Recently, a growing body of literature has shown the importance of emotions in e-learning processes by pointing out their effect on academic achievement. Nevertheless, within innovative teaching models, the affective-behavioral notion of engagement has been neglected. The aim of the present pilot study is to analyse the experienced emotions by students within different e-learning contexts (chats with teacher, private group discussions, forum threads and content activities) and understand their possible relation with students’ engagement. Our results point out that when e-learners experience positive emotions across synchronous learning activities (chats with teachers and among students) the engagement dimensions of affective relevance and participation significantly increase. Further, we found that negative emotions play a central role during the interactive activities with teacher, as performing these learning tasks can be a first warning of an insufficient preparation. Therefore the study demonstrates the importance for an
e-teacher to regulate students’ negative emotions experienced across the e-learning activities, as they can negatively influence both affective and behavioural dimensions of engagement.

1 Introduction

In the last years, affective computing domain has shown smart solutions to detect students’ emotions by improving both models of multimodal analysis and recognition of emotional cues (Burleson et al., 2004). Within this field, recent applications have been built, as in the case of Learning companion developed by MIT Affective Computing Group that can support students in their learning processes. Other tools have been developed in order to promote emotions’ awareness and management, as in the case of the affective agents (see for example Emotcontrol, in Feidakis et al., 2014). These are just some examples of research contributions that highlight the importance of monitoring student’s emotions by focusing in particular on interactive on-line settings by means of technical tools/agents.

More in general educational psychology literature has clearly shown the role of emotions in promoting positive academic outcomes, focusing mainly on possible achievements such as grades or number of exams (Artino & Stephens, 2009; Daniels et al., 2009). Nevertheless besides the student’s learning achievements, a growing body of research is focusing on the variables involved ‘in the process’. Pekrun et al. (2006), for instance, considered engagement, which can be defined as one of qualitative indicators of the learning process, and more in general a potential predictor of students’ academic adjustment. Within this framework, our hypothesis is that students’ engagement can be affected by experienced emotions during different learning activities. In particular, innovative teaching models still need providing comprehensive studies on emotions’ functions within different e-learning environments by specifically observing their effects on students’ engagement. Consequently, the present study aims to better understand the role of both positive and negative emotions during different e-learning activities (both synchronous and asynchronous, in interaction with teacher or with peers) through the testing of their potential effects on students’ engagement.

As a starting point, some theoretical hints and recent contributions on students’ emotions in e-learning processes and their relationships with engagement will be presented. Then, an empirical study will be illustrated on the potential role played by emotions on student’s engagement within four different e-learning settings.
2 Emotions in learning context

To understand the role of emotions within e-learning contexts, in this paper we refer to a socio-cognitive approach (Castelfranchi & Miceli, 2009) and appraisal theories (Scherer, 2000), which define emotions as adaptive devices that monitor the state of achievement or thwarting of individuals’ goals. Thus, emotions can be defined as multifaceted internal states, encompassing feelings and cognitive, physiological, expressive, and motivational aspects, that are triggered whenever an individual’s goal is achieved/thwarted or it is likely to be (Poggi, 2008). Besides the appraisal models of emotions, that help understand the underlying cognitive features, we can also consider “dimensional” theories of emotions, that define cognitive processes as the attribution of a cause to some perceived physiological reaction. In this view, emotions can be framed within dimensions of polarity and valence (Russell, 1980), thus allowing a mapping of emotions encompassing positivity/negative polarity or activating/deactivating valence (for a review see D’Errico & Poggi, 2016).

In addition to the subjective dimension, not less important seems the contextual one. At this purpose, Tyson et al. (2009) postulated that emotions can be defined as subjective experiences, and yet depending on the context in which they are elicited. Nevertheless, research in the field of e-educational psychology has relatively deepen their role within specific e-learning contexts (Feidakis et al., 2014). Then, it has been suggested that emotions are pervasive in distance educational settings (Artino, 2012). They can be at the basis of the enrollment choice, and profoundly impact student’s behavior in academic situations (Marchand & Gutierrez, 2012). A student may experience a negative emotion such as embarrassment if the teacher criticizes his argument or ask for the whole class to judge the correctness of his solution to an assignment. On the other hand, students can experiment positive emotions (e.g. interest) in the task they are performing and enjoy their learning activities. Pekrun and colleagues (2011) have created the definition of academic emotions, which comprise both affective states (such as confusion, anger, stress) and cognitive states (for instance interest, boredom, fatigue). These authors identified classes of emotions and demonstrated that positive emotions can predict creative way of thinking and reflecting on notions, fostering good academic results, whereas negative emotions are more likely associated with low grades. More specifically, enjoyment, hope and pride have been positively associated with effort, self-regulation and more sophisticated learning strategies, whereas anger, frustration, shame, anxiety and boredom have been associated with lower performances and external regulation (Pekrun et al., 2011). It has also been posited that negative emotions can alter the use of cognitive strategies and
motivation during learning (Kim et al., 2014). In addition, it has been proved that e-learning students may experience specific negative affective states such as anxiety, boredom, fatigue and confusion during particularly challenging assignments, and some research has demonstrated that reporting on their own emotions to others or sharing them in the community of students can empower their achievement in the learning process (Pekrun, 2006). It is noteworthy that achievement emotions (Ibidem) in on-line situations are suggested to be context-specific, so that they can vary across learning activities. Thus, several authors have recommended assessing diverse learning tasks, formal (with teacher, for example chat discussions or videoconferencing) or informal (with peers but without the presence of the teacher, e.g forum discussions or chats among peers) (Efklides & Volet, 2005).

Furthermore, the learning process and its link with academic emotions can be described also in terms of particular ‘object focus’. This is the case of ‘Control-Value Theory’ of achievement emotions (Pekrun & Perry, 2014) that suggested how students’ could feel different positive and negative emotions being focused on a specific learning ‘activity’ and/or ‘outcome’. For example when a student is focused on the exam accomplishment he is more likely to experience anxiety, differently, when he is focused on the activity he can experience a sense of frustration.

On the role played by negative emotions other studies show a more complex framework in the sense that they can present their positive role, considering also cognitive and motivational aspects. Artino and Stephens (2009) for example suggest that negative emotional experiences might increase students’ metacognitive activities and support motivation to study. It is noteworthy that not all negative emotions have been related to positive academic outcomes. In fact, while frustration can activate more effective metacognitive strategies, boredom may negatively impact on them, causing poor achievements.

3 The notion of engagement and its relationship with students’ emotions in e-learning

While in face-to-face situations students interact and exchange information that includes emotion signals (e.g. facial expressions, gestures, voice intonation, etc.), on-line learners encounter more difficulties in sharing emotion cues. Nevertheless, in a socio-costructivist standpoint (Vygotskji, 1978; Leone, 2012), quality interactions among on-line students are also relevant, for instance when they are involved in a synchronous virtual conversation (e.g. in a chat discussion) or in an asynchronous environment (e.g. when posting contents in a blog, in a wiki or in a forum). These processes have been defined as a social presence, that is the capacity of on-line teachers and learners to share more than
mere facts concerning their course of study. Moreover, it represents the way of experiencing and feeling meaningfully emotions, values and attitudes in the cyberspace (Akyol & Garrison, 2014), which in this sense may be considered a vital system (Guercio & Maresca, 2013).

Nevertheless, the status of “social presence” can differ across learning contexts in relation to “interactive” variables as the real presence of the teacher and time of encounters (synchronous and asynchronous). Considering the intersection of these two e-learning dimensions, it is possible to describe 4 different activities. When teacher is present synchronous chatting activities and asynchronous web-forum may take place; when teacher is not present students can synchronously meet and interact solely among their peers in private groups and chats, or they can study mainly attending video-contents (content activities; Garito, 2013).

Further, in accordance with the media richness theory (Liu et al., 2009), previous studies have tested that these different activities (which are characterized by an increasing level of interactivity) are correlated to a higher perception of social presence, but also to academic engagement. When the number of activities increases, social presence and engagement also increase, and this is certainly true for content activities, for student-to-student interactions but in particular for teacher-to-student interactions (Dixson, 2010).

Engagement, in particular, has been identified as a crucial variable fostering academic outcomes and it has been defined as the extent to which students feel actively engaged by their learning activities (e.g. thinking, talking and generally interacting with their peers and instructor) (Dennen et al., 2007).

Let us now more specifically define the notion of engagement; it can be considered more than just behavioral aspects as “time and energy spent by the student” and, as in Handelsman definition (2005) it is also composed by the affective investment of a person engaged in their on-line course. In this sense, Handelsman and colleagues suggest that engagement is marked by four dimensions: 1) ‘skills’ and 2) ‘performance’ - that can be considered as behavioral components - and two other affective ones that are 3) ‘affective relevance’ and 4) ‘participation’. Other authors (Fredricks et al., 2004) define, in the same vein, this feature as “cognitive engagement” that includes the willingness to master difficult task. Participation includes not only emotions and sense of connectedness but also participative behaviors in on-line activities. In distance learning settings the notion of engagement has also been explored by Sun and Rueda (2012) in relation to students’ situational interest. They observed that emotional engagement is strongly linked to interest. This seems primarily evident for students in advanced years, probably due to their greater technical expertise. Sun and Rueda found that it is possible to facilitate emotional engagement by means of enhancing student’s interest, but in their study they
involved students who solely interacted with video-recorded lectures, without considering other learning medias.

At this purpose it seems important to consider the complexity of e-learning interactions by looking at different e-learning activities.

4 Research questions

This study aims at investigating the role of students’ emotions within different activities such as chats and forums in a context of distance learning (with or without teacher).

In particular, our goal is to detect how emotions are associated to students’ engagement, with particular attention to its behavioral and affective dimensions. Therefore, the research questions are as follows:

1. Are e-learning activities differently associated to emotions?
2. Is there a relationship between e-learning emotions and engagement?
3. If so, how e-learning emotions affect different behavioral and affective relevance of engagement?

The theoretical models and previous studies (Pekrun, 2011; Efklides & 2005; Liu et al., 2009; Dixson, 2010) help us assume that (1) positive emotions are higher, when students interact with teacher and their peers than when they perform individual learning tasks, coherently with the “social presence” standpoint; (2) emotions affect engagement especially in more interactive e-learning activities and (3) in particular, positive emotions influence “affective relevance” engagement; however, we cannot exclude that the whole range of emotions considered in the present study influences engagement across different dimensions.

5 Method

5.1 Participants

Participants were 78 Italian university students attending on-line courses (females 71,8%), with a mean age of 38,6 years (SD = 12,09). Most participants were employed in a broad range of very heterogeneous jobs (90%), from freelance (11,7%) to office work (34,7%), teaching (5%), health care jobs (6%), representing humanistic (50%), technical-scientific (43%) and social-health sectors (5,2%). The majority of participants were attending the first (48,7%) and third year (37%) of the undergraduate program in a Faculty of Psychology.
5.2. Procedure and measures

The members of the research team informed students enrolled in their online classes about the study and collected the written informed consent from voluntary participants. Thus, the data were collected through online self-report surveys including measures of emotional experiences during e-learning activities, engagement dimensions and socio-demographic variables.

**Learning Emotions.** This is an ad hoc scale composed by 14-item Likert scale measuring the levels of intensity of different learning emotions (for example: anxiety, sadness, enthusiasm, satisfaction, surprise) during four conditions: chat discussions with teacher (CDT), private student chats (without the teacher - PSC), web-forum discussions (WFD), and content activities (CA). Response options were presented on a 5-point continuous scale ranging from 1 = not at all to 5 = very much, where higher scores indicate more learning emotion intensity. Preliminary EFA attested the bi-dimensionality of the scale in all four learning activities (the average explained variance is 46%). The first factor refers to positive e-learning emotions (8 items), the second factor refers to negative e-learning emotions (6 items). Internal consistency for positive e-learning emotions (Factor 1) and negative e-learning emotions (Factor 2) in the current sample range from .64 to .88 (positive emotions: .84 for CDT; .87 for PSC; .88 for WFD; .81 for CA; negative emotions: .68 for CDT; .79 for PSC; .64 for WFD; .80 for CA).

**E-learning Engagement** (Dixson, 2015). This scale is a 19-item Likert scale measuring the affective and behavioral components of engagement. Respondents were asked how well different behavior, thought, and feeling characterize their e-learning engagement. Response options were presented on a 5-point continuous scale ranging from 1 = not at all to 5 = completely. The scale consists of four subscales: skills (item example is: “being organized”); affective relevance (item example is: “really desiring to learn the material”); participation (item example is: “helping fellow students”); and performance (item example is: “doing well on the tests”). Internal consistency coefficients in the current sample were .87 for skills, .83 for participation, .70 for affective relevance and .81 for performance.

5.3 Plan of Analyses

Before performing analyses, the Student T-test was utilized to examine gender, undergraduate years and job specialization (humanistic vs technical-scientific) differences on positive and negative emotions during the four e-learning activities and on engagement dimensions. Moreover, age differences were examined using correlation analysis. The preliminary T-test results attested
that there are no significant difference linked to gender, undergraduate years and specialization. Correlation analyses attested only one negative associations between age and negative learning emotion during content activities (r=-.24; p=.03). Based on these preliminary results, we decided not to consider gender, age, job sector and undergraduate years as control variables in the subsequent analyses.

In order to examine the within-subject differences on positive and negative learning emotions, profile analyses were performed by using repeated measures ANOVA using learning emotions in the four leaning conditions (CDT, PSC, WFD, and CA) as dependent variables. Then correlation analyses were performed to examine the relationships between positive and negative emotions during learning activities and engagement dimensions (skills, participation, affective relevance, and performance). Finally, regression models were performed to examine the unique contribution of emotions during the four learning conditions on skills, participation, affective relevance and performance. In particular we evaluated separately the influence of positive and negative learning emotions on the engagement dimensions.

5.4 Results

5.4.1 Student’s Leaning Emotional Profiles

Profile analyses attested significant differences on positive [F(3,231)= 8.87 p.000] and negative e-learning emotions [F(3,231)= 36.79 p. 000] during the four learning activities (CDT, PSC, WFD, and CA). In particular, multiple pairwise comparisons procedure attested that students show lowest levels of positive emotions during web-forum discussions (M= 3.13, SD =.81) than during chat with teacher (M= 3.50, SD =.68), private student discussion(M= 3.42, SD =.77) and content activities (M= 3.48, SD =.73). Moreover, they show highest levels of negative emotions during chat discussions with teacher (M= 1.54, SD =.52) than web forum (M= 1.30, SD =.38) and private group discussions (M= 1.37, SD =.49) (Figure 1).
Correlation analyses attested that (a) positive emotions during the four learning activities are significantly associated among them, and at same time (b) negative emotions are reciprocally related (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Activity</th>
<th>1</th>
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<th>7</th>
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<tbody>
<tr>
<td>1 Chat with Teacher (POS)</td>
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<tr>
<td>2 Private Students’ Group (POS)</td>
<td>.51***</td>
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<td></td>
</tr>
<tr>
<td>3 Web-Forum Discussion (POS)</td>
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<td>.49***</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4 Content Activities (POS)</td>
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<td>.47***</td>
<td>.50***</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5 Chat with Teacher (NEG)</td>
<td>.09</td>
<td>.09</td>
<td>.09</td>
<td>.00</td>
<td>-26*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Private Students’ Group (NEG)</td>
<td>.24*</td>
<td>.17</td>
<td>.04</td>
<td>.30**</td>
<td>.52***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Web-Forum Discussion (NEG)</td>
<td>.28*</td>
<td>.06</td>
<td>.10</td>
<td>.30**</td>
<td>.46***</td>
<td>.50***</td>
<td></td>
</tr>
<tr>
<td>8 Content Activities (NEG)</td>
<td>.21</td>
<td>.03</td>
<td>.21</td>
<td>.18</td>
<td>.37***</td>
<td>.46***</td>
<td>.45***</td>
</tr>
</tbody>
</table>

POS = Positive Learning Emotions; NEG = Negative Learning Emotions. *** p < .001; ** p < .01; * p < .05
5.4.2 Student’s Learning Emotions and Engagement

Correlation analyses shows that: a) skill is positively associated with positive emotion during learning activities, with the exception of web-forum discussions, and it also negatively associated with negative emotions in all the four learning conditions; b) participation and affective relevance are positively associated with positive emotions in all the four learning activities; c) affective relevance is also negatively associated with negative emotions during formal (chat with teacher) and private students group discussions; d) performance is positively associated with positive learning emotions during private students’ chats and content activities during exam preparation and negatively associated with negative learning emotions during private students discussions (Table 2).

Table 2
CORRELATIONS AMONG LEARNING EMOTIONS (POSITIVE AND NEGATIVE) AND ENGAGEMENT

<table>
<thead>
<tr>
<th></th>
<th>SKILL</th>
<th>PART</th>
<th>A-RL</th>
<th>PERF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat with Teacher (POS)</td>
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<td>.29*</td>
<td>.35**</td>
<td>.09</td>
</tr>
<tr>
<td>Private Students’ Group (POS)</td>
<td>.28*</td>
<td>.45***</td>
<td>.36***</td>
<td>.30**</td>
</tr>
<tr>
<td>Web-Forum Discussion (POS)</td>
<td>.14</td>
<td>.24*</td>
<td>.23*</td>
<td>.04</td>
</tr>
<tr>
<td>Content Activities (POS)</td>
<td>.43***</td>
<td>.42***</td>
<td>.36***</td>
<td>.29*</td>
</tr>
<tr>
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<td>.13</td>
<td>.37***</td>
<td>-.33**</td>
</tr>
<tr>
<td>Private Students’ Group (NEG)</td>
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<td>.08</td>
<td>.22*</td>
<td>.25*</td>
</tr>
<tr>
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<td>-.28*</td>
<td>.14</td>
<td>.15</td>
<td>-.13</td>
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<tr>
<td>Content Activities (NEG)</td>
<td>-.29*</td>
<td>.02</td>
<td>.11</td>
<td>-.09</td>
</tr>
</tbody>
</table>

***p < .001; **p < .01; *p < .05; SKILL = skills; PART = participation; A-RL = affective relevance; PERF = performance; POS = Positive Emotions; NEG = Negative Emotions

With regard to the role of positive learning emotions on engagement (Table 3), regression models results attested the influence of positive learning emotions on skill (16% of explained variance), participation (22% of explained variance), affective relevance (14% of explained variance) and performance (11% of explained variance). In particular, positive emotions during private students interactions and content activities positively influence both students participation and performance. Moreover positive learning emotions during content activities affect skill engagement.
Table 3

THE INFLUENCE OF POSITIVE LEARNING EMOTIONS ON ENGAGEMENT DIMENSIONS

<table>
<thead>
<tr>
<th></th>
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<th>PART</th>
<th>A-RL</th>
<th>PERF</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.04</td>
<td>.19</td>
<td>.16</td>
</tr>
<tr>
<td>Private Students’ Group (POS)</td>
<td>.14</td>
<td>.36**</td>
<td>.23+</td>
<td>.31*</td>
</tr>
<tr>
<td>Web-Forum Discussion (POS)</td>
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<td>.07</td>
<td>-.12</td>
<td>-.16</td>
</tr>
<tr>
<td>Content Activities (POS)</td>
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<td>.19</td>
<td>.32*</td>
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<tr>
<td>R²</td>
<td>.20</td>
<td>.26</td>
<td>19</td>
<td>.16</td>
</tr>
<tr>
<td>AR²</td>
<td>.16**</td>
<td>.22***</td>
<td>14**</td>
<td>.11**</td>
</tr>
</tbody>
</table>

ß = beta coefficients; R² = R Square; AR = Adjusted R²; ** significant at p < .01; * significant at p < .05; + significant at p < .08; SKILL = skills; PART = participation; A-RL = affective relevance; PERF = performance; POS = Positive Emotions

With regard to the role of negative learning emotion on engagement (Table 4), regression models results attested the influence of negative emotions on skill (22% of explained variance), affective relevance (9% of explained variance), and performance (8% of explained variance). More specifically, negative emotions during formal chats with teacher negatively influence skill, affective relevance and performance.

Table 4

THE INFLUENCE OF NEGATIVE LEARNING EMOTIONS ON ENGAGEMENT DIMENSIONS

<table>
<thead>
<tr>
<th></th>
<th>SKILL</th>
<th>PART</th>
<th>A-RL</th>
<th>PERF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat with Teacher (NEG)</td>
<td>.44***</td>
<td>.10</td>
<td>.36**</td>
<td>-.30*</td>
</tr>
<tr>
<td>Private Students’ Group (NEG)</td>
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</tr>
<tr>
<td>AR²</td>
<td>.22***</td>
<td>.00</td>
<td>.09*</td>
<td>.08*</td>
</tr>
</tbody>
</table>

ß = beta coefficients; R² = R Square; AR = Adjusted R²; *** significant at p < .001; ** significant at p < .01; * significant at p < .05; + significant at p < .08; SKILL = skills; PART = participation; A-RL = affective relevance; PERF = performance; NEG = Negative Emotions

Conclusion

The present study had two main goals: first of all we aimed at assessing different emotional profiles within different learning activities and, then we intended to verify if they have some possible effects on academic engagement.
Rooting on previous studies we highlighted how positive vs negative emotions can play a crucial role in academic settings (Pekrun et al., 2011), in particular our aim was to explore the way students behave and affectively experience different learning activities through the notion of engagement (Handelsman et al., 2005). Our findings point out the salience of positive emotions across different learning activities (higher than the negative ones) and in particular during synchronous activities with teacher and also with peers. A lower positive emotional activation is present in forum activities. The positivity of the emotions during the exam preparation (content activities) that consists of attending video-lectures materials is also high across other conditions, this can signal a positive state of flow (Liu et al., 2009), resulting from other positive previous interactions, that can give to the student a sense of mastery on the task, besides to the pleasure of content understanding. This inference is strengthened by resulting correlations among positive and negative emotions during different learning activities that demonstrate how “exam preparation” (video content activity) is strongly correlated with chat discussion, students’ groups and also forum discussion. The emotional positivity experienced during different e-learning activities could increase students’ sense of mastery during the exam preparation. As to the effect on student engagement our results clearly indicate that experiencing positive emotions during the exam preparation is strongly correlated with the four behavioral and affective dimensions of engagement, meaning that feeling positive mastery during the different phases of e-learning process help students to enact constructive behaviors and achieve positive results but also to experience “affective relevance” in relation to acquired contents.

A particular attention must be devoted to negative emotions reported during the chat interactions with teacher and in lesser extent with peers, that present very strong negative correlation with affective relevance and also performance dimensions of engagement, suggesting how chats can be lived as a first warning for the students of a flawed preparation. This is particularly evident during the content activity that usually takes place when the exam is approaching and students have to maximize their efforts and to focus on task on their own. Then, the first import regarding the results on negative emotions concerns the fact that e-teachers can learn to manage the emotions by giving to the students who feel negative emotions further support or hints. In this view, future studies could clarify which didactic strategies could be more effective in order to regulate emotional activation and successful outcomes. For instance some authors suggest (Robinson et al., 2009; Boukricha et al., 2011) the crucial role of the affective feedbacks in e-learning processes.

This pilot study has some limitations. First, the relative paucity of the sample does not allow a generalization of results and it requires a wider academic
population. Nevertheless it would represent a starting point for future studies.

Second, we did not consider individual differences in emotion regulation of the subjects. Some students could have a more effective capacity of moderating negative emotions emerging in the learning process and this could have protected him/her from successfully engage in the activities. Third, we did not consider a possible effect of emotion contagion, which has been indeed found in technologically mediated environments (Järvelä, 2013). Furthermore, the role of a student’s e-efficacy (as defined by Di Mele et al., 2015) must be considered, so that individuals who actively employ on-line learning tools right from the start of their courses, may develop positive academic emotions and may be less impaired by temporary set-backs in their learning process. Notwithstanding the above limitations, the present paper has several strengths. It is the first study, to our best knowledge, to address affective and behavioral components of students’ engagement during distance learning processes and their relationships with positive and negative emotions. Moreover, consistently with the recommendations of previous literature, we focused on diverse learning activities (such as chats, forums, and content use) that imply synchronous and asynchronous interactions among students and that can elicit different types of emotions.

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