 2011). Another component is *personal relevance* that indicates the significance of learning to the learner's goals (Duda & Nicholls, 1992). *Self-efficacy* refers to learners' confidence that they can achieve high outcomes (Bandura, 2006), and *self-determination* refers to the control learners' believe they have over their learning process (Black & Deci, 2000).

### 1.2. Motivation to learn in online learning environments

Understanding motivation to learn in online environments is gaining much interest among researchers. For example, Shroff, Vogel, and Coombes (2008) found that online learners were more intrinsically motivated than their on-campus counterparts. Cho and Heron (2015) found that online learners' intrinsic motivation is positively related to their learning performance. Studies on online learning suggest that unmotivated students may fail to use cognitive and meta-cognitive strategies, such as mastery learning or self-monitoring (Cho & Heron, 2015). In the context of MOOCs, because it is an open and free learning environment, participants tend to choose only segments of the learning environment, following their goals and interests (Kizilcec & Schneider, 2015; Wang & Baker, 2015). For example, Wang and Baker (2015) found that course completers tend to be more interested in the course content, whereas non-completers tend to be more interested in MOOCs as a type of learning experience. In a wider perspective, Kizilcec and Schneider (2015) found that different motivational goals (e.g. relevant to job, career change, meet new friends), may predict different behavioral patterns for MOOC learners. In specific, they found that learners who enrolled with friends were more likely to be engaged with course materials than their counterparts (Kizilcec & Schneider, 2015). These results correspond with other studies, showing that MOOC participants who were engaged in significant interactions with peers were less likely to dropout (Ferguson & Clow, 2015; Halawa et al., 2014; Jordan, 2014; Onah et al., 2014).

Research on MOOCs, as described above, examined social engagement via large online groups (Alario-Hoyos et al., 2013; Jordan, 2014; Kizilcec & Schneider, 2015). Research also examined social engagement via small face-to-face groups, indicating a positive effect on MOOC completion (Li et al., 2014). To date, MOOC research lacks knowledge about the relationships between motivation and learning in small online groups. In addition, given that social engagement is mediated by language, this construct may also play a significant role in MOOC participants' motivation to learn.

### 1.3. The impact of language and culture on motivation

Language, whether written or spoken, plays a significant role in the development of cognitive, social, and motivational factors (Ragupathi, 2014; Slavin, 1987; Vygotsky, 1978; Wertsch, 1991). According to the sociocultural theory, learners are not 'blank slates'; they bring with them a set of ideas and belief systems, adopted from the social and cultural group to which they belong (Lemke, 2001; Palincsar, 1998; Vygotsky, 1978). Learners, coming from different cultural backgrounds, can differ in terms of learning methods, communication style, and rules of behavior. This calls attention to the significant role of language in participants' motivation to learn in online environments.

Language mediates learning by facilitating communication among learners and the manifestation of thoughts, ideas, and knowledge. Proper use of language and good communication is feasible when meaning is correctly interpreted by the learner (Lemke, 2001; Palincsar, 1998). However, improper or ineffective use of language might lead to miscommunication, misunderstandings, thus hinder students' learning outcomes and motivation (Slavin, 1987; Vygotsky, 1978).

In higher education, English has become an international medium for communication among learners who do not share the same native language (Altbach, 2014; Vinkea, Snippea & Jochemsa, 1998). Nowadays, many MOOCs, even from non-

English speaking universities are produced in English to provide a common language for all learners (Altbach, 2014). Academic courses delivered in English were found to enhance feelings of internationalization, and had a positive impact on modernization, and on the quality of learners' experience (Coleman, 2006; Vinkea, Snippea & Jochemsa, 1998). The use of a common language allows efficient exchange of ideas and facilitates cultural awareness, diverse perspectives, and communication skills (Coleman, 2006). However, the adoption of English as a common language for MOOC instruction may exclude many learners who do not speak the language (Altbach, 2014). Furthermore, research has shown that the optimal language for learning is the learner's native language (UNESCO, 2008). Given that English is not the native language of most MOOC learners', their learning process and motivation to learn might be impeded, even if they speak and understand English. This problem affects learners from all over the world, but we still lack knowledge about adult learning in courses with masses of participants.

In light of the aforesaid, the goals of this study were: a. to compare motivation patterns of MOOC participants who study the same course but in a different language of instruction; b. to examine relationships between motivation gain and diverse modes of engagement; and c. to characterize MOOC completers according to their motivation to learn. These goals raised the following questions:

1. Are there motivational differences between MOOC participants who study the same course but in a different language?
2. What are the relationships between motivation gain, number of forum posts, and the number of members in the online groups?
3. What are the characteristics of MOOC completers according to their motivation to learn?

The following sections describe the research methodology and settings. The findings section includes three sub-sections; each provides an answer to one of the research questions. The summary and discussion section deliberates on the relationships between social engagement, language, and MOOC participants' motivation to learn. The final section discusses the research limitations and possible future directions.

## 2. Research design and methodology

This study employed a mixed methods research design in the form of an exploratory case-study, in which the quantitative and qualitative methods were prioritized equally (Johnson & Onwuegbuzie, 2004). Mixed methods research facilitates the examination of a phenomenon within its context using diverse data sources (Creswell & Plano Clark, 2007; Johnson & Onwuegbuzie, 2004). In this study, we applied the explanatory sequential design, which starts with the collection and analysis of quantitative data followed by the collection and analysis of qualitative data (Creswell & Plano Clark, 2007). The quantitative phase was conducted to answer the first and second research questions, and the qualitative phase was conducted to answer the third research question.

### 2.1. Data collection and analysis

*The quantitative data* was collected using a pretest-posttest design with two comparison groups (English vs. Arabic). In this study, the 'motivation questionnaire' was administered online before and after each MOOC. The questionnaire included 20 items on a 1 (strongly disagree) to 5 (strongly agree) Likert-type scale, adapted from the 'science motivation questionnaire' (Glynn et al., 2011). This questionnaire was selected since it was specifically designed to assess motivation to learn science in higher education. It provides a more focused view on science and engineering education than general content-area questionnaires such as the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1993) or the Online Learning Enrollment Intentions (Kizilcec & Schneider, 2015). The questionnaire includes five scales: intrinsic motivation, self-determination, self-efficacy, career motivation, and grade motivation (Glynn et al., 2011). Intrinsic motivation refers to the inherent satisfaction to be engaged in science activity for its own sake. Self-determination is the ability of the students to be in control and regulate their science learning. Self-efficacy indicates the students' confidence in their ability to complete successfully a science learning task. The fifth scale: grade motivation, was not included since it is less relevant to open and free learning environments such as MOOCs.

In this study, the reliability of the motivation questionnaire, determined by Cronbach's alpha, was 0.94. For each scales, Cronbach's alpha was: 0.73 for intrinsic motivation, 0.90 for self-determination, 0.90 for self-efficacy, and 0.94 for career motivation. The motivation questionnaire ratings were the dependent variable; while the independent variables included the number of posts in the forums and the number of members in the small online groups.

To answer the first research question, we applied parametric statistics, due to the fact that mean ratings for 'motivation' met the assumptions of normal distribution, homogeneity, and independence, for both groups (Field, 2009). Accordingly, we conducted a series of Analysis of Covariance (ANCOVA) tests to examine motivational differences between the English and Arabic groups and repeated measures analysis of variance (ANOVA) to examine interactions between time and completion status. To answer the second and third questions, we applied nonparametric (Field, 2009) and semiparametric statistics (Keele, 2008). This was due to the fact that the number of forum posts and the number of members in the small online groups

were not normally distributed. Accordingly, our analysis included Spearman's correlations to examine relationships between variables, and scatter plots and curvilinear regressions to illustrate these relationships (Keele, 2008).

*The qualitative data* was collected from the English and Arabic forums (1289 and 329 posts, respectively) and 23 email messages sent to the course teaching team. The participants used the forums in order to introduce themselves, find learning mates, and ask questions about the lectures' content and the learning assignments. The participants' written assertions were content analyzed using the inductive analysis method, an open-coding method allowing themes to emerge from raw data (Hsieh & Shannon, 2005; Thomas, 2006). This method is typically applied in studies that examine a new phenomenon for which a theory-based categorization matrix does not exist. It was applied in our study because little is known about what motivates learners to complete a MOOC. The analysis of forum posts and email messages enabled us to identify explicit as well as implicit factors related to participants' incentives. Following the work of previous studies (Hsieh & Shannon, 2005; Thomas, 2006) our analysis and coding process included four main steps. First, we compiled all the messages into one coherent file according to a chronological and hierarchical order: a single message, a thread, and a forum that is composed of several threads. Second, three independent researchers read it in rigorously and marked relevant text segments that indicated (explicitly or implicitly) participants' motivation to learn. Third, the marked text segments were rearranged in new paragraphs according to thematic relations. We identified relationships and established links between sentences. We identified emerging categories and made inferences. Fourth, we used the constant comparative method, by comparing each text assigned to a category with each of those already assigned to that category, through inter-coder assessment agreement of three researchers.

### 2.2. Research participants

The research included participants from two MOOCs in *Nanotechnology and Nanosensors*, one in English and the other in Arabic, delivered on Coursera platform (www.coursera.org). Participation was voluntary and the participants could withdraw at any given time. Table 1 presents a summary of the number of first week viewers, MOOC completers, research participants, and sample completers, by course.

As Table 1 shows, the total number of first week viewers was 13,405 for both courses. The total number of completers was 400; 377 in the English MOOC and 23 in the Arabic MOOC. The research sample included 325 participants who signed the informed consent form and answered the pre- and post-questionnaires; 289 from the English MOOC and 36 from the Arabic MOOC. This reflects the difference in the number of participants of each MOOC. In both samples (English and Arabic), about half were MOOC completers. In both samples, most of the participants were males (72% in the English course and 75% in the Arabic), about 60% were at the ages of 21–35, and about 60% were graduates. Chi-square test indicated that there were no statistically significant differences between the two samples in respect to gender, age, and academic level. The demographic distribution of our sample was similar to other MOOCs in science and engineering (Breslow et al., 2013).

### 2.3. Research settings

The study was conducted in the settings of two MOOCs in *Nanotechnology and Nanosensors*, one in English and the other in Arabic, via Coursera online system (www.coursera.org). Both MOOCs were delivered at the same time in English and Arabic by the same teaching team (lecturer and TAs). All learning materials were prepared in English and Arabic, including the course guidelines, presentation slides, learning assignments, and lecture videos. The Arabic MOOC was developed to provide access to innovative information for people who do not speak English. This is in line with the sociocultural approach, which places much emphasis on the language learners use to interact and co-construct knowledge (Lemke, 2001; Vygotsky, 1978; Wertsch, 1991).

The ten weeks long MOOCs introduced nanotechnology principles and the vital role of nanomaterials in novel sensing applications. They presented innovative contents and advanced approaches for the fabrication of nanosensors in diverse science and engineering fields. Both courses discussed broad and interdisciplinary topics that encompass chemistry, physics, biology, medicine, material science, and electrical engineering. The online platform included video lectures, articles, and an e-book. It also included six online forums: a. Questions about the learning materials, b. Questions about the course assignments, c. Who are you, telling about yourself, d. Find friends and arrange meet ups, e. General discussion, and f. Course feedback. Participation in the forums was optional and free, encouraged and supported by the course teaching team.

**Table 1**
The number of first week viewers, MOOC completers, research participants, and sample completers, by course.

| | Number of participants | | |
|---|---|---|---|
| | English MOOC | Arabic MOOC | Total |
| First week viewers | 11,210 | 2195 | 13,405 |
| MOOC completers | 377 | 23 | 400 |
| Research sample | 289 | 36 | 325 |
| Sample completers (% of research sample) | 133 (46%) | 17 (47%) | 150 |

To complete the course, learners were required to carry out ten weekly quizzes, three peer-graded essay questions, and a final project (20%, 20% and 60% of the course total grade, respectively). The final project included a written essay that describes the utilization of nanotechnology and nanosensors to imitate a specific human sense: vision, hearing, taste, smell, or touch. Guided by the sociocultural theory and the belief that learning is a social act (Lemke, 2001; Vygotsky, 1978), the MOOC participants were advised to work on the final project in online groups of 3-to-4; however, it was not mandatory. Some chose to work individually, some in dyads and some in groups of 3–5 members.

The translation to Arabic was a challenging process due to the fact that there are many dialects. Another challenge was our effort to close the gap between the spoken Arabic language and the scientific language that is written mostly in English, especially in emerging scientific fields such as nanotechnology. In order to overcome these challenges we consulted with linguistic experts who assisted with the translation. In addition, all the translated learning materials were validated by three Arabic speakers; two experts in nanotechnology and one in engineering education. Since the learning materials and teaching teams were the same, our null-hypothesis was that no significant differences exist between the two groups' in participants' motivation to learn.

## 3. Findings

This section includes three sub-sections; each answers one of the research questions. The first section describes differences in motivation to learn between the English and Arabic MOOCs participants. The second section describes the relationships between motivation to learn and participants' involvement in the online forums and small group learning. The third section portrays the motivational characteristics of MOOC completers.

### 3.1. Motivational differences between MOOC participants who study the same course, but in a different language

Motivational differences were examined by comparing between the English and Arabic MOOCs participants on their post-questionnaire ratings after controlling for their pre-questionnaire ratings. Findings indicated that the English participants expressed slightly higher adjusted post means for 'overall motivation' compared to the Arabic participants ($M = 3.89$, $SD = 0.84$; $M = 3.76$, $SD = 0.90$). Similar results were found for each motivation component, as presented in Table 2.

Analysis of covariance (ANCOVA) tests indicated no statistically significant differences between the two courses for each motivation category. This suggests that participants from both MOOCs had a similar 'motivation profile', which includes high means for *intrinsic motivation* and *self-determination*, and relatively low means for *self-efficacy* and *career motivation*.

When examining the differences between completers and non-completers, in both courses, the completers showed a moderate increase in motivation (solid lines in Fig. 1), but non-completers, showed a decrease in motivation (dashed lines in Fig. 1). The motivational difference between the completers and non-completers was statistically significant for the English group ($F(1, 287) = 9.83$, $p < .05$); and borderline significant for the Arabic group ($F(1, 34) = 8.45$, $p = .057$).

Fig. 1 shows that while the motivation of the MOOC completers increased during the ten-week course, the motivation of the non-completers' decreased. A repeated measures analysis indicated interactions between time (before and after the course) and completion status (completers vs. non-completers), for both English and Arabic MOOCs (Wilks' $\lambda = 0.79$, $F(1, 287) = 76.73$, $p < .001$, $\eta_p^2 = 0.21$; Wilks' $\lambda = 0.55$, $F(1, 34) = 27.38$, $p < .001$, $\eta_p^2 = 0.45$, respectively).

The results presented above are not surprising, since they suggest that those who lost interest in the course, decided to drop out. However, the question is why? To answer this question, we performed a deeper analysis, looking into the motivational components (Fig. 2). ANCOVA tests indicated statistically significant differences between English completers and non-completers for *self-determination* and *self-efficacy* ($F(1, 287) = 7.80$, $p < .01$, $\eta_p^2 = 0.03$; $F(1, 287) = 12.20$, $p < .05$, $\eta_p^2 = 0.04$, respectively). A similar pattern was observed among the Arabic participants, with a significant difference for *self-efficacy* ($F(1, 34) = 5.60$, $p < .05$, $\eta_p^2 = 0.03$).

Findings presented in Fig. 2 suggest that the difference between completers and non-completers is mainly based on their self-efficacy, i.e. one's confidence in their ability to complete successfully a science learning task. Given that non-completers, in both groups, rated low on *career motivation* (i.e. their belief that learning will benefit their professional development) suggests that this factor has bearing on attrition and dropout rates.

**Table 2**
Participants' adjusted post means and standard deviations for each motivation component by group.

| Motivation components | English (N = 289) | | Arabic (N = 36) | |
|---|---|---|---|---|
| | Adjusted post mean* | SD | Adjusted post mean* | SD |
| Intrinsic motivation | 4.05 | 0.69 | 3.90 | 0.97 |
| Self-determination | 4.02 | 0.89 | 3.80 | 0.97 |
| Self-efficacy | 3.80 | 0.94 | 3.50 | 0.98 |
| Career motivation | 3.70 | 0.99 | 3.55 | 0.98 |

On a scale of 1–5.

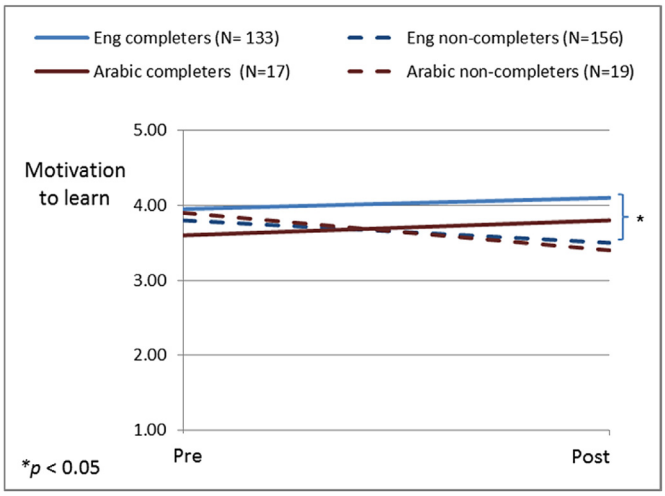


**Fig. 1.** Motivation to learn before and after the MOOC, comparing between English and Arabic completers and non-completers.

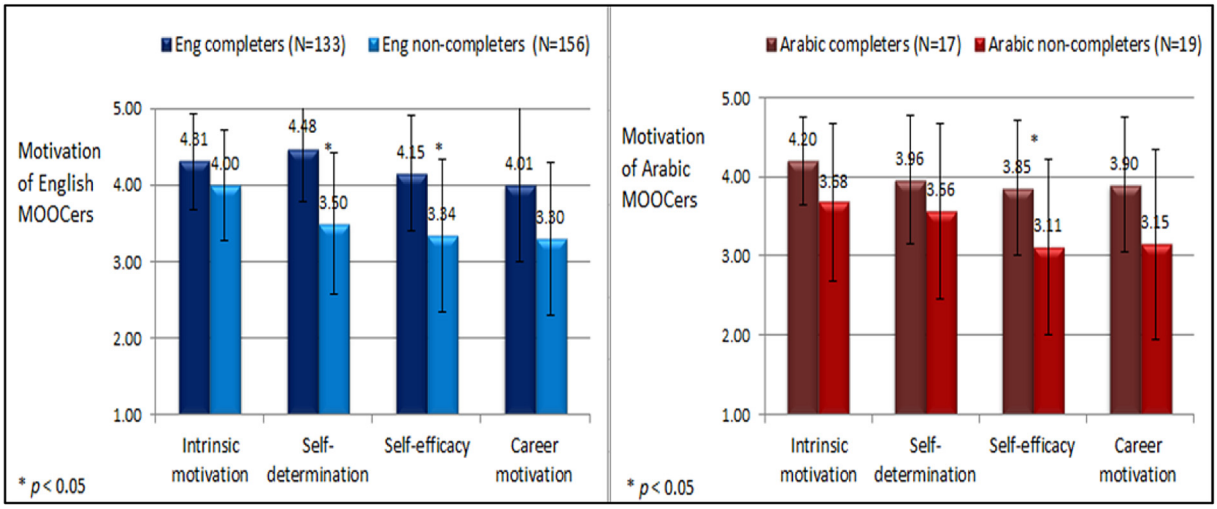


**Fig. 2.** Adjusted post means for each motivation component, comparing between completers and non-completers within the English (left) and Arabic (right) groups.

### 3.2. Motivation gain, forum activity, and the size of online groups

To further understand MOOC participants' motivation to learn, we examined their engagement in online forums and small group learning. Findings indicated a positive relationship between participants' motivation gain (i.e. the difference between pre- and post-ratings) and the number of messages they posted to the online forums. Spearman's rank-order correlation indicated a statistically significant positive correlation for both English and Arabic courses ($rs(289) = 0.42$, $p < .01$; $rs(36) = 0.81$, $p < .01$, respectively). That is, the more messages the participants posted, the higher their motivation gain was. This trend is illustrated in the scatter plot and curvilinear regression lines presented in Fig. 3.

Fig. 3 shows that most of participants in both groups, English and Arabic, posted less than 10 messages (88% and 70%, respectively). About 25% of the participants posted only one message, and only seven participants posted more than 35 messages. The scatter plot presented in Fig. 3 illustrates a curvilinear approach, suggesting the cubic regression model (Keele, 2008). Analysis indicated that the number of forum posts was a significant predictor for motivation gain in both the English and Arabic courses ($F(3, 285) = 28.80$, $p < .001$, $R^2 = 0.23$; $F(3, 32) = 25.51$, $p < .001$, $R^2 = 0.705$). Motivation gain (y) for the English and Arabic groups can be predicted by forum posts (x) according to the following polynomial equations:

(a) English group: $y = 0.17 + 0.07x + -1.78{*}10^{-3}x^2 + 1.65{*}10^{-5}x^3$
(b) Arabic group: $y = -0.03 + 0.09x + -2.33{*}10^{-3}x^2 + 1.63{*}10^{-5}x^3$

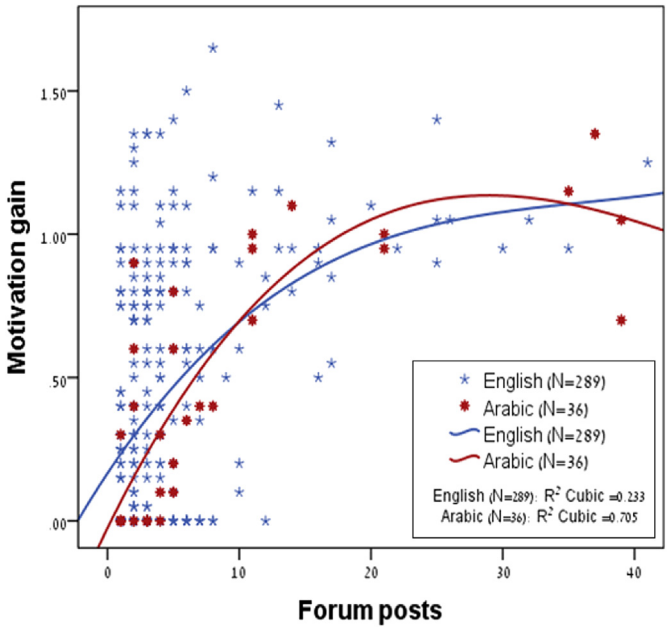


**Fig. 3.** Motivation gain with relation to the number of forum posts, displayed by courses.

Both equations indicate similar coefficients. In addition, both regression lines reach a certain point – between 20 and 25 posts, in which the slopes becomes less steep. This might suggest that posting two to three messages per week, (e.g. sharing knowledge, asking questions, and receiving answers from peers) has a significant impact on participants' motivation to learn. However, since the sample size of the Arabic group was relatively small, further analysis should be conducted on a larger sample size in order to determine generalizability.

To further understand social factors that influence participants' motivation, we examined the relationships between motivation gain and the number of participants in the small online groups. The Nontechnology and Nanosensors MOOCs' participants were encouraged to work on a final project in small online groups of 3-to-4, but it was not mandatory. This resulted in a variety of groupings, from participants who worked individually, through dyads and trios, to groups of four or even five participants. The means and standard deviations of participants' motivation gain, by course and number of group members are presented in Table 3.

Table 3 indicates a similar trend for both courses - participants who worked individually or in dyads on the final project asserted relatively low motivation gain, while those who working in groups of four or five asserted relatively high motivation gain. This trend is illustrated in the scatter plot presented in Fig. 4.

Spearman's rank-order correlation indicated a statistically significant positive correlation for the English group ($rs(133) = 0.50$, $p < .01$). No statistically significant correlations were indicated for the Arabic group. It is possible that in a larger sample, these differences will become significant.

### 3.3. Motivational characteristics of MOOC completers

In order to characterize MOOC completers according to their motivation to learn, we examined more than 1600 email messages and forum posts. Our analysis focused on 144 messages that showed reference to participants' motivational goals. The inductive content analysis method (Hsieh & Shannon, 2005; Thomas, 2006) revealed five types of MOOC completers according to their learning motivation: Problem-solvers, Networkers, Benefactors, Innovation-seekers, and Complementary-learners. The following examples present participants' assertions for each motivational characteristic.

a. Problem-solvers – MOOC participants who seek solutions for a real problem. Their motivation to learn is based on their desire to solve real scientific or engineering problems that they have encountered in their work place. For example, the case of B.J., a scientist from India, working in the area of ocular cancer research. He participated in the English MOOC and sent the following message to the course lecturer:

> *My main aim to take your course was to practically find a quick solution to lengthy diagnostic analysis. I was very much impressed with your Na-nose technology. I would like to explore the same in the area of ocular cancer research.*

**Table 3**
Means and standard deviations of participants' motivation gain, by course and number of group members.

| Course | | No. of group members | N | Motivation gain | SD |
|---|---|---|---|---|---|
| English | Individual | 1 | 32 | 0.41 | 0.44 |
| | | 2 | 23 | 0.39 | 0.43 |
| | Collaborative | 3 | 34 | 0.62 | 0.44 |
| | | 4 | 36 | 0.93 | 0.30 |
| | | 5 | 8 | 1.13 | 0.39 |
| | | Total | 133 | 0.64 | 0.47 |
| Arabic | Individual | 1 | 6 | 0.54 | 0.37 |
| | Collaborative | 2 | 3 | 0.85 | 0.48 |
| | | 3 | 6 | 0.87 | 0.14 |
| | | 4 | 2 | 1.20 | 0.21 |
| | | Total | 17 | 0.79 | 0.36 |

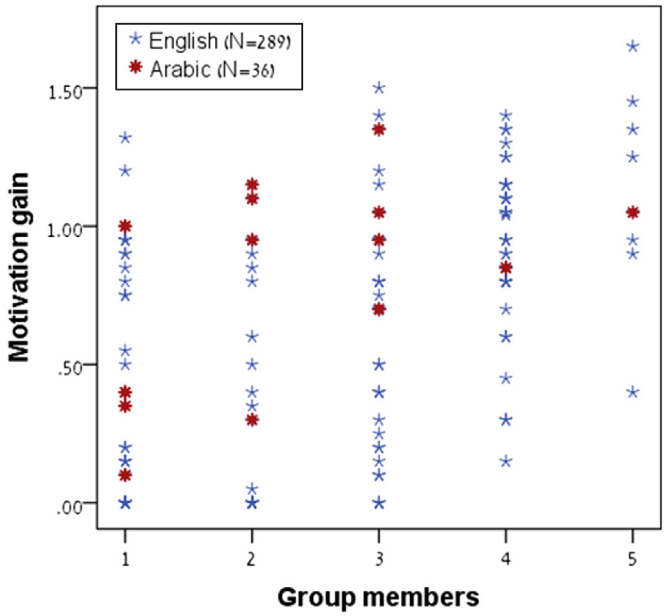


**Fig. 4.** Motivation gain with relation to the number of members in an online group, displayed by courses.

Another example is M.F., an electrical engineer from the US. He initiated a discussion on nano-particles as diagnostic tools in order to assist him in his work:

> *I have a background in communications and microelectromechanical systems (MEMS). Tuberculosis is becoming a serious problem due to drug resistance. If there is a way to get ahead of this disease using nanoparticles, it would be a very good idea. If nano-particles could be used as a therapy as well as for diagnostic tests, that would be even better.*

b. Networkers – MOOC participants who wish to be part of a community of people with a similar interest. Their motivation to learn is based on their desire to meet people with similar expertise and interests in order to share ideas and collaborate. For example, the case of E.M., an engineer from the US who participated in the English MOOC. He used the discussion forums to present his startup company and to invite other participants to contribute ideas for advancing his business:

> *I am currently running my own business based on Gamification mobile apps. I am very interested in developing EDA VLSI tools for programmable nano-chips, Embedded Nanosensor Systems & CGH via photonic-multi-walled nanotubes.*

Another example is K.K., an environmental protector from the US. He uses gas sensing devices for pollutant measurements. At the end of the English course, after submitting the final project, he wrote:

*The gas sensor nanotechnology is amazing and holds great promise for pollution monitoring. The project was special as I was able to tie it to my work as an environmental engineer and "met" 3 friendly and knowledgeable colleagues from all over the world to collaborate with.*

c. Benefactors – wish to learn about innovations in nanotechnology for the benefit of others. Their motivation to learn is based on their desire to contribute to the advancement of their society and country. For example, M.K. is an Engineer from Egypt who participated in the Arabic MOOC. At the end of the course he sent a message to the course lecturer:

*It wasn't that easy, but your course taught me many things about nanomaterials and nanosensors which I wish to apply in my career as an engineer … I'd like to learn more for the benefit of other people.*

Another example is J.R., a therapist from Spain who participated in the English MOOC. At the end of the course he wrote:

*I hope to learn more and more and design useful things for my area that is health … Thanks a lot for your knowledge, I promise I will use it to improve my daily life and help others since this technology has many benefits for all of us.*

d. Innovation-seekers – wish to stay updated and informed about innovations in nanotechnology. Their motivation to learn is based on their desire to staying informed about the latest innovations in nanotechnology. For example, W.C. an engineer from the US wrote:

*I've been in technology sales for 20 years now, and have been using Coursera to stay current on the latest technology that will be used in consumer devices. This is my second Nano Technology course, and I am learning so much!*

e. Complementary-learners – seek to expand their school curriculum with worldwide knowledge. They are university students and their motivation to learn is based on their desire to broaden and deepen their curriculum. For example, H.L. a Pharmacy student from Colombia, wrote:

*I am very interested in nanoscience … I like to expand my knowledge, understand the many applications in medicine, drug delivery, Nanoemulsions, Nanocapsules for Drug Delivery and Nano-based Drug Synthesis.*

Another example is M.A., a 19 years old Sudanese who studied mechanical engineering in a University in Turkey. He participated in the Arabic MOOC, and at the end he wrote:

*I was taking this course online through the end of my second semester in university, I had a lot of classes and exams, but that didn't stop me from continuing the course! Online Courses don't affect general school time.*

Overall, completers from both English and Arabic courses asserted motivation to learn a MOOC in nanotechnology and nanosensors based on their desire to solve real scientific and engineering problems and communicate with people with similar interests. Some wish to stay updated about innovations in the field and others to apply their knowledge for the benefit of others.

## 4. Summary and discussion

This study follows recent studies on motivation to learn in online environments (Cho & Heron, 2015; Kizilcec & Schneider, 2015; Shroff et al., 2008). Since learning is mediated by both language of instruction and social engagement (Ragupathi, 2014; Vygotsky, 1978), their relationships with motivation were examined in this study. Our main findings are summarized and discussed in the following paragraphs.

### *4.1. Motivation to learn and the language in which a MOOC is delivered*

Language, whether written or spoken, plays a significant role in the development of cognitive, social, and motivational factors (Ragupathi, 2014; Slavin, 1987; Vygotsky, 1978; Wertsch, 1991). In higher education, English has become an international medium for communication among scholars who do not share the same native language (Altbach, 2014; Vinkea, Snippea & Jochemsa, 1998). The use of a common language allows efficient exchange of ideas and facilitates cultural awareness, diverse perspectives, and communication skills (Coleman, 2006). However, the adoption of English as a common language for MOOC instruction may exclude many learners who do not speak the language (Altbach, 2014). In this study, we developed the same course in two languages - English and Arabic, comparing motivational differences between participants. Findings indicated that our null-hypothesis was correct. Although the English group expressed slightly higher motivation ratings compared to the Arabic group, the mean differences were not statistically significant. Our study indicated a similar 'motivation profile' consisting of high ratings for *intrinsic motivation* and *self-determination*. Participants in both MOOCs

asserted an inherent satisfaction of being engaged in science and engineering learning and an ability to be in control and regulate their learning process. Compared to *intrinsic motivation* and *self-determination*, *self-efficacy* and *career motivation* were rated relatively low among the general population in both MOOCs.

When comparing between MOOC completers and non-completers, findings indicated an increase in completers' motivation to learn during the ten-week course, and a decreased in the motivation of non-completers. This result is not surprising, since it suggests that those who lost interest in the course, decided to drop out. However, our findings suggest an explanation for the difference between completers and non-completers, based on their self-efficacy. MOOC completers indicated significant higher ratings with relation to their confidence in their ability to complete successfully a science learning task. Our result coincides with the recent work of Wang and Baker (2015) who found that students who complete a MOOC tend to have high self-efficacy and self-confidence in their ability to complete the course. Adding to this, our results show that non-completers, in both groups, rated low on *career motivation*. This suggests that participants' lack of belief that learning will benefit their professional development and career may have bearing on their lack of motivation and attrition. Indeed, while low self-efficacy and career motivation hinder learning achievements in traditional classrooms (Glynn et al., 2011), in online environments, it might result in attrition and dropout (Barak & Watted, 2015; Kizilcec & Schneider, 2015; Onah et al., 2014; Wang & Baker, 2015).

### 4.2. Motivation to learn and social engagement

In the past decade, many studies on online learning examined social interactions in the forms of: communities of learners (Barak & Rafaeli, 2004; Selwyn, 2010), online forums (Barak, 2012; Barak & Dori, 2009; Jackson & Seiler, 2013), and web 2.0 applications (Barak & Ziv, 2013; Selwyn, 2010). Research on social interactions in MOOC environments is in its initial stages (Alario-Hoyos et al., 2013; Ferguson & Clow, 2015; Halawa et al., 2014; Jordan, 2014; Li et al., 2014). MOOC forums are inherently different than online forums in regular courses since they involve occasional participants from different countries who are strangers to one another. MOOC forums include people that are not only unfamiliar with each other, but also come from diverse academic and cultural backgrounds.

The analysis of the forums in both MOOCs indicated a positive relationship between participants' motivation gain (i.e. the difference between pre- and post-ratings) and the number of messages they posted to the online forums. That is, the more messages the participants posted, the higher their motivation gain was. This result is in line with recent MOOC studies that indicated that online forums are preferred communication method (Alario-Hoyos et al., 2013) and that engagement in significant interactions reduces dropout rates (Ferguson & Clow, 2015; Kizilcec & Schneider, 2015; Sinha, 2014).

Our findings suggest that posting two or three messages per week, (e.g. sharing knowledge, asking questions, and receiving answers from peers) has a significant impact on participants' motivation. This result supports the theory that asserts that learning is most effective when it is self-regulated, well managed, and sustainably repeated (Glynn et al., 2011; Pintrich, 2003; Schunk et al., 2008).

While examining the social aspect of online learning, findings indicated positive relationships between the number of group members and participants' motivation gain. Those who worked alone on the final project asserted relatively low means for motivation to learn, while those who worked in groups of four or five asserted the highest means. These results are interesting since it suggests that communication in small online groups has a contributing impact on participants' motivation. Our results add to previous studies that examined motivation in small online group learning. Studies found that small group discussions stimulated students' interest in the subject matter and therefore raised their motivation to learn (Dolmans & Schmidt, 2006; Gomez, Wu, & Passerini, 2010). Our study contributes to the existing body of knowledge by showing that participants who worked in small online groups asserted high commitment to the learn process and high confidence in their learning abilities.

### 4.3. Motivational characteristics of MOOC completers

Previous studies on MOOC focused on engagement patters, analyzing patterns of course involvement and characterizing types of learners. For example, Kizilcec and colleagues (2013) identified four patterns of engagement: Completing - learners who completed the majority of assessments; Auditing - learners who watched most of the videos but completed assessments infrequently, if at all; Disengaging - learners who completed assessments at the start of the course, then reduced their engagement; and Sampling – learners who explored some course videos. A more recent study identified seven distinct patterns of engagement: keen completers, late completers, nearly there, mid-way dropouts, returners, strong starters, and samplers (Ferguson & Clow, 2015). Contrary to previous studies that focused on engagement patterns of MOOCs' general population, in this study we focused on completers, characterizing them according to what motivated them to learn the MOOC. Study maintained that the goals that learners pursue have an important role in the quality of their engagement and achievement (Bandura, 2006; Utman, 1997). Hence, in this study we identified five types of MOOC completers according to their learning goals and motivation. The *networkers* are participants who desire to be part of a community of people with similar interest in nanotechnology. The *problem-solvers* seek to find a solution to a specific science or engineering problem that they encountered in their workplace. The *benefactors* learn in order to contribute to their country and society. The *innovation-seekers* wish to stay constantly updated and informed. The *complementary-learners* are university students who take the MOOC to expand their regular curriculum. It is most likely that participants who hold one or more of these learning

goals will complete a MOOC in a successful way. This supposition is based on the assertion that learning is most effective when it is self-regulated and goal-oriented (Bandura, 2006; Glynn et al., 2011; Utman, 1997).

## 5. Conclusions

This study adds another layer to the growing body of knowledge on MOOC participants' motivation to learn (Kizilcec & Schneider, 2015) and effective methods for social engagement (Alario-Hoyos et al., 2013; Ferguson & Clow, 2015). Following the results presented above, this study suggests three main conclusions. First, similar motivation patterns were found in both English and Arabic participants, indicating a broad cross-cultural trend. Though the participants came from different countries and ethnicities, they were driven to learn by similar goals and incentives. Second, social interactions, in the form of large and small online groups, are important for successful learning. Participants, who were highly involved in both social arenas indicated high motivation gains. Third, MOOC completers can be characterized according to their motivation to learn. In this study, we identified five types of MOOC completers.

Understanding the types of MOOC completers according to their motivation is important for both learners and developers. MOOC learners can better understand what motivates them to learn, and thus, take effective actions to pursue their goals. Whilst MOOC developers can design unique learning environments and assignments that help the learners accomplish their goals. For example, MOOC developers can provide diverse communication platforms for the '*networkers*' who desire to be part of a community of people with similar interest. For the '*problem-solvers*', who seek to find a solution to a specific science or engineering problem, MOOC developers can design open assignments that present real-word problems. For the '*benefactors*', the developers can design performance tasks that encourage the application of knowledge for the benefit of others. For the *innovation-seekers* and the *complementary-learners* the developers should present the most up-to-date information.

## 6. Limitations and future directions

This paper describes an exploratory case study that included a relatively small sample size which might hinder the generalization of the results. However, following the concept of 'naturalistic generalization' (Stake, 1980), we believe that the most effective mean for adding to the understanding of educational processes is by providing specific examples of natural experiences. This is especially true when a case study is conducted through a strict data collection and analysis process, as was presented in this study. Despite the fact that the sample size was relatively small, it provided a good representation of the MOOCs' population, allowing a thorough review of participants' written statements and assertions. Hence, our methodological framework can be applied in other MOOC studies, adding to the growing body of knowledge on learners' motivation.

Research on motivation to learn in MOOC environments is in its initial stages (Kizilcec & Schneider, 2015). Given the importance of motivation to the learning process of MOOC participants, further research should examine relationships between motivation, language of instruction, and social engagement. Further research on MOOCs should also examine relationships between participants' motivation, achievement goals, and learning outcomes with relation to the five types of MOOC completers, as identified in this study.

## Acknowledgments

The authors gratefully acknowledge the Israeli Ministry of Science, Technology, and Space (3-10841) for the generous support. The Authors would also like to acknowledge the generous support of the Technion's President Foundation. The authors would like to thank Meital Bar-Segev and Nisreen Shehada who contributed to the development and delivery of the English and Arabic MOOCs in Nanotechnology and Nanosensors.

## References

Alario-Hoyos, C., Pérez-Sanagustín,, M., Delgado Kloos,, C., H.A., Parada G., Muñoz-Organero, M., & Rodríguez-de-las-Heras, A. (2013). Analysing the impact of built-in and external social tools in a MOOC on educational technologies. In D. Hernández-Leo, T. Ley, R. Klamma, & A. Harrer (Eds.), *Lecture notes in computer science: Vol. 8095. Proceedings 8th European Conference on technology enhanced learning* (pp. 5–18).

Altbach, P. G. (2014). MOOCs as neocolonialism: who controls knowledge? *International Higher Education, 75*, 5–7.

Ames, C. (1992). Classrooms: goals, structures, and student motivation. *Journal of Educational Psychology, 84*, 261–271.

Bandura, A. (2006). Going global with social cognitive theory: from prospect to paydirt. In S. I. Donaldson, D. E. Berger, & K. Pezdek (Eds.), *The rise of applied psychology: New frontiers and rewarding careers* (pp. 53–70). Mahwah, NJ: Erlbaum.

Barak, M. (2012). Distance education: towards an organizational and cultural change in higher education. *Journal of Enterprising Communities: People and Places in the Global Economy, 6*(2), 124–137. http://dx.doi.org/10.1108/17506201211228930.

Barak, M., & Dori, Y. J. (2009). Enhancing higher order thinking skills among in-service science education teachers via embedded assessment. *Journal of Science Teacher Education, 20*(5), 459–474. http://dx.doi.org/10.1007/s10972-009-9141-z.

Barak, M., & Rafaeli, S. (2004). Online question-posing and peer-assessment as means for Web-based knowledge sharing. *International Journal of Human-Computer Studies, 61*(1), 84–103.

Barak, M., & Watted, A. (April 2015). *Nanotechnology for all: Examining students' motivation and learning outcomes in a massive online open course*. Chicago, USA: National Association for Research in Science Teaching (NARST).

Barak, M., & Ziv, S. (2013). Wandering: a Web-based platform for the creation of location-based interactive learning objects. *Computers & Education, 62*, 159–170. http://dx.doi.org/10.1016/j.compedu.2012.10.015.

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: a self-determination theory perspective. *Science Education, 84*, 740–756.

Breslow, L., Pritchard, D. E., DeBoer, J., Stump, G. S., Ho, A. D., & Seaton, D. T. (2013). Studying learning in the worldwide classroom: research into edX's first MOOC. *Research & Practice in Assessment, 8*, 13–25.
Brophy, J. (2004). *Motivating students to learn* (2nd ed.). Mahwah, NJ: Erlbaum.
Cho, M.-H., & Heron, M. L. (2015). Self-regulated learning: the role of motivation, emotion, and use of learning strategies in students' learning experiences in a self-paced online mathematics course. *Distance Education, 36*(1), 80–99.
Coleman, J. A. (2006). English-medium teaching in European higher education. *Language Teaching, 39*(1), 1–14.
Creswell, J. W., & Plano Clark, V. L. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.
Dolmans, D. H. J. M., & Schmidt, H. G. (2006). What do we know about cognitive and motivational effects of small group tutorials in problem-based learning? *Advances in Health Sciences Education, 11*, 321–336.
Duda, J. L., & Nicholls, J. G. (1992). Dimensions of achievement motivation in schoolwork and sport. *Journal of Educational Psychology, 84*, 290–299.
Ferguson, R., & Clow, D. (2015). Examining engagement: analysing learner subpopulations in massive open online courses (MOOCs). In *The 5th International learning analytics and knowledge Conference (LAK15), 16–20 March 2015*. Poughkeepsie, NY, USA: ACM.
Field, A. P. (2009). *Discovering statistics using SPSS: And sex and drugs and rock 'n' roll* (3rd ed.). London: Sage Publications.
Glynn, S. M., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011). Science motivation questionnaire II: validation with science majors and nonscience majors. *Journal of Research in Science Teaching, 48*, 1159–1176.
Gomez, E. A., Wu, D., & Passerini, K. (2010). Computer-supported team-based learning: the impact of motivation, enjoyment and team contributions on learning outcomes. *Computers & Education, 55*, 378–390.
Halawa, S., Greene, D., & Mitchell, J. (2014). Dropout prediction in MOOCs using learner activity features. In U. Cress, & C. D. Kloos (Eds.), *Proceeding of the European MOOC stakeholder summit, Lausanne, Switzerland, February 10-12, 2014* (pp. 58–65).
Ho, A. D., Chuang, I., Reich, J., Coleman, C., Whitehill, J., Northcutt, C., et al. (2015). *HarvardX and MITx: Two years of open online courses* (HarvardX Working Paper No. 10). http://dx.doi.org/10.2139/ssrn.2586847.
Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277–1288. http://dx.doi.org/10.1177/1049732305276687.
Jackson, P. A., & Seiler, G. (2013). Science identity trajectories of latecomers to science in college. *Journal of Research in Science Teaching, 50*(7), 826–857.
Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: a research paradigm whose time has come. *Educational Researcher, 33*(7), 14–26.
Jordan, K. (2014). Initial trends in enrolment and completion of massive open online courses. *International Review of Research on Open and Distance Learning, 15*, 133–160.
Keele, L. J. (2008). *Semiparametric regression for social sciences*. Chichester: John Wiley & Sons Ltd.
Kizilcec, R. F., & Schneider, E. (2015). Motivation as a lens to understand online learners: toward data-driven design with the OLEI scale. *ACM Transactions on Computer-Human Interactions, 22*(2). http://dx.doi.org./10.1145/2699735.
Lemke, J. L. (2001). Articulating communities: sociocultural perspectives on science education. *Journal of Research in Science Teaching, 38*(3), 296–316.
Li, N., Himanshu, V., Skevi, A., Zufferey, G., Blom, J., & Dillenbourg, P. (2014). Watching MOOCs together: investigating co-located MOOC study groups. *Distance Education, 35*, 217–233.
Onah, D. F. O., Sinclair, J., & Boyatt, R. (2014). Dropout rates of massive open online courses: behavioral patterns. In *Proceedings of EDULEARN14* (pp. 5825–5834). Barcelona: Spain.
Palincsar, A. S. (1998). Social constructivist perspective on teaching and learning. *Annual Review of Psychology, 49*, 345–375.
Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology, 95*, 667–686.
Pintrich, P. R., Smith, D., Garcia, T., & McKeachie, W. (1993). Predictive validity and reliability of the motivated strategies for learning questionnaire (MSLQ). *Educational and Psychological Measurement, 53*, 801–813.
Ragupathi, K. (2014). Virtually Vygotsky: using technology to scaffold student learning. *Technology in Pedagogy, 20*, 1–9.
Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2008). *Motivation in education* (3rd ed.). Upper Saddle River, NJ: Pearson.
Selwyn, N. (2010). Web 2.0 and the school of the future, today. In *Inspired by technology, driven by Pedagogy*. Paris: OECD Pub.
Shroff, R. H., Vogel, D. R., & Coombes, J. (2008). Assessing individual-level factors supporting student intrinsic motivation in online discussions: a qualitative study. *Journal of Information Systems Education, 19*(1), 111–125.
Sinha, T. (2014). Together we stand, together we fall, together we win: dynamic team formation in massive open online courses. In *Proceedings of the 5th IEEE International Conference on application of digital information & web technologies (ICADIWT), India*.
Slavin, R. E. (1987). Developmental and motivational perspectives on cooperative learning: a reconciliation. *Child Development, 58*, 1167–67.
Stake, R. (1980). The case study method in social inquiry. In H. Simons (Ed.), *Towards a science of the singular: Essays about case study in educational research and evaluation* (pp. 62–73). Norwich, England: Centre for Applied Research in Education, University of East Anglia.
Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation, 27*(2), 237–246.
UNESCO. (2008). *Mother tongue matters: Local language as a key to effective learning*. Paris: UNESCO.
Utman, C. H. (1997). Performance effects of motivational state: a meta-analysis. *Personality and Social Psychology Review, 1*, 170–182.
Vinkea, A. A., Snippea, J., & Jochems, W. (1998). English-medium content courses in non-english higher education: a study of lecturer experiences and teaching behaviours. *Teaching in Higher Education, 3*(3), 383–394.
Vygotsky, L. S. (1978). *Mind in society: Interaction between learning and development*. Cambridge. MA: Harvard University Press.
Wang, Y., & Baker, R. (2015). Content or platform: why do students complete MOOCs? *MERLOT Journal of Online Learning and Teaching, 11*(1), 17–30.
Wertsch, J. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.