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The implicit meaning of TIMSS: Exploring ethics in teachers' practice

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HIGHLIGHTS

- We found that TIMMS teacher questionnaires includes implicit meanings of ethics in teacher practice.
- We elicited four-dimensional structure of ethics in teachers' practice in our analyses.
- Results support the existence of both a universal and national approaches to teachers' ethical practice.

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ABSTRACT

This study explored whether the TIMSS 2015 teacher questionnaires reflects shared perceptions of ethics in teachers' practice. Quantitative analysis of teachers' responses to TIMSS questionnaires, from 45 countries, yielded a four-dimensional structure of the concept "ethics in teachers' practice": caring about students' learning, interacting with colleagues, respecting the rules, and teacher professionalism. Our results support the idea that perceived ethical behavior among teachers exhibits both universal perspectives, as well as particularistic, national ones. The findings can help teachers develop awareness concerning ethics in their profession, and may encourage assessment of ethics in teachers' practice by using TIMSS teacher questionnaires.

1. Introduction

It is important to explore whether teachers' responses to TIMSS[1] questionnaires reflect shared ethical aspects of teachers' practice. This is because ethics constitutes an inherent component of teaching throughout the world. One of the main goals of TIMSS[2] is to promote educational equity and equality that will reduce achievement gaps (Mullis, Martin, Foy, & Hooper, 2016). Since this goal reflects a key element in the ethics of teachers' practice, TIMSS was used in this study as a basis for exploring shared ethical aspects among teachers' from 45 different countries[2].

For the last 20 years, TIMSS reports have led to government awareness of ethical issues, such as the importance of identifying gaps in resources, opportunities, inequity and equity (Mullis et al., 2016). As a result, participating countries design educational policies that take into consideration equity issues, such as promoting students' potential development by maximizing the performance of low-achieving students (Hanushek & Woessmann, 2015). Thus, the ethical content that appears in the TIMSS reports (Mullis, Martin, et al., 2016) has led us to the understanding that the TIMSS teacher questionnaire contains implicit ethical aspects. By choosing countries for our sample that participated in the TIMSS, and by analyzing teacher responses to the questionnaires, we explored whether teachers in different countries share perceptions concerning ethical aspects of teachers' practice.

To summarize, our approach is that the TIMSS teacher questionnaire reflects teachers' practice. Since ethics is an inseparable part of such practice, our main goal was to uncover the ethical

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[1] Trends in International Mathematics and Science Study.

[2] TIMSS (Trends in International Mathematics and Science Study) is a cross-national assessment of students' math and science knowledge in the fourth and eighth grades, which has been administered every four years, in over 60 countries, since 1995. The International Association for the Evaluation of Educational Achievement (IEA) developed TIMSS in order to enable a comparison of educational achievement across the participating countries (Mullis et al., 2016). The TIMSS assessment and questionnaire data provide an authoritative account of how the world's students are performing in mathematics and science, and the changes that have occurred in curriculum, instruction, and other aspects of education that affect teaching and learning. In addition, TIMSS assessment includes students', teachers' and principals' questionnaires concerning their perceptions and attitudes of school safety, discipline, teachers' and students' engagement, challenges, resources, conditions, and academic success. The participants come from diverse educational systems, in terms of economic development, geographical location, and population size (Mullis, Martin, et al., 2016).

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aspects shared by teachers in different countries, by analyzing their responses to the TIMSS questionnaire. In specific, the aims of this study were: (a) to explore whether there are items in the TIMSS teacher questionnaires that have an implicit ethical meaning and, hence, reflect ethical aspects in teachers' practice. If we were to find such an ethical meaning, then the second aim was: (b) to explore whether the teachers' responses reflected shared ethical perceptions.

Our study is important for *academic reasons,* since exploring the meaning of ethics in teachers' practice, based on the last international assessment TIMSS 2015, can uncover the deep meaning of the concept of ethics in teachers' practice, including its components and complexity. Furthermore, our research has *educational significance*. It can help teachers become more aware of what their ethical practice includes and better understand their ethical obligations and roles. Our study also has *social significance* since it suggests that the TIMSS questionnaire also contains ethical meanings, which go beyond its original measures of math and science achievements. Therefore, use of this questionnaire can help us evaluate ethics in teachers' practice in international assessments. This assessment can then shed light on the ethical challenges faced by teachers throughout the world. By learning about these challenges, we can then use this knowledge to help reduce inequalities in education, currently reflected by gaps in the TIMSS student scores.

2. Theoretical background

In this study, we explored the implicit existence of shared ethical aspects in the TIMSS teacher questionnaire describing teachers' practice. We begin with a description of proposed main dimensions[3] that represent ethics in teachers' practice, reflected in international studies. Then, we describe the context of the study, and the meaning of national and universal culture in terms of ethics in education. We discuss the dimensions that comprise ethics in teachers' practice, in the context of a shared cross-national ethical perspective (reflective of universal culture) while also exploring the dissimilarities in perspective between countries (reflective of national cultures).

2.1. Ethics in teachers' practice in international studies

Ethics focuses on attitudes and behaviors, such as evaluating, choosing, acting, and considering desirable actions associated with human rights and responsibility for other people (Rausch, Lindquist, & Steckel, 2014; Sanger & Osguthorpe, 2011; Smith & Smith, 2016). Previous studies discussed five main dimensions that represent one way to categorize the ethical dimensions of teachers' practice: (1) caring about students' learning and well-being, (2) professionalism, (3) collegial relationships among teachers, (4) respecting the law, school regulations and students' rights, and (5) respecting parents and school community.

2.1.1. Caring about students' learning and well-being

Ethical teachers care about their students by developing their students' potential, and promoting inquiry and creativity (Joseph, 2016). Ethical teachers create a safe environment, with fair and equitable treatment of each student (Scott, Webber, Lupart, Aitken, & Scott, 2014), thus ensuring a high quality learning environment, which promotes student excellence and high achievement (Koellner & Jacobs, 2015).

[3] We do not assert here that these are the *only* dimensions, but rather that these dimensions offer a solid framework of ethical behavior among teachers.

2.1.2. Professionalism

Ethical teachers base their practice on continuous professional development and on teaching up-to-date topics (Louws, Meirink, van Veen, & van Driel, 2018). They are well versed in the subject matter and use a wide range of strategies and assessments in the classroom (Ronfeldt, Farmer, McQueen, & Grissom, 2015). In addition, they act as role models in their schools, communities and other social spheres, thus creating and maintaining a good reputation of the teaching profession (Körkkö, Kyrö-Ämmälä, & Turunen, 2016).

2.1.3. Collegial relationships among teachers

Ethical teachers collaborate with colleagues and other professionals in the interest of student learning. They share knowledge, which may contribute to their professional development and their students' achievements (Ning, Lee, & Lee, 2015). They treat colleagues in a just and equitable way, engaging in positive cooperation, respecting opposing opinions, and respecting each other's privacy (Uitto, Jokikokko, & Estola, 2015).

2.1.4. Respecting the law, school regulations and students' rights

Ethical teachers respect the democratic system, the country's laws and government policies. They are aware of the importance of abiding by the rules, since these rules are designed to protect the rights of all the students and teachers connected to the school. When conflict arises, ethical teachers are expected to search for ways to uphold regulations while continuing to act according to their personal values and ethics. This way, teachers can create a balance between their independence and their commitment to school regulations and guidelines (Mansfield, Beltman, Broadley, & Weatherby-Fell, 2016).

2.1.5. Collaborating with parents and school community

Ethical teachers are motivated to collaborate with parents and community since they believe they have a shared responsibility to promote opportunities and learning processes (Minke, Sheridan, Kim, Ryoo, & Koziol, 2014). Studies emphasize that collaboration among teachers, parents and community directly affects student achievements (Jeynes, 2015) and school effectiveness (Weiss, Lopez, & Rosenberg, 2010).

2.2. A cross-national context of ethics in educational systems

There are two main approaches discussed in the literature regarding ethics and culture. One approach focuses on ethical perceptions that are unique to a country's culture and norms (Melé & Sánchez-Runde, 2013; Rausch et al., 2014), while the other approach focuses on ethical attitudes and behaviors that are shared across different cultures (Cullen, Parboteeah, & Hoegl, 2004; Donnelly, 2013). The literature that focuses on differences in ethical perceptions in different countries claims that *national culture* affects ethical perceptions and behaviors in organizations (Minkov & Hofstede, 2011). The literature that focuses on shared ethical attitudes and behaviors across countries is based on a claim of *universalism* vis-à-vis the perception of ethics. This perspective asserts that there are basic universal values or principles, such as equality and equity, and that these common principles appear in major world religions and traditions (Terry, 2011; Tullberg, 2015).

In the field of education, both approaches to ethics exist. On the one hand, there are studies that focus on cultural diversity and dissimilarity in different countries regarding ethical issues, such as social justice (Banks, 2015), ethical dilemmas (Milner, 2010) and the importance of developing student potential (Klassen, Usher, & Bong, 2010). On the other hand, there are studies that explore globalization and similarity, such as human rights in educational

systems (Stromquist & Monkman, 2014), the reduction of gaps (Zhao, 2010), and quality education (Wang, Lin, Spalding, Odell, & Klecka, 2011).

Based on the above, in our study, we analyzed the dimensions that characterize ethics in teachers' practice in the context of international assessments that include national and universal effects. Our analyses considered both effects.

3. Method

3.1. The ethical context of TIMSS

This study is based on questionnaires completed by science teachers, and focuses on their perceptions regarding challenges, satisfaction, professional development, and experiences in teaching. We analyzed the original parameters found in the questionnaires that reflect ethical aspects of teaching. One example of items that relate to ethical behavior includes: "this schools' rules are enforced in fair and consistent manner. We analyzed responses to 'the challenges facing teachers scale', which includes, for example, the items: "I feel too much pressure from parents; " and "I need more time to assist individual students". In addition, we analyzed responses to 'teaching limited by student need scale', which includes items such as, "To what extent do disruptive students/students with mental, emotional, or psychological disabilities, limit how you teach this class?"

Our analysis is based on a dataset that includes the relevant items described below in the teachers' questionnaires. The date is available to the public on the TIMSS website.

3.2. Sample

Our sample was comprised of 8353 science teachers (67.7% women) in 8353 different schools (mainly from a single class per school) across 45 countries that participated in the TIMSS 2015 survey. The majority of teachers had a Bachelor's degree or an equivalent (58.2%), and the others had graduate degrees (the majority had a Master's level, 1.6% had a doctoral degree). The age distribution was as follows: 15% of the teachers were between 20 and 30, 35% were between 31 and 40, 32.5% were between 41 and below 50, and the remaining were between 50 and 60 years of age, with an average of about 37.6 (SD = 8.2). The teaching experience varied from 1 to 48 years with an average of about 15 years (SD = 9.0).

3.3. Sampling procedure

We received approval from the research ethics committee of our university. Our main sampling procedures were as follows:

3.3.1. Weighting

We found that the distribution of the number of schools in each country ranged from 48 schools (Malta) to 477 schools (United Arab Emirates). The analysis required that the number of schools within a country would be similar across all 45 countries. Therefore, we constructed a country weight (COUWGT) that equalized the number of schools across countries (Foy, 2017). Table 1 presents the overall frequencies by country in comparison to the weighted number of schools, where weight was calculated around the mean number of schools per country (M = 186). That is, when the number is lower, the weight inflates it towards the mean, and if it is higher, the weight deflates it towards the mean.

3.3.2. Missing values

Four hundred and fifty three teachers, out of the 8353 teachers, did not answer any of the 86 survey items that pertained to teachers' practice and 10 teachers provided partial answers (20 items or less). As a result, the questionnaires of those teachers were excluded from the data. We then tested the missing value patterns of the remaining 7890 schools. Our preliminary analysis for missing values showed that one percent or less was missing. Although the missing pattern did not exhibit clear randomness (Little & Rubin, 2014), we imputed the missing values since the number of observations was high. For the imputation procedure, we used the expectation maximization (EM) method that improves likelihood in comparison to the known likelihood of the data (Do & Batzoglou, 2008).

4. Analysis procedure and results

In our analysis, we used Mplus V.8.0 (Muthén & Muthén, 2017). The analysis of the TIMSS data was carried out in five steps: obtainment of expert judgment, exploratory factor analysis, multilevel confirmatory analysis, multiple group confirmatory analysis and a final measurement model.

4.1. Expert judgment

We used our 'COST' network (an intergovernmental framework for cooperation). We sent emails to a random sample of 12 educators (one educator from each country: Ireland, Hong Kong, United Kingdom, United States, Sweden, Israel, Australia, Italy, Chinese Taipei, Hungary, Canada and New Zealand) who were actively employed, or had previously worked as teachers in the TIMSS participating countries (as subject teachers, homeroom teachers, professors in the university). The educators were asked to independently rate 86 questionnaire items concerning the degree to which they reflected ethical aspects of teachers' practice. Specifically, the question was: "Below are items that relate to teachers' perceptions about their practice. Please rate each item on a scale of 1 (low ethical meaning) to 5 (high ethical meaning) according to its relevance to ethics in teachers' practice."

Ten educators agreed to participate (83.3% response rate). Each item was rated on a scale of 1 (low) to 5 (high), according to its relevance to ethics in teachers' practice. This rating was then used to choose items that were perceived as highly relevant for ethics in teachers' practice (4–5). Our final set of items consisted of 38 out of 86 items in the TIMSS teacher questionnaire (examples of items excluded from the study were: How would you characterize each of the following in your school: teachers' expectations regarding student achievement; parental pressure on the school to maintain high academic standards (very high/high/medium/low/very low)).

4.2. Exploratory factor analysis

Exploratory factor analysis was run on a training set (approximately one third of the total teachers' data, n = 2629 teachers). Table 2 provides the final factor loadings for four representing factors. Out of the primary 38 items, seven were excluded, due to poor loadings (loadings < 0.36) (Costello & Osborne, 2005; Osborne, 2015). The final factors were determined according to their ethical meaning, which produced four main dimensions: 'teacher professionalism', 'caring about student learning', 'interaction with colleagues', and 'Respecting the rules'. These four dimensions correspond to four of the five dimensions that are reported in the literature, with the exclusion of 'respecting parents and school community'. At the bottom of Table 2, we note the internal consistency (Cronbach's Alpha) which shows high internal consistency among the factor items (alpha>.80). The shaded cells represent the final set of items for each factor. At that exploratory

Table 1
Unweighted and weighted school frequency.

Country Code	Country Name	Unweighted School Frequency	Weighted School Frequency
36	Australia	285	186
48	Bahrain	105	186
72	Botswana	159	186
124	Canada	276	186
152	Chile	171	186
158	Chinese Taipei	190	186
268	Georgia	153	186
344	Hong Kong, SAR	133	186
348	Hungary	144	186
364	Iran, Islamic Republic of	250	186
372	Ireland	149	186
376	Israel	198	186
380	Italy	161	186
392	Japan	147	186
398	Kazakhstan	172	186
400	Jordan	252	186
410	Korea, Republic of	150	186
414	Kuwait	168	186
422	Lebanon	138	186
440	Lithuania	208	186
458	Malaysia	207	186
470	Malta	48	186
504	Morocco	345	186
512	Oman	301	186
554	New Zealand	145	186
578	Norway	143	186
634	Qatar	131	186
643	Russian Federation	204	186
682	Saudi Arabia	143	186
702	Singapore	167	186
705	Slovenia	148	186
710	South Africa	292	186
752	Sweden	150	186
764	Thailand	204	186
784	United Arab Emirates	477	186
792	Turkey	218	186
818	Egypt	211	186
840	United States	246	186
926	England	143	186
5788	Norway –8	142	186
7841	United Arab Emirates (Dubai)	135	186
7842	United Arab Emirates (Abu Dhabi)	156	186
9132	Canada (Ontario)	138	186
9133	Canada (Quebec)	122	186
32001	Argentina, Buenos Aires	128	186
Total			8353

point, the multilevel structure of the data is ignored. The four dimensional structure of ethics in teachers' practice was approved by the 10 educators who had been selected to provide expert judgment.

4.3. Multilevel confirmatory analysis

Our exploratory analysis (4.2) led to a four-dimensional factor structure, which represents a proposed multidimensionality of ethics in teachers' practice. In the confirmatory modeling method, we aimed to confirm this factor structure. A question arose as to the multilevel arrangement of these factors. Do factors remain the same; that is, do they show similar loadings for the school level and the country level? To test this possibility, we first ran a multilevel confirmatory analysis and compared the fit quality to the fit quality of a constrained model in which loadings are held equal across the two levels. The confirmatory runs were done on the complementary set ($n = 5261$) of the data ($n = 7890$). When measures of goodness of fit remained similar, for example, $\Delta CFI < 0.01$, the equal loading constraint did not cause a severe reduction in the goodness of fit model. Therefore, it can be concluded that the factor structure at the school level remains similar at the country level (Heck & Thomas, 2015). Moreover, this implies that countries are similar in the overall meaning of the concept 'ethics in teachers' practice'.

Table 3 presents the result of this methodology. For each original item, the intra-class correlation (ICC) coefficient was added to test the variability, which stems from the country level. We found that the ICC values were greater than 0.05 across all items; that is, a meaningful variation existed across countries as well as across schools.

The factor loadings were high both within and between levels. We tested whether factor loadings were similar across the two levels by means of measurement invariance; that is, we compared the configural (unconstrained) model fit and the equal loading constrained model to one another.

The reduction in CFI between the unconstrained and constrained model was $0.956 - 0.952 = 0.004$ for the 'teacher professionalism' factor, which is lower than 0.01. Therefore, we concluded that there was structural similarity for the factor - 'teacher professionalism'. In other words, we could conclude that a similar 'teacher professionalism' factor structure exists, both at the school level and at the country level. Factor 2, 'caring about student

Table 2
Exploratory factor analysis and factor loadings (N = 2629 teachers[a]).

	F1	F2	F3	F4
Teacher professionalism				
BTBS17D Adapting my teaching to engage students' interest	0.70	0.12	-0.06	-0.08
BTBS17E Helping students appreciate the value of learning science	0.70	0.10	-0.02	-0.08
BTBS17A Inspiring students to learn science	0.65	0.10	-0.08	-0.03
BTBS17F Assessing student comprehension of science	0.64	0.08	-0.06	0.04
BTBS17C Providing challenging tasks for the highest achieving students	0.64	0.03	0.03	-0.05
BTBS17G Improving the understanding of struggling students	0.62	0.09	-0.03	0.01
BTBS17B Explaining science concepts or principles by doing science experiments	0.55	0.12	-0.05	0.00
BTBG14G Encourage students to express their ideas in class	0.54	-0.10	0.04	0.03
BTBG14D Encourage classroom discussions among students	0.53	-0.12	0.16	0.04
BTBG14C Ask students to complete challenging exercises that require them to go beyond the instruction	0.51	-0.16	0.11	0.07
BTBG14F Ask students to decide their own problem solving procedures	0.49	-0.11	0.15	0.01
BTBG14B Ask students to explain their answers	0.47	-0.18	0.03	0.08
Caring about students' learning				
BTBG06P Amount of instructional support provided to teachers by school leadership	-0.10	0.86	0.06	-0.04
BTBG06O Collaboration between school leadership and teachers to plan instruction	-0.05	0.84	0.08	-0.09
BTBG06Q School leadership's support for teachers' professional development	-0.11	0.77	0.08	-0.02
BTBG06N Clarity of the school's educational objectives	0.06	0.70	-0.08	0.07
BTBG06A Teachers' understanding of the school's curricular goals	0.13	0.52	-0.06	0.04
BTBG06D Teachers working together to improve student achievement	0.05	0.47	0.19	0.02
BTBG06C Teachers' expectations for student achievement	0.15	0.36	-0.14	0.18
Interaction with colleagues				
BTBG09E Work together to try out new ideas	0.05	0.01	0.82	-0.04
BTBG09C Share what I have learned about my teaching experiences	0.01	-0.03	0.75	0.00
BTBG09F Work as a group on implementing the curriculum	0.05	0.05	0.73	0.03
BTBG09A Discuss how to teach a particular topic	0.05	-0.05	0.72	0.04
BTBG09G Work with teachers from other grades to ensure continuity in learning	-0.01	0.07	0.71	0.05
BTBG09D Visit another classroom to learn more about teaching	0.00	0.09	0.63	-0.09
Respecting the rules				
BTBG07D The students behave in an orderly manner	0.01	-0.09	-0.01	0.90
BTBG07E The students are respectful of the teachers	0.04	-0.06	0.00	0.88
BTBG07F The students respect school property	0.00	-0.02	0.01	0.81
BTBG07G This school has clear rules about student conduct	-0.06	0.31	0.00	0.47
BTBG07H This school's rules are enforced in a fair and consistent manner	-0.10	0.36	0.07	0.46
BTBG06M Students' respect for classmates who excel in school	0.05	0.27	-0.03	0.39
Mean Score				
STD				
Reliability – Alpha Cronbach	.87	.86	.89	.87

Item BTBG06C is excluded from the final analysis due to low loading (L<.35).

[1] One teacher per school

Table 3
The multilevel confirmatory model results – Factor loadings and invariance test (N = 5261 teachers[a]).

Teacher professionalism	Within Level		Between Level		ICC
	Loadings	SE	Loadings	SE	
BTBS17D	0.74***	0.01	0.97***	0.02	.11
BTBS17E	0.73***	0.01	0.93***	0.04	.14
BTBS17A	0.67***	0.02	0.83***	0.07	.18
BTBS17F	0.66***	0.01	0.84***	0.07	.09
BTBS17C	0.66***	0.02	0.83***	0.05	.10
BTBS17G	0.63***	0.01	0.76***	0.09	.10
BTBS17B	0.63***	0.01	0.59***	0.11	.12
BTBG14G	0.40***	0.02	0.73***	0.07	.15
BTBG14D	0.37***	0.02	0.72***	0.09	.21
BTBG14C	0.36***	0.02	0.64***	0.10	.17
BTBG14F	0.40***	0.02	0.63***	0.08	.18
BTBG14B	0.30***	0.02	0.63***	0.12	.13
Unconstrained Model fit: CFI = .956, TLI = .940, RMSEA = .035, Chi Square = 722.43, df = 97, p < .001, AIC = 100691.91, BIC = 101158.24					
Constrained Model fit: CFI = .952, TLI = .942, RMSEA = .035, Chi Square = 792.85, df = 109, p < .001, AIC = 100730.67, BIC = 101118.19					
Caring about students' learning	Within Level		Between Level		ICC
	Loadings	SE	Loadings	SE	
BTBG06P	0.83***	0.01	0.97***	0.02	.14
BTBG06O	0.86***	0.01	0.94***	0.03	.02
BTBG06Q	0.73***	0.01	0.92***	0.03	.13
BTBG06N	0.70***	0.01	0.79***	0.07	.09
BTBG06A	0.52***	0.02	0.42**	0.13	.09
BTBG06D	0.58***	0.01	0.68***	0.09	.11
Unconstrained Model fit: CFI = .949, TLI = .910, RMSEA = .068, Chi Square = 424.91, df = 17, p < .001, AIC = 53359.45, BIC = 53563.06					
Constrained Model fit: CFI = .948, TLI = .932, RMSEA = .059, Chi Square = 438.91, df = 23, p < .001, AIC = 53394.42, BIC = 53558.62					
Interaction with colleagues	Within Level		Between Level		
	Loadings	SE	Loadings	SE	
BTBG09E	0.84***	0.01	0.98****	0.01	.14
BTBG09C	0.72***	0.01	0.92***	0.03	.11
BTBG09F	0.79***	0.01	0.89***	0.03	.18
BTBG09A	0.67***	0.01	0.88***	0.05	.10
BTBG09G	0.73***	0.01	0.91***	0.03	.16
BTBG09D	0.63***	0.01	0.73***	0.08	.29
Unconstrained Model fit: CFI = .982, TLI = .968, RMSEA = .047, Chi Square = 212.58, df = 17, p < .001, AIC = 55935.67, BIC = 56139.28					
Constrained Model fit: CFI = .980, TLI = .972, RMSEA = .043, Chi Square = 236.65, df = 22, p < .001, AIC = 55936.32, BIC = 56107.09					
Respecting the rules	Within Level		Between Level		
	Loadings	SE	Loadings	SE	
BTBG07D	0.82***	0.01	0.88***	0.05	.09
BTBG07E	0.84***	0.01	0.99***	0.02	.08
BTBG07F	0.84***	0.01	0.91***	0.05	.09
BTBG07G	0.60***	0.02	0.58***	0.13	.05
BTBG07H	0.63***	0.02	0.63***	0.11	.07
BTBG06M	0.56***	0.02	0.78***	0.09	.09
Unconstrained Model fit: CFI = .998, TLI = .997, RMSEA = .014, Chi Square = 29.47, df = 15, p < .001, AIC = 49703.95, BIC = 49920.70					
Constrained Model fit: CFI = .994, TLI = .991, RMSEA = .023, Chi Square = 78.51, df = 21, p < .001, AIC = 49754.16.54, BIC = 49931.50					

***p < .001. # of observations = 5,261, # of clusters = 45.
[a] One teacher per school.

learning', yielded a similar result. The CFI difference equals 0.001. This was also true for the other two factors. The CFI difference for 'interaction with colleagues' was 0.002, and 0.004 for 'respecting the rules'. In sum, the factor structure that was found within each country (school level) was also found between countries (country level).

4.4. Multiple group confirmatory analysis

Another method to confirm similar dimensionality of factors across countries is the implementation of a multiple group analysis by employing a measurement invariance test. We first allowed free factor loadings for each country; that is, we used an independent measurement model (configural model) across the different countries. This step provided a reference for the overall goodness of fit. The measurement invariance test is a gradual imposition of loading constraints across countries to assess fit reduction due to these constraints (Scmitt & Kuljanin, 2008; Vandenberg & Lance, 2000). We gradually imposed equal loadings and then equal intercepts across all countries.

The first constraint, metric model, tested whether the factor structure (regression slopes) was equal across all countries. The stricter constraint model (Scalar model) tested whether the structure and the level (intercepts) of the factors differed across countries. Similar to the multilevel test, if fit indices demonstrated minor reduction, the conclusion would be that all countries shared a similar factor structure. However, if the reduction in goodness-of-fit was significant (ΔCFI>0.01), it would indicate a different structure across countries and would require a finer comparison to detect the countries which were different.

Table 4 shows the results of the measurement invariance test. The comparison is between the unconstrained model, which was used as a basis for fit quality, and the constrained models (metric = weak invariance constraints; scalars = strong invariance constraints). In comparison to the multilevel analysis, the multiple group analysis is more sensitive to the 'within' variance. This means that the invariance test compares countries to one another and does not provide two-level structures, as in the multilevel model (school and country levels).

Regarding the configural and the metric model, we found similar fit quality, based on our comparisons of the 45 countries, which generated a large variance. The CFI differences between the metric and the configural models were, respectively: 0.031, 0.009, 0.012, and 0.018 for 'teacher professionalism', 'caring about student learning', 'interaction with colleagues', and 'respecting the rules'. These findings demonstrate that the difference was insignificant, except for the first factor - 'teacher professionalism'. Thus, we can cautiously conclude that a universal structure exists across all countries. The countries share four dimensions: 'caring about student learning', 'interaction with colleagues', 'respecting the rules' and 'teacher professionalism'. The last factor was found in all countries, but it is perceived differently, as reflected in the variance of teachers' responses between the 45 countries.

4.5. The final measurement model

To confirm the full factor structural model, we ran an integrative measurement model on two-thirds of the sample (N = 5261 teachers) that included all four factors. Table 5 shows all factor loadings in an integrative measurement model. Since all loading values are high and similar to one another, the overall confirmation of the factor structure is strong. This supported the undertaking of further analysis, using these latent factors in comparison to one factor (Common Method Variance [CMV] test - Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

A measure of internal consistency was added, the composite reliability measure, which replaced the common alpha (Raykov, 1997). The composite reliability is a measure of the latent and the observed variance, in which the loadings represent the latent variance. The composite reliability is the ratio between the squared sum of loadings and the variance of the latent factor (set to a unit variance) over the sum of the latent variance from above and the sum of the variances of the observed items. Our results indicated a high level of reliabilities (composite reliability > .70) for all four factors. The model fit was above the acceptance level (e.g., CFI = 0.93, TLI = 0.92).

Table 4
Multiple group analysis for the ethics in school practice dimensions (N = 5261 teachers[a]).

	Configural Model	Metric Model	Scalar Model	Metric versus Configural	Scalar versus Configural	Scalar versus Metric
Teacher professionalism						
CFI	.945	.914	.624	0.031	0.29	0.593
TLI	.921	.902	.642	0.019	0.26	0.623
RMSEA	.067	.075	.142	−0.008	−0.067	0.15
Chi-Square	2627.36	3574.25	8784.80	953.57	6222.58	5227.80
df	1724	2164	2604			
P	<.001	<.001	<.001			
SRMR	.066	.134	.301			
# of parameters	1741	1301	861			
AIC	89690.47	89826.48	94624.99			
BIC	101125.49	98371.54	100280.11			
Caring about students' learning						
CFI	.948	.939	.762	0.009	0.186	0.177
TLI	.902	.929	.799	−0.027	0.103	0.13
RMSEA	.122	.104	.175	0.018	−0.053	−0.071
Chi-Square	989.94	1319.26	3680.35	356.49***	2658.46***	2597.25***
df	360	580	800			
P	<.001	<.001	<.001			
SRMR	.051	.185	.265			
# of parameters	855	635	415			
AIC	49803.50	49834.12	52024.49			
BIC	55419.20	54004.85	54750.25			
Interaction with colleagues						
CFI	.978	.966	.748	0.012	0.23	0.218
TLI	.959	.961	.788	−0.002	0.171	0.173
RMSEA	.078	.077	.179	0.001	−0.101	−0.102
Chi-Square	619.03	981.28	3788.96	360.98***	3270.23***	2832.48***
df	360	580	800			
P	<.001	<.001	<.001			
SRMR	.034	.112	.303			
# of parameters	855	635	415			
AIC	52863.34	52790.88	55419.76			
BIC	58479.04	56961.61	58145.51			
Respecting the rules						
CFI	.992	.974	.859	0.018	0.133	0.115
TLI	.979	.964	.866	0.015	0.113	0.098
RMSEA	.061	.079	.153	−0.018	−0.092	−0.074
Chi-Square	386.37	845.47	2649.41	455.16***	2267.21***	1897.55***
df	270	490	710			
P	<.001	<.001	<.001			
SRMR	.027	.177	.260			
# of parameters	945	725	505			
AIC	46073.11	46158.10	47661.85			
BIC	52279.94	50919.96	50978.73			

***p < .001. # of observations = 5261, # of countries = 4.
[a] One teacher per school.

Table 5, like Table 2, illustrates that a few of our dimensions include items that belong to more than one original scale that is assessed in the TIMSS teacher questionnaire. For example, the dimension, 'teacher professionalism', includes items from two separate scales in the TIMSS: 'challenges facing teachers' and 'teaching science'; the dimension 'respecting the rules' includes items from the two TIMSS scales 'self-emphasis on academic success' and 'safe and orderly school'. Other dimensions we found, 'caring about student learning' includes a few items from the scale, 'self-emphasis on academic success', and the dimension 'interaction with colleagues' includes a few items from the scale, 'about being a teacher'. These findings suggest that there is an additional ethical meaning to the items appearing in the teachers' TIMSS questionnaires.

Thus, regarding our two goals, which were to explore whether TIMSS teacher questionnaires have an implicit ethical meaning, and whether the teachers' responses reflected shared ethical perceptions in their practice, we found a shared concept of ethics in teachers' practice that includes four dimensions, based on exploratory and confirmatory factor analyses. Three of these dimensions ('caring about student learning', 'interaction with colleagues', and 'respecting the rules') are highly similar across the 45 countries, while the dimension of 'teacher professionalism' was perceived differently in the different countries. In any case, the differences found in the perceptions of 'teacher professionalism' do not negate the universality of this dimension, across the participant countries. The factor analyses and multilevel confirmatory analysis demonstrated that this dimension appeared from the teachers responses in each country. However, it was perceived differently across countries.

5. Discussion

The main goal of this study was to explore whether shared ethical aspects in teachers' practice could be elicited from TIMSS teacher questionnaires in 45 countries. Based on the analyses, we constructed a four-dimensional structure of the concept "ethics in teachers' practice," which was shared by the teachers in the different countries. The dimensions were: caring about students' learning, interacting with colleagues, respecting the rules, and teacher professionalism. Therefore, we believe these dimensions represent one relevant way to categorize the ethical aspects of teachers' practice in a universal way.

The first shared dimension we found, 'caring about student

Table 5
Confirmatory factor analysis (measurement model), factor loadings and consistency (N = 5261 teachers[a]).

Factor	Loadings	SE
Factor 1: Teacher professionalism; CR = .84		
BTBS17D Adapting my teaching to engage students' interest	0.76***	0.01
BTBS17A Inspiring students to learn science	0.69***	0.01
BTBS17F Assessing student comprehension of science	0.67***	0.01
BTBS17C Providing challenging tasks for the highest achieving students	0.70***	0.01
BTBS17G Improving the understanding of struggling students	0.65***	0.01
BTBS17B Explaining science concepts or principles by doing science experiments	0.64***	0.01
BTBG14G Encourage students to express their ideas in class	0.43***	0.01
BTBG14D Encourage classroom discussions among students	0.45***	0.01
BTBG14C Ask students to complete challenging exercises that require them to go beyond the instruction	0.43***	0.02
BTBG14F Ask students to decide their own problem solving procedures	0.44***	0.02
BTBG14B Ask students to explain their answers	0.35***	0.02
Factor 2: Caring about students' learning; CR=.87		
BTBG06P Amount of instructional support provided to teachers by school leadership	0.83***	0.01
BTBG06O Collaboration between school leadership and teachers to plan instruction	0.86***	0.01
BTBG06Q School leadership's support for teachers' professional development	0.75***	0.01
BTBG06N Clarity of the school's educational objectives	0.72***	0.01
BTBG06A Teachers' understanding of the school's curricular goals	0.53***	0.01
BTBG06D Teachers working together to improve student achievement	0.62***	0.01
Factor 3: Interaction with colleagues; CR=.89		
BTBG09E Work together to try out new ideas	0.85***	0.01
BTBG09C Share what I have learned about my teaching experiences	0.74***	0.01
BTBG09F Work as a group on implementing the curriculum	0.81***	0.01
BTBG09A Discuss how to teach a particular topic	0.69***	0.01
BTBG09G Work with teachers from other grades to ensure continuity in learning	0.77***	0.01
BTBG09D Visit another classroom to learn more about teaching	0.64***	0.01
CR	.89	
Factor 4: Respecting the rules; CR=.87		
BTBG07D The students behave in an orderly manner	0.81***	0.01
BTBG07E The students are respectful of the teachers	0.84***	0.01
BTBG07F The students respect school property	0.84***	0.01
BTBG07G This school has clear rules about student conduct	0.62***	0.01
BTBG07H This school's rules are enforced in a fair and consistent manner	0.65***	0.01
BTBG06M Students' respect for classmates who excel in school	0.59***	0.01
CR	.87	

Goodness-of-Fit: CFI = 0.934, TLI = 0.924; RMSEA = 0.044, SRMR = 0.050; CR=Composite Reliability.
[a] One teacher per school.

learning', refers mainly to improving student learning through the school administration's support of the teachers, for example, by encouraging professional development and promoting dialogue with school leadership. This finding expands upon the dimension 'caring about student learning and well-being' that appears in the literature. The literature has focused mainly on ensuring a high quality-learning environment by promoting student inquiry and a fair and equitable treatment of each student, but it did not emphasize the element of support from school leadership that is essential for achieving ethical environment in school.

The second shared dimension we found in the study, 'interaction with colleagues', also expands upon the correlating dimension that appears in the literature. The literature describes interaction with colleagues as sharing and discussing teaching experiences in order to contribute to teachers' professional development and student achievement. Our study adds collegial interaction strategies, such as teacher peer observation for learning purposes and cooperation with teachers from other grades to ensure learning continuity.

The third dimension found in this study, 'respecting the rules', focuses mainly on student conduct, such as respecting teachers, classmates and school property. These findings add to findings presented in the literature regarding the dimension 'respecting the law, school regulation and students' rights' – a dimension which focuses mainly on teachers' perceptions concerning their respect of the democratic system, the law and government policies.

The fourth dimension found in the study, 'teacher professionalism' expands upon the correlating dimension in the literature by adding strategies such as asking students to complete challenging exercises, encouraging students to express their ideas in class and improving the understanding of students struggling with the material. This supplements the existing literature, which focuses mainly on participating in continuous professional development and being role models.

The ethical dimension of 'collaborating with parents and school community' was not reflected in responses to the questionnaires, although items relating to this dimension do appear in the questionnaire. This finding may be explained by findings from previous studies (Epstein, Galindo, & Sheldon, 2011; Lawson, 2003), indicating that, in practice, teachers are reluctant to solicit parental involvement for fear of parental intervention.

We were aware of the fact that when searching for universal values, national policies, norms and culture also affect teachers' perceptions. Our results demonstrate that while there are shared dimensions in the different countries, there are also differences between them. These findings illustrate that while we can identify certain universal values, at times, the meaning of these values is perceived in different ways in different countries. For example, in our study, the dimension of 'teacher professionalism' includes ethical aspects elicited different perceptions in the different countries. These differences may be explained in the context of national policy concerning procedures, regulations and course content of continued professional development (Mullis, Martin, et al., 2016).

To illustrate, most states in the US require continued professional development for renewal of a teacher's license. This requirement may make teachers aware of the importance of

keeping up to date with new educational developments and research. It may encourage them to incorporate new and innovative teaching methods into the classroom. In the UK, school administrations are expected to offer training and development opportunities to staff members, but are given the freedom to define their own approach to professional development, based on teachers' needs. The focus on professional development, which is specifically tailored to the needs of each school, may help teachers in awareness of the importance of gaining in-depth knowledge of their students' socio-economic background and their scholastic and social abilities. This could help the teachers adapt their teaching to the specific class and school. In Morocco, pedagogical inspectors design teacher professional development programs and supervise teachers in order to improve teaching practices (Mullis, Martin, Goh & Cotter, 2016). It appears that teachers' perceptions about the meaning of professionalism are influenced, in part, by their country's specific educational policies and regulations (Mullis, Martin, Goh & Cotter, 2016). Perhaps this is what led to the differences in perceptions among teachers from the different countries, regarding their responses to the dimension 'teacher professionalism'.

In addition, the difference between countries regarding teachers' perceptions of professionalism might be explained by the example of how teachers from different countries perceive the concept of 'inspiring students' (one of the items that comprises the dimension of 'teacher professionalism'). Teachers from countries with high expenditures on education may perceive the concept of 'inspiring students' as recommending that students take university-level courses. In contrast, in countries with low expenditures on education, teachers may perceive inspiration as giving students the opportunity to participate in school lab experiments, an activity which may be perceived as elementary in countries that have high budgets for education.

In sum, we used a new approach for the exploration of the meaning of ethics in teachers' practice, by analyzing the TIMSS teacher questionnaires. Our findings mainly expanded upon previous studies that explored the meaning of ethics in teachers' practice. Specifically, our study provided additional significance of the TIMSS teacher questionnaires. We elicited a deeper cross-national meaning for the concept of 'ethics in teachers' practice' from these questionnaires while supporting a dual existence of a universal and national perspectives, when exploring teachers' perceptions of ethical behaviors.

6. Conclusions

Our findings support the existence of a shared, universal perspective, which was reflected in the construction of a four-dimensional structure of the concept "ethics in teachers' practice." In addition, we found that national culture affects teachers' ethical perceptions, for example, concerning 'teacher professionalism'. The effect that national culture has on perceptions of universal values may be explained by the influence of national policies and norms on a country's school system. In turn, these influences may affect the way teachers perceive professionalism.

From the *academic aspect*, our results provide a deeper understanding of the meaning of ethics in teachers' practice. We were able to identify its four dimensions by exploring responses to the TIMSS teacher questionnaire and to expand upon the meaning of each dimension, as reported in the literature. From an *educational standpoint*, the results have the potential to encourage teachers to become more aware of their ethical practices and obligations. From the *social aspect*, analyzing responses from the TIMSS teacher questionnaire makes it possible for us to evaluate teachers' perceptions of ethics in their practice. This might encourage governments to be aware of ethical challenges teachers deal with, leading them to allocate human resources and budgets, in order to reduce inequalities in education.

7. Strengths, limitations and directions for future research

One of the limitations of this study is that the ethical meanings of TIMSS items were implicit. Based on the expert judgment of educators and a quantitative approach, we found these items as reflecting ethics in teacher practice. Future studies should continue investigating the validity of these items as reflective of ethics in teachers' practice, for example, by examining additional countries, and using additional educators for expert judgment.

In addition, we still cannot unequivocally determine that there is consensus concerning the four dimensions found in our study. Therefore, a future study that would analyze our proposed dimensions, would add needed information concerning the issue of consensus.

The strength of this study is in our findings regarding the additional meaning that can be attributed to the TIMSS teacher questionnaire. Our study uncovered the concept of ethics in teachers' practice through use of expert judgment and numerous quantitative methods described in detail above. These methods demonstrated high internal reliability for the different dimensions of ethics in teachers' practice. Future studies should continue to investigate whether our findings can help promote the development of additional measures for ethical aspects in educational practice, such as measures based on the TIMSS student and principal questionnaires and on analysis of the codes of ethics that exist in various countries.

Since the teachers' perceptions in this study were gleaned through self-reports, the data may be somewhat inaccurate. However, the strategies used by the TIMSS administration to maintain the anonymity of the participants may have contributed to reducing the potential of this inaccuracy. The questionnaires were administered in different languages, since they were given out in a variety of countries. Thus, it was difficult to ensure that the phrasing of the questionnaires and the cultural appropriateness of content were equivalent in all languages.

Finally, in this study, we analyzed all 45 countries together. Future studies should consider analyzing the relationship between our proposed dimensions and students' science achievements by comparing high and low science - achieving countries, developed and developing countries, countries with high and low expenditure on education and other comparisons that may affect the relationship between ethics in teachers' practice and students' science achievements.

8. Educational implications: toward ethical education for teachers

We encourage future TIMSS assessments to consider incorporating the dimensions of ethics in teachers' practice that have emerged from this study, due to their high internal reliability. This could help teachers in the participant countries become more aware of what their practice includes and help them better understand their obligations and roles as educators.

Developing educational programs and professional development training for teachers that focus on the dimensions of ethics in teachers' practice might increase teachers' ethical behaviors. In turn, this might improve student achievement and reduce achievement gaps. Such educational programs can help teachers understand the ethical expectations of the educational system and their role in promoting ethical practices in their schools.

It is important that teachers increase their professionalism, strengthen their relationships with colleagues, develop their sense

of caring, and obey school rules. All these can help promote an ethical school environment and, subsequently, help reduce inequalities in education, which are currently reflected by gaps in TIMSS student scores.

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