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Achievement Emotions in Technology Enhanced Learning: Development and Validation of Self-Report Instruments in the Italian Context.

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Abstract. The increased use of technology within the educational field gives rise to the need for developing valid instruments to measure key constructs associated with performance. We present some self-report instruments developed and/or validated in the Italian context that could be used to assess achievement emotions and correlates, within the theoretical framework of Pekrun's control-value model. First, we propose some data related to the construction of two instruments developed to assess ten achievement emotions: the Brief Achievement Emotions Questionnaire, BR-AEQ, used with college students, and the Graduated Achievement Emotions Set, GR-AES, used with primary school students. Second, we describe some data concerning the validation within the Italian context of two instruments assessing achievement goals as antecedents of achievement emotions: the Achievement Goal Questionnaire-Revised, AGQ-R, and its more recent version based on the 3 X 2 achievement goal model.

Keywords: Achievement Emotions, Learning Environment Design, Technology Enhanced Learning, Achievement Goals, Assessment

1 Introduction

Achievement emotions have recently roused particular interest within educational psychology for both their theoretical and applied importance as constructs linked to cognitive, motivational, and behavioural domains related to learning [25]. Even if it is difficult to observe emotional dynamics in technology-based learning environments, as happens in traditional learning contexts, emotions have important influence on learning, engagement, and achievement [14]. For instance, individual differences in achievement emotions affect students' choosing to use online versus face-to-face learning modes [34]. However, relationships between emotions and other constructs are complex and they have not yet been explored deeply within technological contexts. For example, while some research studies document the links between adaptive and maladaptive motivational patterns and positive and negative emotions, others reveal that for motivated students, anger can be associated with persistence in order to master dense technical materials

[14].

In this work, we aim at presenting some self-report instruments developed and/or validated in the Italian context that could be used to assess achievement emotions and correlates in technology-based learning environments, within the theoretical framework of Pekrun's control-value model [20]. In such contexts, self-report measures concurrent with learning activities are indeed among the most frequently used methodologies, enabling researchers to track moment-to-moment affective states [14]. First, we discuss the construction of two instruments developed to assess ten achievement emotions: the Brief Achievement Emotions Questionnaire, BR-AEQ used with college students [3, 28, 32], and the Graduated Achievement Emotions Set, GR-AES used with primary school students [2, 30, 31]. Second, we discuss the translation and validation into the Italian language of two instruments aimed to assess achievement goals, conceptualized as antecedents of achievement emotions [20]: the Achievement Goals Questionnaire-Revised, AGQ-R [9] used with primary, secondary, and college students [31, 33], and its more recent version based on the 3 X 2 achievement goal model [10], used with college students [3].

In light of the pervasive diffusion of technology within educational contexts, such instruments could be useful for assessing the emotional and motivational dimensions, before, during, or after learning delivered through technological systems.

1.1 Emotions and Correlates in Educational Contexts

Emotions–as multi-componential phenomena "including affective, cognitive, motivational, expressive, and peripheral physiological processes" [20, p. 316]–have historically been studied in the context of learning as related to causal attribution processes [37] and test anxiety [38]. Only in the last two decades has attention been paid to achievement emotions, rather than to states pertaining to different valences [25]. According to theoretical frameworks such as control-value theory, achievement emotions can be defined as those emotions related to achievement activities or outcomes: Activity-related emotions pertain to on-going achievement related activities, while outcome-related emotions pertain to the outcome of these activities. They can also be conceptualized according to two underlying dimensions, valence (positive versus negative emotions) and activation (activating versus deactivating emotions) [20], allowing us to distinguish between positive-activating emotions (e.g., enjoyment, pride, hope), positive-deactivating emotions (e.g., relief, relaxation), negative-activating emotions (e.g., anxiety, anger, shame), and negative-deactivating emotions (e.g., boredom, hopelessness). Even if some research studies suggest the salience of a low number of emotions for deep learning in technological environments–such as engagement/flow, boredom, frustration, and confusion [14]–examining a wider range of emotions has several advantages. It enables us to compare emotional processes typical of traditional versus technological learning settings, and when shallow as opposed to deep learning is involved. In addition, such variety of emotions could be relevant when learning activities have implications for

technology-based environments in which students do not directly interact with the technology, as in the case of cooperative learning techniques used to develop game prototypes with users. Finally, it is worth noting that recent research studies highlight the nature of the links between achievement emotions as conceptualized by Pekrun [20] and engagement [15], one of the key emotions, for example, characterizing advanced learning technologies [14] amongst mature-aged distance students.

The control-value model, based on assumptions from different theoretical perspectives such as expectancy-value theories of emotions, transactional approaches, and attributional theories [16, 35, 37], considers achievement emotions in terms of their antecedents and outcomes. On the one hand, achievement emotions would deeply influence learning and performance by mediating mechanisms such as motivation, strategy use, and learning regulation. On the other hand, feelings of control–or lack of it–like self-efficacy beliefs and task-value are assumed to be the proximal antecedents of emotions. Among distal antecedents, a key role is played by achievement goals, probably the most popular motivational construct currently investigated [8, 9, 10].

Achievement goals can be defined as "cognitive-dynamic aims that focus on competence", comprising two dimensions: Definition–in terms of mastery and performance constructs–and valence–in terms of approach or avoidance strivings [9, p. 614]. The first dimension, identified back in the eighties [5], refers to criteria for judging competence: For mastery goals, individuals strive to reach competence, while for performance goals individuals, focus on comparisons with others. According to empirical findings, mastery goals had adaptive consequences for learning, while performance goals were associated to maladaptive behaviours [5]. However, these negative consequences (not so univocally found compared to positive consequences of mastery goals) have been recently revised, after the identification of the approach-avoidance dimension that can characterize both performance goals and mastery goals [8]. Specifically, individuals can compare themselves to others in two ways: Striving either to show competence (approach goals) or not show incompetence (avoidance goals).

As a result, the so-called 2 X 2 achievement goal model comprising four kinds of goals has been proposed, including mastery-approach goals, mastery-avoidance goals, performance-approach goals, and performance-avoidance goals. The introduction of this distinction has cleared up some previous ambiguous results, according to which, for example, performance goals were linked both to positive outcomes, such as high self-efficacy and effort, and negative outcomes, such as low task persistence. Negative consequences were probably related to performance-avoidance goals, and positive consequences to performance-approach goals [36]. Considering the most recent developments of achievement goals models, it is worth noting that until now scant attention has been paid to mastery-avoidance goals compared to the other three goals.

Looking at possible relationships between achievement emotions and achievement goals, the literature suggests associations between mastery goals and both activity-focused and outcome-focused emotions, and associations between performance goals and outcome-related emotions [22, 23, 27]. However, the hypothesized matching between valence of goals (as approach or avoidance

strivings) and emotions (as positive or negative) has only been partially supported.

Recently, a further distinction characterizing mastery goals and separating task-based and self-based goals has been proposed, resulting in a 3 X 2 model encompassing six goals: task-approach goals, focused on acquiring competence related to the task; task-avoidance goals, focused on avoiding showing incompetence related to the task; self-approach goals, focused on acquiring competence based on the self; self-avoidance goals, focused on avoiding showing incompetence based on the self; other-approach goals, focused on acquiring competence compared to others; and other-avoidance goals, focused on avoiding showing incompetence compared to others [10]. However, little attention has been paid to the study of the relationships between these six goals and achievement emotions, including a wide range of emotions partially neglected by the literature, such as relief or relaxation.

2 Some Instruments to Assess Achievement Emotions and Correlates

Within educational environments, the sole emotion that has received much attention from both theoretical and applied perspectives is test anxiety [38], with the first inventories dating back to the 1930s [21]. However, in light of the recognized relevance of a wide range of achievement emotions for learning outcomes [25], researchers have recently proposed measures to assess multiple emotions [21]. Among them, a key role is played by self-report measures relying on verbal language, as an economic and privileged way to have access to conscious representations of emotional information [21]. Given the role of achievement goals as distal antecedents of emotions [20], self-report measures of these constructs assume particular salience in learning environments [9, 10].

The increased use of technology within the educational field gives rise to the need for developing valid instruments to measure key constructs rapidly, often taking measurements from many people at one time. The key characteristics of the self-report instruments we propose, such as accuracy in the correspondence between the measured concepts (i.e., achievement emotions and achievement goals) and operationalized items, make them suitable for technology-based environments. The brevity, word simplicity, pictorial support, and answer modality (Likert-type scales) makes them suitable for computer presentation (see for example, Meier et al [19]) which, in turn, has logistical and economic advantages for wide-scale administration.

2.1 Development of Instruments to Assess Ten Achievement Emotions

Based on findings from previous qualitative and quantitative research studies, Pekrun and colleagues [24] developed a multidimensional measure focused on nine achievement emotions, the Achievement Emotions Questionnaire, AEQ. It

was originally used with college students, and comprises different subscales for three settings: class-related emotions, learning-related emotions, and test emotions. For each subscale, items assess different components of emotions in terms of affective, cognitive, physiological, and motivational dimensions. The reliability and structural validity of the AEQ have well established. In addition, it has been shown to have external validity, predicting the role of emotions towards school performance and dropping out of school [21]. Different versions have been adapted from the AEQ for use in specific domains such as mathematics (the AEQ-Mathematics [12]), and for specific age groups (the AEQ-Elementary School [17]). In particular, the AEQ-ES is focused on three emotions, enjoyment, anxiety, and boredom, assessed using graphical displays. However, there is a lack of measurement instruments covering a wide range of achievement emotions and using pictorial representations, which could suit children or individuals with special needs. Such instruments would be particularly useful for TEL products aimed at assessing emotions in learning contexts.

To fill this gap in available measurement tools, we have developed two self-report instruments focused on a wide range of achievement emotions. These are the Brief Achievement Emotions Questionnaire, BR-AEQ, and the Graduated Achievement Emotions Set, GR-AES. The first instrument has been used with secondary school and college students, while the second instrument with younger students.

Brief Achievement Emotions Questionnaire, BR-AEQ. The Brief Achievement Emotions Questionnaire, BR-AEQ, is a self-report questionnaire developed on the basis of the AEQ [24] and designed to assess the intensity of ten achievement emotions. Preliminary data on this instrument have already been discussed [28], involving secondary school students and college students referring to both current school testing and future professional testing–specifically, participating to job selection interviews. In contrast to the AEQ, the BR-AEQ focuses on a larger number of achievement emotions while being shorter to administer. It is a multi-item structured questionnaire that could be adapted for measuring emotional states in different settings, such as learning and testing. In this context, we have administered the BR-AEQ to college students, and have presented data concerning its statistical properties on a sample of students [3]. One particular aim was to investigate the internal validity of the BR-AEQ. The methodology of this project and the main results are summarised below.

Method. The participants were 409 Italian college students (mean age: 24 years, range: 20-55; 93% female). Their participation was voluntary, and the data were gathered during the academic year 2011-2012. They were tested while also taking a compulsory test they had to pass to enrol in their second year at the Faculty of Education at the University of Verona. They were administered a version of the BR-AEQ that included 30 items relating to ten achievement emotions: enjoyment, pride, hope, relief, relaxation, anxiety, anger, shame, boredom, and hopelessness. There were three adjectives for each emotion which were presented randomly. The students responded using a 7-point Likert-type scale (1 = *strongly disagree*

and 7 = *strongly agree*). The items were focused on learning exam-relevant material related to the courses the students were attending at the time we administered the BR-AEQ.

Results. To investigate the goodness of the factorial structure of the BR-AEQ, we carried out two confirmatory factor analyses (CFA) separated for positive and negative emotions, using AMOS 7.0 [1]. We considered the following fit indexes: Chi-square, comparative fit index (CFI), incremental fit index (IFI), root-mean-square error of approximation (RMSEA), Akaike information criterion (AIC), and Bayesian information criterion (BIC), with CFI and IFI ≥ .90, and RMSEA ≤ .08 as thresh-old values [7].

We tested two models in which items about positive and negative emotions (Figure 1), separately, load on five distinct latent factors. The results indicate that the two latent models adequately fitted the data, for both positive ($\chi^2(80)$ = 289.50, CFI = .92, IFI = .92, RMSEA = .08, AIC = 369.50, BIC = 530.05) and negative ($\chi^2(78)$ = 289.59, CFI = .92, IFI = .93, RMSEA = .08, AIC = 373.59, BIC = 542.17) emotions. On the whole, fit indexes are acceptable, and all the loading factors are sufficiently high, i.e., higher than .54.

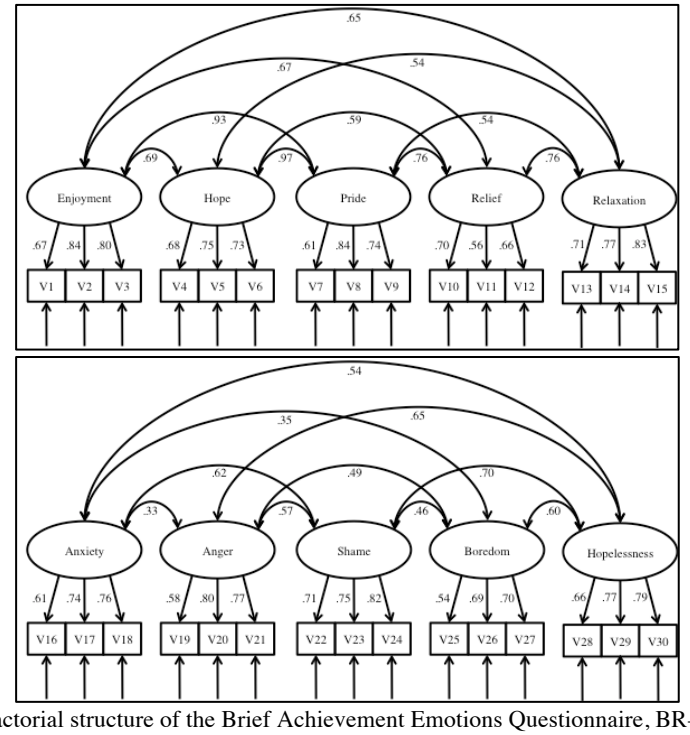

Fig. 1. Factorial structure of the Brief Achievement Emotions Questionnaire, BR-AEQ.

Discussion. These preliminary findings support the internal validity of the BR-AEQ amongst first-year college students in a learning context. Subsequently, we have administered the BR-AEQ to other two cohorts of first-year college

students, during the academic years 2012-2013 and 2013-2014, for a total of more than 1,400 participants. We focused on learning and testing settings separately. Currently, statistical analyses are in progress to assess the internal and external validity of the BR-AEQ. For a sub-sample of students, multitrait-multimethod CFAs concerning two moral emotions, pride and shame, have also demonstrated the salience of the distinction between different settings [32]. As a second step, we are using the BR-AEQ online with second and third-year college students to monitor changes in achievement emotions.

Graduated Achievement Emotions Set, GR-AES. The Graduated Achievement Emotions Set, GR-AES, is a verbal-pictorial instrument currently under development, aiming to assess the intensity of ten achievement emotions with primary school children [2, 20, 30], thus extending the AEQ-ES [17].

When evaluating children's emotions, instruments in which verbal labels are supported by graphical devices have several advantages, for example favouring more direct access to the semantic network in which emotional information is stored [13]. Such instruments can be used relatively early, given the precocious development of facial recognition abilities, serving the adaptive functions of detecting individuals' emotions that, in turn, favour the appropriate responses to the social context [7]. At the age of two or three, children recognize the facial expressions of basic emotions, and during preschool age they acquire the ability to represent knowledge about the basic expression of emotion through verbal labels; they develop the same abilities on complex emotions a little later [26].

With the wider diffusion of new technologies, affective facial stimuli such as photographs or drawings have increasingly been used in emotion research. There are several sets of stimuli representing facial expressions of emotions, only sometimes specifically devoted to children: They mainly focus on basic emotions, and are composed of graphical stimuli like photographs and computer generated faces, or–less frequently–drawings [e.g., 4, 6, 11, 13]. Scant attention has been paid to the development of sets of drawings including a wide range of achievement emotions, which could be used to evaluate children's emotions related to learning, their antecedents, or their consequences. Drawings are more flexible than photographs, as, for example, the same version of a drawing can be used with children of different ages, avoiding the proliferation of versions adapted to participants' characteristics, which may become a confounding variable. Besides, drawings are particularly familiar to children and are characterized by higher ecological validity than schematic or computerized faces [11].

We are currently working on the construction of the GR-AES, using primary school and college students as subjects. In the first phase of the project, we tested an initial version of a set of ten drawings representing the ten achievement emotions cited above, to obtain data on the cognitive validity of the instrument, through three written tasks: an agreement task, a matching task, and a naming task [29]. Given some critical issues in the correspondence between drawings and emotional labels, we revised the set and gathered data on the cognitive validity of both this second version with the three tasks cited above [30] and the extended

graduated version in which each emotion is depicted with five levels of increasing intensity, the GR-AES, through an ordering task [2]. The drawings were made by a professional illustrator, following guidelines developed by Ekman and Friesen [7], with different versions for males and females. We describe the main findings related to the two phases below.

Phase 1–Method. For the agreement task, the participants were 46 Italian students (63% female): 13 second-graders (mean age: 8 years 0 months, range: 7 years 6 months-9 years 4 months; for brevity, years and months are separated by a semi-colon in the following lines), 13 fifth-graders (mean age: 10;11, range: 10;5-11;10), and 20 college students (mean age: 22;7, range: 19;7-38;2). They were asked to evaluate how much they agreed on the correspondence between each of the ten drawings and the hypothesized linguistic emotional label on a 5-point Likert-type scale (1 = *no agreement* and 5 = *very high agreement*).

For the matching task, the participants were 47 Italian students (51% female): 13 second-graders (mean age: 7;10, range: 7;5-8;3), 14 fifth-graders (mean age: 10;10, range: 10;6-11;3), and 20 college students (mean age: 22;6, range: 19;7-24;2). They were asked to match the labels of ten achievement emotions to the same ten drawings presented in the previous task.

For the naming task, the participants were 53 Italian students (41% female): 14 second-graders (mean age: 7;9, range: 7;5-8;3), 19 fifth-graders (mean age: 10;11, range: 10;5-11;3), and 20 college students (mean age: 22;10, range: 20;4-27;3). They were asked to write the name of the emotions expressed by each of the ten faces used in the previous tasks.

For the last two tasks, responses were coded as accurate or not (1/0).

Phase 1–Results and Discussion. For the agreement task, the median value was 4 (high agreement) for pride, hope, relief, relaxation, shame, and hopelessness, while it was 5 (very high agreement) for enjoyment, anxiety, anger, and boredom.

For the matching task, Chi square tests revealed that the percentage of participants who accurately matched the faces to the corresponding achievement emotions was significantly higher than the chance level for all emotions except for boredom, in which case all the participants gave the accurate response (Table 1).

For the naming task, Chi square tests indicated that the percentage of participants who wrote the accurate term was significantly higher than the chance level for enjoyment, relaxation, anxiety, anger, and shame; for hopelessness, all the responses were accurate (Table 1).

In summary, both in the agreement and in the matching task, the participants' responses were very accurate, indicating that the proposed drawings adequately correspond to the hypothesized achievement emotions. However, the analysis of the responses in the naming task–which requires more elaborate abilities than the other two tasks–reveals some difficulties concerning complex emotions such as pride, hope, relief, and boredom in particular.

Table 1. Frequency (percentage) of accurate responses and Chi square tests (degrees of

freedom) for each achievement emotion, for matching and naming tasks (phase 1)

	Matching Task		Naming Task	
Emotions	Freq. (%)	X^2 (1, 47)	Freq. (%)	X^2 (1, 53)
Enjoyment	42 (89%)	29.128***	52 (98%)	49.075***
Pride	37 (79%)	15.511***	26 (49%)	.019
Hope	38 (81%)	17.894***	35 (66%)	5.453*
Relief	41 (87%)	26.064***	20 (38%)	3.189
Relaxation	39 (83%)	20.447***	45 (85%)	25.830***
Anxiety	40 (85%)	23.170***	42 (79%)	18.132***
Anger	46 (98%)	43.085***	52 (98%)	49.075***
Shame	44 (94%)	35.766***	39 (74%)	11.792***
Boredom	47 (100%)	-	10 (19%)	20.547***
Hopelessness	45 (96%)	39.340***	53 (100%)	-

*p < .05, **p < .01, ***p < .001.

Phase 2–Method. In this phase, only college students were used as a group of experts–given that their general higher cognitive ability is moderately related to emotional intelligence [18]–were involved. The participants were 134 Italian college students: 45 for the agreement task (mean age: 22, range: 18-38; 69% female), 44 for the matching task (mean age: 22, range: 17-49; 66% female), and 45 for the naming task (mean age: 23, range: 18-44; 72% female). The three tasks were the same as in the previous phase, but a second version of the set of ten achievement emotions was developed, after selection of the most appropriate drawing among four alternatives for the critical emotions (i.e., pride, hope, relief, and boredom) by a sample of 259 college students (mean age: 20, range: 18-47; 93% female).

An additional ordering task which includes five drawings of faces of increasing intensity for each of the ten emotions was used to validate the GR-AES. In its final version, for use with children it will have both verbal labels, with intensity ranging from 1 = *not at all* to 5 = *very much*, and pictorial representations. The participants were 78 Italian college students (mean age: 21; range: 20-25; 86% female). For each emotion, they were asked to order five drawings depicting faces with increasing levels of intensity. Responses were coded as accurate or not (1/0).

Phase 2–Results and Discussion. For the agreement task, the median value was 3 (medium agreement) for anxiety and pride, 4 (high agreement) for hope, shame, relief, boredom, and relief, while it was 5 (very high agreement) for enjoyment, anger, and sadness.

For the other three tasks, Chi square tests revealed that the percentage of participants who responded accurately was significantly higher than the chance level for all the emotions (Table 2).

In summary, the findings from matching, naming, and ordering tasks showed that the participants evaluated the drawings as corresponding to the hypothesized emotion labels, supporting the utility of the second version of the ten drawings

and its extension representing different levels of intensity. However, the data from the agreement task suggest that some drawings need to be revised, given that only basic emotions of enjoyment, anger, and sadness were evaluated as fully corresponding to the proposed labels. Therefore, a third revision of the set of drawings is in progress, adhering more strictly to Ekman and Friesen's recommendations [7] and adding postural elements for all the emotions.

Table 2. Frequency (percentage) of accurate responses and Chi square tests (degrees of freedom) for each achievement emotion, for matching, naming, and agreements tasks (phase 2)

	Matching Task		Naming Task		Agreement Task	
Emotions	Freq. (%)	X^2 (1, 44)	Freq. (%)	X^2 (1, 45)	Freq. (%)	X^2 (1, 78)
Enjoyment	43 (98%)	40.09***	45 (100%)	-	45 (100%)	59.28***
Pride	43 (98%)	40.09***	33 (73%)	9.80**	33 (73%)	55.85***
Hope	43 (98%)	40.09***	30 (67%)	5.00*	30 (67%)	55.85***
Relief	43 (98%)	40.09***	32 (71%)	8.02**	32 (71%)	49.28***
Relaxation	43 (98%)	40.09***	37 (82%)	18.69***	37 (82%)	32.05*
Anxiety	42 (95%)	36.36***	34 (76%)	11.76**	34 (76%)	5.13***
Anger	43 (98%)	40.09***	42 (93%)	33.80***	42 (93%)	29.54***
Shame	42 (95%)	36.36***	39 (87%)	24.20***	39 (87%)	62.82***
Boredom	43 (98%)	40.09***	39 (87%)	24.20***	39 (87%)	46.15***
Hopelessness	43 (98%)	40.09***	44 (98%)	41.09***	44 (98%)	43.13***

*$p < .05$, **$p < .01$, ***$p < .001$.

2.2 Translation and Validation of Instruments to Assess Achievement Goals

Given the relevance of exploring the relationships between achievement emotions and other constructs linked to performance such as motivation in technology-based contexts [14], we are currently working on the validation of some of the leading self-report instruments aimed at assessing achievement goals according to both the 2 X 2 and the 3 X 2 models [9, 10].

Translation and Validation of a Questionnaire to Assess Achievement Goals according to the 2 X 2 Model. One of the instruments currently most used to evaluate achievement goals is the Achievement Goal Questionnaire, AGQ [8], which assesses the four goals described in the 2 X 2 model. However, the authors of the AGQ have recently identified some conceptual and methodological problems in their instrument, such as references to values, concerns, or affect rather than goals; lack of separation between aims and underlying reasons; absence of consistency in item content. To solve these problems, they developed the Achievement Goal Questionnaire-Revised, AGQ-R [9], a 12-item questionnaire first tested with American college undergraduates and focusing on their first psychology exam. The analyses supported the structural validity of the AGQ-R: The model distinguishing the four factors was confirmed, and it was characterized by better fit indexes compared to alternative models. Also its

predictive validity is supported, considering both antecedents such as need for achievement and fear of failure, and consequences such as intrinsic motivation and achievement.

We translated the AGQ-R into the Italian language, using back-translation to validate the process. We then explored its psychometric properties as a first step preceding a future computerized implementation of the instrument. We adapted it both for college students, referring to a specific course [33], and for primary and secondary school students, referring to two domains, i.e. Italian and mathematics [31]. On the whole, our data support both internal and external validity of the AEQ-R, and measurement invariance across country (Italy, USA), age groups, and gender.

Translation and Validation of a Questionnaire to Assess Achievement Goals according to the 3 X 2 Model. As anticipated, a further elaboration of the 2 X 2 model has been recently proposed, and a corresponding questionnaire aimed to assess the six goals was validated [10]. This instrument is an 18-item questionnaire originally tested with German and American college students, referring to test situations. As for the questionnaire referred to the previous model, both internal and external validity have been documented.

We translated the questionnaire into the Italian language, and validated the translation by back-translation. We then administered it to college students, adapting it for two different settings, learning and testing [3, 33]. Again, our data supported both internal and external validity of the instrument. Furthermore, we investigated the relationships between achievement emotions and achievement goals through a path analysis. Our results indicate that task goals predict activity- and outcome-related emotions, matched by valence; self-approach goals positively predict one positive activity-related emotion; other-avoidance goals positively predict activity- and outcome-related emotions.

3 Discussion and Conclusions

Nowadays, the role of TEL is assuming an increasing relevance within the educational field, where the mutual links between cognitive, motivational, and affective processes have been only partially documented [14]. However, unlike initial expectations, learning within technological environments is frequently associated with negative emotions such as boredom, frustration, and confusion, usually negatively correlated to performance and implying disengagement [14]. Therefore, in order to promote positive emotions and diminish negative emotions, there is a need for further theoretical and empirical knowledge concerning salience of emotions and nature of causal antecedents [14]. To reach this goal, there is a need for the development of methodologies designed to measure emotions, taking into account the constraints and the resources typical of technological environments.

In this light, the development of valid instruments designed to assess achievement emotions in different contexts, such as within technology-based

learning environments, assumes high priority. In this work, we have proposed two self-report measures focused on a wide range of achievement emotions–i.e. the Brief Achievement Emotions Questionnaire, BR-AEQ, and the Graduated Achievement Emotions Set, GR-AES–to be used with adults and children, with Pekrun's control-value model as the theoretical framework [20]. In addition, we have presented two questionnaires–i.e. the Achievement Goal Questionnaire-Revised, AGQ-R [9] and its more recent version based on the 3 X 2 achievement goal model [10]–validated in the Italian context, to assess achievement goals as a way to understand more deeply the complex processes related to learning.

Due to their self-report nature, such instruments have some limitations, related to social desirability effects, assumptions about sufficient levels of metaknowledge of emotions, or cultural differences in the meaning of emotional terms and/or pictorial representations [21, 14]. On the one hand, some problems concerning desirability could be solved assuring confidentiality to the participants, while cultural differences could be addressed through measurement invariance analyses or verbal probing techniques. On the other hand, other limitations could be dealt with triangulating different methodologies, such as observational approaches, neuroimaging, and peripheral physiological measures [21, 14].

However, self-report instruments as those proposed in this paper still have the great advantage of enabling a direct access to all the different emotional components consciously experienced by individuals in achievement contexts, and specifically to cognitive and affective components, particularly salient for performance outcomes in technology-based learning environments.

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