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Passion for math: Relationships between teachers' emphasis on class contents usefulness, motivation and grades

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ABSTRACT

The purpose of this study was to examine the relationship between teacher emphasis on the usefulness of class content and students' harmonious passion, intrinsic motivation to learn, and math achievement in 1170 high school students. Data were analyzed using multilevel structural equation model and results showed support for the hypotheses tested. First, we found that harmonious students perceived passion and intrinsic motivation to learn as different constructs. Second, harmonious passion was positively associated with math achievement. Third, the relationship between harmonious passion and math performance was mediated by intrinsic motivation to learn. Fourth, teacher emphasis on class contents usefulness predicted students' harmonious passion. Finally, findings were discussed in terms of their implications for educational practice and methodological suggestions for future research.

1. Introduction

Passion surrounds us, permeating all aspects of our lives. The people who emphasize its importance tend to be those who have made a difference in their areas of expertise or in their lives (Vallerand, 2015). Passion propels persistence (Bonneville-Roussy, Vallerand, & Bouffard, 2013), portends performance (Bonneville-Roussy, Lavigne, & Vallerand, 2011; Vallerand et al., 2007), boosts creativity (Luh & Lu, 2012), and eases dedication (Bonneville-Roussy et al., 2011; Stoeber, Childs, Hayward, & Feast, 2011; Vallerand et al., 2007). Therefore, passion has been hypothesized to play a key role in students' academic functioning.

However, because research on passion for activities is very recent, only dating back to Vallerand et al. (2003), few researchers have studied passion within academia and the ways in which youth experience it (Coleman & Guo, 2013). Likewise, research analyzing the role of teachers in the development of students' passion is also scarce. Although teaching quality is an increasing topic and the literature shows that it affects different aspects of students in class, very few studies have been conducted on how teaching quality affects students' passion. This absence of research in the academic context is more pronounced if we consider that, to the best of our knowledge, there has been no research that analyzes the role of passion on mathematics until now.

This lack of research warrants some attention because of the relevance of math skills on other academic areas (Gaspard et al., 2015), its influence on other subjects, such as science, technology, and engineering (Wang, 2013), and its increasing importance on the students' future professional achievement (Duncan et al., 2007; Seaton, Parker, Marsh, Craven, & Yeung, 2014). Moreover, mathematics are difficult, tedious, and boring for some students (Gersten et al., 2009).

Therefore, in this study, we aimed to explore the relationship between teaching quality, specifically the teacher's emphasis on the usefulness of class contents, and students' harmonious passion, motivation, and math grades.

1.1. On the concept of passion

Most of the research on passion conducted to date has used the conceptualization of Vallerand et al. (2003). Vallerand defines passion as "a strong inclination toward a self-defining activity, object, concept, or person that one likes, loves, or highly values, and in which one invests a significant amount of time and energy." Additionally, Vallerand and colleagues propose, within the dualistic model of passion, two forms of passion that differ on how the activity is internalized into one's identity and reflect qualitatively different experiences and outcomes. Thus, harmonious passion comes from an autonomous internalization of the activity and leads people to freely engage in it because they feel that what they are doing is in line with their values. This type of passion is in harmony with other aspects of the self and leads to adaptive outcomes, such as experiencing high levels of concentration, positive affect, enhanced energy, and flow (Vallerand, 2015). On the other hand, obsessive passion comes from a controlled internalization of the activity into one's identity, leading people to experience an

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uncontrollable urge to engage in the activity and feeling controlled by internal or external pressures that command their commitment on it (Bonneville-Roussy et al., 2011, 2013; Carbonneau, Vallerand, Fernet, & Guay, 2008; Luh & Lu, 2012; Vallerand et al., 2007). In this article, we focused on harmonious passion because of its positive benefits in the educational context (Bonneville-Roussy et al., 2011, 2013; Ruiz-Alfonso & León, 2016; Stoeber et al., 2011; Vallerand et al., 2007).

1.2. On the role of passion in academic performance

Although more than 100 studies have addressed the concept of passion on different topics (Vallerand, 2015), research is still scarce within the educational context. A recent systematic review conducted by Ruiz-Alfonso and León (2016) shows that only 13 studies have analyzed passion and its relationship with causes and consequences in the educational context.

Concerning the relationship between passion and academic performance, Bonneville-Roussy et al. (2011) noticed that harmonious passion predicted students' achievement via mastery goals in a sample of music and college students. The high level of performance needed to achieve excellence is also largely reached by an extensive amount of time devoted to the activity. Thus, Bonneville-Roussy et al. (2011) and Vallerand et al. (2007) observed that harmonious passion predicts dedication in music and dramatic arts students. Similarly, the relationship between passion and persistence within the educational context was also analyzed by Bonneville-Roussy et al. (2013), who observed that students retain harmonious passion along with strong interest for the activity.

In view of the above, even though passion influences performance, it is assumed that this relationship is not direct (Vallerand, 2015) and might be mediated by other variables, such as deliberate practice (Vallerand, 2015), persistence (Mageau et al., 2009), or motivation to learn (Stoeber et al., 2011).

1.3. Passion and motivation: different constructs

Passion shares conceptual similarities with other motivational constructs, such as intrinsic motivation, identified regulation, and integrated regulation (Vallerand, 2015). On the one hand, passion and intrinsic motivation share the love for the activity and the engagement in it for pleasure (Vallerand, 2015), but the non-internalization of the activity into one's identity makes the difference (Vallerand et al., 2003, 2007). In this sense, when someone feels intrinsically motivated toward an activity, this activity is not internalized into the person's identity (as in the case with passionate people), and the intrinsic motivation emerges from the person-task interaction on the short-term level (Koestner & Losier, 2002). Thus, passion portends longer-term consequences than motivation, and it allows researchers to predict more specific outcomes over time (Houlfort, Philippe, Vallerand, & Ménard, 2014).

On the other hand, integrated and identified regulation are different types of extrinsic motivation that share with passion the internalization of the activity into the person's identity. Although these types of motivations imply a valuation and internalization of the activity into the persons' identity (Vallerand, 2015), the difference between them is that extrinsically motivated people engage in the activity to get something outside of the task itself, and not for the love of the activity itself (Vallerand, 2015). Special reference needs to be made to integrated regulation. Although both, integrated regulation and harmonious passion, imply some degree of self-regulation, it is important to highlight that self-regulation is not the equivalent to intrinsic motivation. Both concepts differ on the reasons why the individual gets involved in the activity: People with integrated regulation engage in the activity for instrumental reasons and harmoniously passionate people engage in the activity for more intrinsic reasons, although both pertain to the self. Differences between these concepts have been empirically supported by other authors such as Vallerand et al. (2003), Houlfort et al. (2014), and Bélanger, Lafrenière, Vallerand, and Kruglanski (2013).

1.4. On the relationship between passion, intrinsic motivation to learn, and math grades

While evidence suggests that harmonious passion is associated with intrinsic motivation in other domains, there is a lack of studies in the educational context. Regarding this association, Vallerand and colleagues suggest a close relationship between harmonious passion and intrinsic motivation, gathering evidence that more harmonious passion leads to more intrinsic motivation. Although several studies outside the classroom have supported this claim (Back, Lee, & Stinchfield, 2011; Curran, Appleton, Hill, & Hall, 2011; Fuster, Chamarro, Carbonell, & Vallerand, 2014; Lee, Chung, & Bernhard, 2013; Wang, Khoo, Liu, & Divaharan, 2008; Wang, Liu, Chye, & Chatzisarantis, 2011), to the best of our knowledge, few studies in the educational context have analyzed how passion affects motivation. In this regard, Stoeber et al. (2011) observed in a sample of college students that the more harmonious passion they possessed, the greater their autonomous motivation to learn. Similarly, Bonneville-Roussy et al. (2011), Coleman and Guo (2013), and Vallerand et al. (2007), also observed that harmonious passion was positively related to a motivational construct: Mastery goals (Fairchild, Horst, Finney, & Barron, 2005; Murphy & Alexander, 2000).

Academic motivation is a widely studied topic in educational psychology (Stover, De la Iglesia, Boubeta, & Liporace, 2012). For over three decades, it has been identified as a main factor in explaining school performance (Leroy & Bressoux, 2016). Students are intrinsically motivated when they study merely for the sake of learning new content, without expecting any reward (Taylor et al., 2015). A large body of studies shows that intrinsic motivation to learn predicts positive characteristics, processes, and outcomes (Stoeber et al., 2011).

Regarding school subjects, if we compare mathematics with other school domains, this subject has the worst levels of students' motivation, which could be a reason for students' poor performance (Leroy & Bressoux, 2016). Although previous studies suggest that intrinsic motivation to learn predicts achievement and learning in math (Areepattamannil, Freeman, & Klinger, 2011; Murayama, Pekrun, Lichtenfeld, & vom Hofe, 2013; Spinath, Spinath, Harlaar, & Plomin, 2006), no studies have analyzed the effects of passion on motivation concerning high school students' math achievement.

1.5. On teaching quality and passion

Teaching quality refers to teacher aspects that promote positive educational outcomes (Cochran-Smith & Fries, 2005), and it has been a growing research topic in recent years (Kunter et al., 2013; Trautwein, Dumont, & Dicke, 2015). Several different terms are used to discuss classroom processes related to student learning and are often used interchangeably, for example, *teaching effectiveness* (Marsh & Roche, 1997; Seidel & Shavelson, 2007), *quality of teaching* (Hattie, 2009), *instructional quality* (Rjosk et al., 2014) or *teacher quality* (Hattie & Anderman, 2013). Research on this topic has shown that classroom processes are a predictor of students' learning (Hattie & Anderman, 2013).

Although research on developing students' passion remains scarce, different studies have also found that certain teachers' aspects help to promote students' passion. For example, Coleman and Guo (2013) and Fredricks, Alfeld, and Eccles (2010) observed that students who perceived their teachers to be encouraging, supportive, and caring were more passionate. Fredricks et al. (2010) also noticed that students were more likely to develop passion for activities when they had challenges and more opportunities for choice, as well as toward those activities that were congruous with their own interests. Bonneville-Roussy et al. (2013) and Fredricks et al. (2010) also noticed that students who perceived their teachers to be supportive of autonomy rather than

controlling, displayed higher levels of passion. These studies suggest that students' passion can be developed by supporting their autonomy, that is, the sense of performing an activity from their self and without external pressures, feeling the origin, agent, and cause of the beginning and maintenance of the activity (Stefanou, Perencevich, Dicintio, & Turner, 2004). In the educational context, students feel autonomous when they consider that schoolwork helps them to achieve their interests (Wang & Eccles, 2013). Teachers explaining why class content or schoolwork are relevant and useful helps students to grasp why what they learn in class contributes to pursuing their interests (Assor, Kaplan, & Roth, 2002; Guay, Ratelle, Larose, Vallerand, & Vitaro, 2013).

In this regard, although some studies have suggested that autonomy support promotes passion, only one of them (Bonneville-Roussy et al., 2013) has gathered empirical evidence. Moreover, no specific teacher's aspect that promotes passion has yet been examined, nor any detailed aspect of autonomy support, such as teacher emphasis the usefulness of class content, with respect to the development of passion. Therefore, efforts to examine the potential influence of teacher emphasis on the usefulness of class content for promoting students' passion and to better understand how this influences students' performance are warranted.

1.6. Teacher emphasis on the usefulness of class content: a climate variable

In this research, we focused our attention on the relationship between passion and an indicator of autonomy support: teacher emphasis on the usefulness of class content. Although other authors (Bonneville-Roussy et al., 2013) have analyzed the relationship between autonomy support and passion or motivation, they did not take into account the nested nature of their data. When researchers evaluate whether school, classroom, or teacher characteristics (e.g. teacher emphasis on the usefulness of class content) contribute to the prediction of students' outcomes (e.g. Harmonious passion), it is recommended to test the study hypotheses using a multilevel analysis (Lüdtke, Robitzsch, Trautwein, & Kunter, 2009; Stapleton, McNeish, et al., 2016).

In multilevel modeling, two kinds of group-level variables are frequently used: (1) variables that have the same value for all students in one class (e.g. teacher's years of experience), and (2) variables that are estimated based on the aggregation of students' value. In the latter case, following Marsh et al. (2012), we can distinguish between contextual and climate variables. Contextual variables are group-level aggregates of student-level variables that are specific to each student in one class (in our study: class-average math achievement, class-average intrinsic motivation, and class-average harmonious passion). Climate variables are the result of asking students about one variable common to students in the same class (in our study: teacher emphasis on the usefulness of class content). In this situation, the reference is the same for all students in one class, unlike in contextual constructs, where there is no common reference and values are assigned on individual characteristics. In this study, we were interested in a climate construct (teacher emphasis on the usefulness of class content) and on contextual constructs (harmonious passion, intrinsic motivation to learn, and math grades). Harmonious passion, intrinsic motivation, and math grades are not only an indicator at the individual level, but if aggregated, they are also an indicator of a shared characteristic of the class.

1.7. The present study

To date, no studies have examined the relationship between teacher emphasis on the usefulness of class content, harmonious passion, intrinsic motivation to learn, and math achievement in high school students. Additionally, no specific teacher's aspect related with autonomy support has been examined with respect to passion. Thus, this study aims to analyze how these variables relate to each other and to high school students' math achievement. The following research questions were addressed to examine whether: (Research Question 1) students perceive harmonious passion and intrinsic motivation to learn as different constructs; (Research Question 2) harmonious passion predicts grades in high school students at the class and individual level; (Research Question 3) motivation to learn, at the class and individual level, mediate the relationship between harmonious passion and achievement; and (Research Question 4) teacher emphasis on the usefulness of class content at the class level predicts harmonious passion in high school students. In this research question, we do not search for relationships at the individual level because teacher emphasis on the usefulness of class content is a climate construct, and our interest is not on how the individual perception affects passion, but on the relationship between teacher emphasis and students' passion (Morin, Marsh, Nagengast, & Scalas, 2014).

For the first research question, we hypothesized, according to previous studies (Bélanger et al., 2013; Houlfort et al., 2014; Stoeber et al., 2011), that passion and intrinsic motivation to learn are different constructs and that students will perceive this difference. For the second research question, and consistent with previous research on passion and performance, we hypothesized that harmonious passion will be positively associated with math achievement.

Contrary to our interpretation regarding the recommendation to use multilevel analysis when dealing with a nested data, it could be said that in these research questions we were just interested in the relationship between individual characteristic and the need of multilevel was not justified. However, the passion and motivation of students nested in classrooms is not an individual characteristic, which can be seen by its intraclass correlation (e.g. LeBreton & Senter, 2007), and the use of multilevel analysis allows us to separate the variance between the two levels of analysis (Friedrich, Flunger, Nagengast, Jonkmann, & Trautwein, 2015). This approach provided more information of the relationship between the studied variables, and of the variables themselves (Morin et al., 2014).

For the third research question, we examine the mediational role of intrinsic motivation to evaluate the relationship between harmonious passion and math performance. Thus, according to the work by Stoeber et al. (2011) and other research outside the educational context (Back et al., 2011; Curran et al., 2011; Fuster et al., 2014; Lee et al., 2013; Wang et al., 2008, 2011), we hypothesized that intrinsic motivation to learn will mediate the relationship between students' harmonious passion and their math achievement. Finally, following the teaching quality research, for the fourth research question, we hypothesized that teacher emphasis on the usefulness of class content will predict students' harmonious passion. In addition to these main hypotheses, we have also examined other mediational pathways in our model to look for an indirect effect between these variables. We examined whether: (1) passion mediated the effects of teacher support on intrinsic motivation; and (2) passion and intrinsic motivation together mediate the effect of teacher support on math achievement (see Fig. 1).

2. Method

2.1. Participants

We recruited 1557 students (778 female, 766 male, 12 not specified) from nine high schools in Gran Canaria, Spain. Students were from second to fourth grades of secondary education (8th to 10th grades in the US system). Some responses were discarded because they were incomplete or because students were identified as non-passionate toward mathematics, so the final sample comprised 1171 students (591 female, 574 male, 6 not specified) from 82 classes. The students' mean age was 15.23 (SD = 1.06). All participants were informed of the data confidentiality and participation was strictly voluntary.

2.2. Procedure

First, we contacted schools by phone to briefly explain the study and

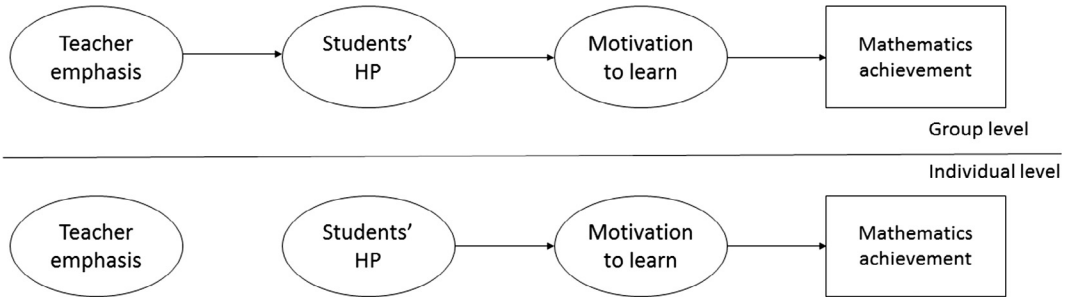

Fig. 1. Multilevel model proposed.

request an appointment with the high school mathematics teachers to request their cooperation. The school principals, mathematics teachers, and parents authorized the participation in the study. Each researcher personally administered questionnaires, explaining the anonymity of the data and the need for accuracy in responses. To keep it as broad as possible, we asked participants by an open-ended question to indicate which type of math they loved the most (e.g. statistics, algebra, calculus, geometry…) and then we instructed them to complete the Passion Scale for this type of math activity. Because some students did not have a favorite math-related activity, they could not complete this section, and they were automatically classified as non-passionate toward math. The surveys were administered during the last period of the last semester.

2.3. Measures

Participants answered demographic questions and completed a questionnaire with measures of harmonious passion, motivation to learn, and their teacher's emphasis on the usefulness of class content. All scales were rated on a 7-point Likert-type scale, ranging from 1 (*I do not agree at all*) to 7 (*I strongly agree*). To examine factorial validity, we performed a confirmatory factor analysis for each variable. Information about the estimation method and missing data can be found in the data analysis section. To assess reliability, we used McDonald (1999) because it has shown evidence of better accuracy than Cronbach's alpha (Revelle & Zinbarg, 2009), and factor loadings do not need to be equal for all items (Zhang & Yuan, 2016). Similar to Cronbach's alpha, McDonald's values above 0.80 are indicators of reliability.

2.3.1. Harmonious passion

Six items of the Passion Scale (Vallerand et al., 2003) adapted to Spanish and to the educational context were used to assess students' harmonious passion (e.g. "The new things that I discover with this activity allow me to appreciate it even more"). According to the standards for cross-cultural adaptation (Muñiz, Elosua, & Hambleton, 2013), the Spanish translation of the scale was performed by two Spanish-speaking researchers and then revised by a bilingual specialist. Regarding the CFA, the chi-squared (χ^2) value and fit indexes were χ^2 (1170, 23) = 238,030 ($p < 0.001$), RMSEA = 0.090, $SRMR_{within}$ = 0.049, $SRMR_{between}$ = 0.155, CFI = 0.90 and TLI = 0.87, and McDonald's Omega was 0.95.

2.3.2. Motivation to learn

We used a subscale of the Spanish validation (Núñez & Martín-Albo, 2006) of the *Échelle de Motivation en Éducation* (EME; Vallerand, Blais, Brierè, & Pelletier, 1989). Because our aim was to assess the pleasure experienced while learning new content in mathematics, we used the four items of the Intrinsic Motivation toward Knowledge subscale (e.g. "Because for me it is a pleasure and satisfaction to learn new things") and presented them with the stem "Why are you trying to do things well in math?" The χ^2 value and fit indexes were χ^2 (1170, 7) = 77,474 ($p < 0.001$), RMSEA = 0.093, $SRMR_{within}$ = 0.035, $SRMR_{between}$ = 0.079, CFI = 0.96 and TLI = 0.93, and McDonald's Omega was 0.88.

2.3.3. Teacher emphasis on the usefulness of class content

To assess students' perception of teacher emphasis on the usefulness of class content, we used six items (e.g. My teacher proposes useful activities) from the subscale Teacher Emphasis on the Usefulness of Class Content of the scale developed by León, Núñez, & Medina (n.d.). These items have shown evidence of reliability in prior research (León et al., n.d.) as well as in the present study (ω = 0.94). The χ^2 value and fit indexes were χ^2 (1170, 23) = 187,426 ($p = 0.001$), RMSEA = 0.078, $SRMR_{within}$ = 0.049, $SRMR_{between}$ = 0.023, CFI = 0.91 and TLI = 0.89, and McDonald's Omega was 0.94.

2.3.4. Math grades

To assess students' math performance, we obtained students' final course grades in mathematics, coded from 1 (lowest mark) to 10 (highest mark). The equivalence in the EEUU system would be: A+: 10; A: 9.175; B+: 8.325; B: 7.5; B−: 6.675; C+: 5.825; C: 5; C−: 4.175; D+: 3.325; D: 2.5; D−: 1.675; F: 1. Unlike in the United States or United Kingdom, where it is usual to assess student's achievement by standardized tests, in Spain, we use grades assigned by teachers to assess the knowledge, skills, and daily work of the students according to rubrics implemented by the government. These grades have a real-world impact on students' academic level and progress in grade school. They even affect the degrees or universities students can choose (Simões & Alarcão, 2014; Sánchez-Pérez, Fuentes, Pina, López-López, & González-Salinas, 2015).

2.4. Data analysis

To test our first hypothesis (H1: Students perceive harmonious passion and motivation as two different constructs) we ran two multilevel confirmatory factor analyses. In the first model, items from passion and motivation loaded on a single factor, and in the second one, items loaded on their correspondent factor. To determine which model showed a better fit to the data, we computed a χ^2 test and an examination of fit indexes for both models.

To test hypotheses two (H2: Harmonious passion will be positively associated with math achievement) and three (H3: The relationship between passion and achievement will be mediated by motivation to learn), we ran two multilevel structural equation models (MSEMs), in which passion predicted motivation, and, in turn, math achievement at the individual and group levels. To test the mediational effect of motivation between passion and achievement, we added, in a nested MSEM, a direct effect from teacher emphasis on the usefulness of class content on math performance. To search for evidence of mediation, we compared both models using a χ^2 test and fit indexes. If there were no differences between both models we would hold the most parsimonious result. Moreover, we computed the unstandardized indirect effect and its standard error using the delta method (Sobel, 1982).

Finally, to examine our fourth hypothesis (H4: Teacher emphasis on class usefulness will predict students' harmonious passion) we tested a

multilevel model, analyzing the effect of the Teacher Emphasis on the Usefulness of Class Content and Interest on students' Harmonious Passion, which predicted math grades via Motivation to Learn. We followed the same approach described above to test the mediational effect of: (1) Passion in the relationship between Teacher Emphasis on the Usefulness of Class Content and Interest and students' Motivation to Learn; (2) Passion and Motivation to Learn in the relationship between Teacher Emphasis on the Usefulness of Class Content and Interest and students' math grades.

There are different strategies to test a MCFA or MSEM (Stapleton, McNeish, et al., 2016; Stapleton, Yang, et al., 2016). In this study, following the recommendations of Morin et al. (2014), we constrained factor loadings of the individual and group level to the same value. We also used standardized scores to simplify the interpretations and to reduce non-essential multicollinearity. With regard to the estimation method, we used maximum likelihood with robust standard errors. This method has shown evidence of performing properly even when data is nonnormally distributed (Schmitt, 2011). We handled missing data using the full information maximum-likelihood method, which provides unbiased parameters in missing at random circumstances and even in cases where data is not missing at random (Enders, 2010). The calculations were conducted with Mplus 7.4 software (Muthén & Muthén, 2016).

3. Results

3.1. Preliminary analysis

Mean values and standard deviations are shown in Table 1. Means varied between 3.632 (Harmonious Passion) and 5.382 (math grades), and standard deviations varied between 1.455 (Harmonious Passion) and 2.164 (math grades). At the individual level, correlations ranged from 0.073 (Teacher Emphasis on the Usefulness of Class Content with math grades) to 0.507 (Harmonious Passion with Motivation to Learn), and at the group level, they ranged from 0.122 (Teacher Emphasis on the Usefulness of Class Content with math grades) to 0.691 (Harmonious Passion with Motivation to Learn). In line with previous studies (Fauth, Decristan, Rieser, Klieme, & Büttner, 2014; Morin et al., 2014), higher correlations were observed at the group level than at the individual level.

3.2. Passion and motivation: Different constructs

We tested whether a multilevel two-factor model in which Passion and Motivation to Learn are two different constructs fit the data better than a model in which all items loaded on a single factor. The χ^2 test and the fit indexes for the two-factor model were χ^2 (1170, 76) = 502.781 ($p < 0.001$), CFI = 0.919, TLI = 0.905, and RMSEA = 0.069, and for the one factor model were χ^2 (1170, 90) = 5288,892 ($p < 0.001$), CFI = 0.648, TLI = 0.599, and RMSEA = 0.142. The χ^2 test comparing both models was significant, and fit indexes were much better for the two-factor model. Therefore, our results showed that students perceive Passion and Motivation to Learn as two different constructs.

Table 1
Descriptive statistics and correlations between major variables.

		Mean	SD	ICC	1	2	3	4
1	Teacher	4.131	1.766	0.465	–	0.305***	0.286***	0.073**
2	Passion	3.632	1.455	0.090	0.470**	–	0.507***	0.113***
3	Motivation	4.363	1.559	0.053	0.671***	0.691***	–	0.249***
4	Math	5.382	2.164	0.083	0.122	0.483***	0.473***	–

Note. Lower diagonal triangle: Group level correlations. Upper diagonal triangle: Individual level correlations.
* $p \leq 0.05$.
** $p \leq 0.01$.
*** $p \leq 0.001$.

3.3. Students' variables: harmonious passion, motivation, and math grades

We tested the hypothesized model, in which Harmonious Passion acts as a determinant of Motivation to Learn, which, in turn, predicts Math Grades. The χ^2 test and fit indexes for the MSEM were χ^2 (1170, 94) = 578.236 ($p = 0.001$), RMSEA = 0.066, $SRMR_{within}$ = 0.058, $SRMR_{between}$ = 0.130, CFI = 0.914, TLI = 0.900. With regard to relationships between variables, at the between level, Harmonious Passion predicted Motivation (β = 0.775; SE = 0.124; $p < 0.001$), explaining 60% of its variance, and this predicted math grades (β = 0.526; SE = 0.193; $p = 0.006$), explaining 28% of its variance. At the individual level, Harmonious Passion predicted Motivation to Learn (β = 0.548; SE = 0.030; $p < 0.001$), explaining 30% of its variance, and this predicted math grades (β = 0.246; SE = 0.033; $p < 0.001$), explaining 6% of its variance.

With regard to the mediational effect of Motivation to Learn, in the relationship between Harmonious Passion and math grades, we compared the above MSEM to an MSEM with an additional path from Passion to Math. The χ^2 test and fit indexes for this MSEM were χ^2 (1170, 92) = 576.890 ($p < 0.001$), RMSEA = 0.067, $SRMR_{within}$ = 0.058, $SRMR_{between}$ = 0.130, CFI = 0.914, TLI = 0.897. We observed no improvement in fit indexes, and the direct effect from Harmonious Passion to math grades was not different from 0 at either the individual level (β = -0.036; SE = 0.038; $p = 0.353$) or the group level (β = 0.346; SE = 0.428; $p = 0.419$). Moreover, both [unstandardized] indirect effects in the fully mediated model were significant different from 0 at the individual level (β = 0.485; SE = 0.077; $p < 0.001$) and at the group level (β = 1.438; SE = 0.710; $p = 0.043$). Therefore, there is evidence of mediation of Motivation to Learn in the relationship between Harmonious Passion and math achievement.

3.4. Teacher emphasis on the usefulness of class content on students' variables

We tested the hypothesized model, in which Teacher Emphasis on the Usefulness of Class Contents predicts students' Harmonious Passion, which determines students' Motivation to Learn and, in turn, predict math grades.

The χ^2 test and fit indexes for the MSEM were χ^2 (1170, 247) = 1061.085 ($p < 0.001$), RMSEA = 0.053, $SRMR_{within}$ = 0.056, $SRMR_{between}$ = 0.162, CFI = 0.908, TLI = 0.898. At the group level, Teacher Emphasis on the Usefulness of Class Content predicted Harmonious Passion (β = 0.549; SE = 0.163; $p < 0.001$), explaining 30% of its variance. Harmonious Passion predicted Motivation (β = 0.840; SE = 0.103; $p < 0.001$), explaining 71% of its variance, and this predicted math grades (β = 0.469; SE = 0.193; $p = 0.015$), explaining 22% of its variance. At the individual level, Harmonious Passion predicted Motivation to Learn (β = 0.554; SE = 0.030; $p < 0.001$), explaining 31% of its variance, and this predicted math grades (β = 0.248; SE = 0.030; $p < 0.001$), explaining 6% of its variance.

With regard to the mediational effect of Harmonious Passion in the relationship between Teachers' Emphasis on the Usefulness of Class Content and Motivation to Learn, we compared the above MSEM to a MSEM with an additional path from Teachers' Emphasis on the Usefulness of Class Content to Motivation to Learn. The χ^2 test and fit indexes for this MSEM were χ^2 (1170, 246) = 1056.138 ($p < 0.001$), RMSEA = 0.053, $SRMR_{within}$ = 0.056, $SRMR_{between}$ = 0.153, CFI = 0.908, TLI = 0.899. We can observe almost no improvement in fit indexes. The direct effect from Teachers' Emphasis on the Usefulness of Class Content and Motivation to Learn was different from 0 (β = 0.459; SE = 0.232; $p = 0.049$), and the [unstandardized] indirect effect in the fully mediated model was significantly different from 0 (β = 0.173; SE = 0.075; $p = 0.020$).

Regarding the mediational effect of Harmonious Passion and Motivation to Learn in the relationship between Teachers' Emphasis on the Usefulness of Class Content and math grades, we compared the proposed model to an MSEM with an additional path from Teachers' Emphasis on the Usefulness of Class Content to math grades. The χ^2 test and fit indexes for this MSEM were χ^2 (1170, 246) = 1061.595 ($p < 0.001$), RMSEA = 0.053, $SRMR_{within}$ = 0.056, $SRMR_{between}$ = 0.161, CFI = 0.908, TLI = 0.898. We observed almost no improvement in fit indexes. The direct effect from Teachers' Emphasis on the Usefulness of Class Contents to math grades was not significantly different from 0 (β = -0.230; SE = 0.241; p = 0.339), neither was the [unstandardized] indirect effect in the fully mediated model (β = 0.242; SE = 0.141; p = 0.086). In this situation, our data provides contradictory information that prevent us from affirming that there is evidence ofthe mediational effect of Harmonious Passion and Motivation to Learn in the relationship between Teachers' Emphasis on the Usefulness of Class Content and math grades. On one hand, we see that the fit of both models is not significantly different, and the direct path from Teachers' Emphasis on the Usefulness of Class Content to math grades is not significantly different from 0, but on the other hand, the indirect effect in the fully mediated model is also not significantly different from 0 (see Fig. 2).

4. Discussion

In this study, we attempted to elucidate the role of passion in the educational context. Our findings extend previous research analyzing the relationship between harmonious passion, intrinsic motivation, and math achievement in high school students as well as examining the effects of teacher emphasis on the usefulness of class content on students' harmonious passion. Thus, to the best of our knowledge, for the first time in the literature, we examined the effects of harmonious passion in an academic discipline such as mathematics, specifically in a sample of high school students. More importantly, we examined a specific teacher's characteristic of autonomy support – teacher emphasis on the usefulness of class content - that has never before been examined with regard to harmonious passion.

The first aim of the study was to test whether students perceive passion and motivation as different constructs. The second aim was to analyze whether harmonious passion could predict math grades in high school students. The third aim was to analyze whether the relationship between harmonious passion and grades was mediated by motivation to learn. Finally, the fourth aim was to test whether teacher emphasis on the usefulness of class content could predict students' harmonious passion. Thus, this study provides support for the hypotheses tested. First, students perceive passion and motivation as different constructs (Hypothesis 1). At the group level, harmonious passion predicted math grades (Hypothesis 2), and this relationship was mediated by motivation to learn (Hypothesis 3). Moreover, harmonious passion was predicted by teachers' emphasis on the usefulness of class content (Hypothesis 4). Similarly, at the individual level, students who displayed higher levels of harmonious passion felt more motivated to learn and this was found to be related to higher math scores.

4.1. Harmonious passion, intrinsic motivation, and math grades

We provided evidence of the relationship between harmonious passion and performance. This is in line with previous studies in other areas: music students (Bonneville-Roussy et al., 2011; Mageau et al., 2009), dramatic arts, and undergraduate psychology students (Vallerand et al., 2007). these findings are also consistent with findings outside the educational context, in which there is also evidence of the relationship between passion and performance (Mageau et al., 2009; Thorgren & Wincent, 2015; Vallerand et al., 2008).

On the other hand, our findings are consistent with previous research supporting the theory that the more harmonious passion, the greater the motivation. Thus, although only a few studies have analyzed how passion affects motivation within the educational context (Bonneville-Roussy et al., 2011; Coleman & Guo, 2013; Stoeber et al., 2011; Vallerand et al., 2007), the relationship between harmonious passion and motivation in other fields has been well documented (see Back et al., 2011; Curran et al., 2011; Fuster et al., 2014; Lee et al., 2013; Wang et al., 2008, 2011). We also found positive associations between motivation to learn and math achievement, and these results are in accordance with those found in previous research (see Areepattamannil et al., 2011; Murayama et al., 2013; Spinath et al., 2006). Finally, our study provides evidence that the relationship between harmonious passion and math performance in high school students is mediated by motivation to learn, which is in agreement with previous studies, while passion is involved in high-level performance, it is not hypothesized to influence it directly (Vallerand, 2015).

4.2. Teacher emphasis on the usefulness of class content and harmonious passion

Although there is no research that has specifically used the concept of teaching quality regarding harmonious passion within the Self Determination Theory (Ryan & Deci, 2000), previous research has shown that the more the students perceive their teachers as supportive of autonomous motivation, the more harmonious passion they display (see Bonneville-Roussy et al., 2013; Fredricks et al., 2010). Therefore, we focused on a key autonomy support factor: teacher emphasis on the usefulness of class content. Our results provided consistent evidence that teachers who strive to explain the usefulness of class content and activities promote harmonious passion in their students, which predicts motivation to learn and grades. Because explaining the usefulness of class content is a strategy to support students autonomy, our findings are consistent with Bonneville-Roussy et al. (2013) and Fredricks et al. (2010), who also showed a positive relationship between these two variables. Bonneville-Roussy et al. (2013) provided evidence that college students who perceived their tutors as supportive of autonomy manifested higher levels of harmonious passion than those who perceived their teachers to be controlling. Fredricks et al. (2010) observed that teachers who provided opportunities for choice and to work on

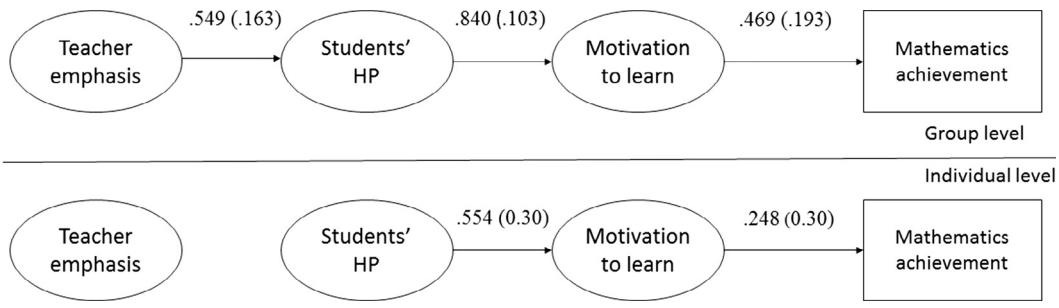

Fig. 2. Multilevel structural equation model including teacher emphasis on the usefulness of class content. The standardized parameters are above the arrows; standard errors are between parentheses.

varied activities, also promoted students' passion.

Finally, we looked at the mediational pathways of passion in the relationship between teachers' emphasis on the usefulness of class content and motivation to learn, and the mediational pathways of both passion and motivation to learn in the relationship between teacher emphasis on the usefulness of class content and math achievement. With regard to the former, we observed a significant indirect effect. Thus, we can conclude that the teacher can enhance motivation via students' passion. For example, if teachers explain why class content and activities are useful, students might feel more passion toward math, and thus, study for the pleasure of learning new things. In the relationship between teacher emphasis and math achievement regarding passion and motivation to learn, we saw a no significant indirect effect ($p = 0.086$). Thus, although we observed that teacher emphasis predicts passion, motivation to learn, and math achievement, our data prevents us from discussing mediation. In another words, we cannot say that changes in math are exclusively due to passion and motivation to learn, accounting for teacher emphasis.

4.3. Limitations and future research

The results of this study should be understood by accounting for several limitations. The first limitation we would like to highlight is using students' math grades as the only indicator of math achievement. Although grades have a real-world impact on students' academic level and progress in grade school (Sánchez-Pérez et al., 2015) and they predict educational attainment and success (Thorsen & Cliffordson, 2012), we believe that for future research, it would be interesting to use standardized tests, such as the Woodcock Johnson Test (Woodcock, McGrew, & Mather, 2001) or the Symbolic Magnitude Processing Test (Brankaer, Ghesquière, & De Smedt, 2016).

The second limitation refers to the characteristics of the study. Because it is not a longitudinal study, we cannot establish causal relationships between the variables tested. Thus, it is important for future research to conduct longitudinal studies to test these relationships, and to assess whether the mediating variables can be understood as mechanisms to establish clear relationships between the variables (Kazdim, 2007). In addition, future longitudinal studies of passion and academic performance could help to better assess if the long-term passion can be enhanced, over time, by the repeated exposure to teachers' autonomy-supportive behaviors.

Third, in this study we only take into account students who felt some passion for mathematics. We did this because we thought, first of all, that it would be very difficult to assess the harmonious passion of students if they did not love any activity related to math, since to love an activity is one of passion's requirements, and it would not make sense for these students to complete this items. However, by administering the scale in this way, we had to excluded 386 participants from our analysis. We encourage future research to take into account these non-passionate students in their analysis, in order to compare them with passionate (or somewhat passionate students), and to better study the benefits of having passion for math.

The fourth limitation refers to the scale used to assess students' harmonious passion. Although it is an instrument validated in many previous studies, and it is the only existing one that has been used so far to evaluate the harmonious passion, we realized that it does not include any item to evaluate the reasons why the individual engages in the activity. If the intrinsic/extrinsic reasons to perform the activity make the difference between harmonious passion and integrated regulation, it is difficult to grasp the difference between both concepts and this scale could be measuring something akin to integrated regulation. So that, this scale presents a weakness that should be addressed in future research, future studies trying to introduce some items to evaluate the intrinsic/extrinsic reasons why the individual performs the activity.

Finally, it would also be interesting to test what other features of teaching quality encourage students' passion (e.g. teacher's care, class structure, acknowledgment of positive feelings, etc.). Thus, we recommend further research to test what classroom practices promote students' passion and the application of training programs to show teachers the importance of passion and what they can do, concretely and specifically, to improve the passion of their students, which offers promising approach to improving their interest in the subject.

4.4. Conclusion

Passion is important for the field of education (Vallerand, 2016). In line with previous evidence, we found that passion influences motivation to learn, which improves academic achievement. Additionally, we have observed that teachers' emphasis on the usefulness of class content is associated with students' passion. Thus, taking into account previous research that has shown that passion leads to important outcomes, such as persistence, dedication, well-being, or competence, our first recommendation is the need for teachers to become aware of the essential role they play in helping their students to discover passionate school activities and their benefits. Moreover, our study suggests to math teachers that they could foster their students' passion by emphasizing the usefulness of the class content. This occurs when teachers, instead of merely explaining the concepts, illustrate why class content is useful and relevant, or when they explain to students how they might be able to apply what they are learning to real life or to other subjects. Although it is often not easy to explain the usefulness of some math content, an example may be to start a lesson on percentages by explaining that percentages are useful for knowing the final prices on sales or to understand the quantity of ingredients in the products that they buy in the supermarket.

Teachers should also know that helping students to foster their own passion, even outside the school context, could help their students to engage more easily in demanding curriculum activities (Haerens, Vansteenkiste, Aelterman, & Van den Bergh, 2016) and maintain their interest in classroom activities (Fredricks et al., 2010). Although more research is needed on this topic, this issue could be even more important if we consider that math is a subject with lower levels of students' motivation (Leroy & Bressoux, 2016).

Appendix

Items to assess students' harmonious passion [The English version is in brackets]

1. Esta actividad se adapta bien al resto de actividades que realizo en mi vida [This activity is well adapted to the other activities in my life]
2. Las cosas nuevas que aprendo y descubro con esta actividad hacen que me guste aún más [The new things that I discover with this activity allow me to appreciate it even more]
3. Esta actividad refleja las cualidades que más me gustan de mí mismo [This activity reflects the qualities I like the most about myself]
4. Esta actividad me permite vivir muchas y variadas experiencias [This activity allows me to life many and a variety of experiences]
5. Esta actividad está bien integrada en mi vida [This activity is well integrated in my life]
6. Esta actividad está en armonía con el resto de cosas que forman parte de mí [This activity is in harmony with the rest of things that are part of me]

Items to assess the teacher emphasis on class contents usefulness [The English version is in brackets]

1. Mi profesora sugiere diferentes tipos de actividades que ayudan a comprender lo que damos en clase [My teacher suggests different types of activities that help me to understand what we learn in class]
2. Mi profesora suele explicar utilizando ejemplos que me resultan

interesantes [My teacher usually explains using examples that I find interesting]
3. Mi profesora pide nuestra opinión para plantear tareas de clase más entretenidas [My teacher asks for our opinion to pose more entertaining class tasks]
4. Mi profesora amplía las explicaciones de clase contándonos cosas interesantes [My teacher expands class explanations telling us interesting things]
5. Mi profesora busca aplicaciones prácticas de lo que aprendemos en clase [My teacher seeks practical applications of what we learn in class]
6. Mi profesora plantea actividades que son útiles para mí [My teacher raises activities that are useful to me]

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