Psychometric Properties of the Disruptive Behavior in Physical Education Scale in Mexican students. Prediction of satisfaction with physical education

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Abstract

The aim of the present study was to analyze the psychometric properties of the Questionnaire for Disruptive Behavior in Physical Education (CCD-EF) in the Mexican context. A non-experimental, cross-sectional, correlational-causal study was designed in which 378 girls (Mean = 13.99; SD = .30) and 375 boys (Mean = 14.02; SD = .33), all high school students participated. The psychometric properties of the scale were analyzed by means of different exploratory and confirmatory analyses that demonstrate that this instrument with four correlated factors, and as higher order models, is valid, reliable, and invariant as a function of sex. A regression model with latent variables showed a positive and significant prediction of boredom with Physical Education on disruptive behaviors, finding that this prediction is higher in boys than in girls. The CCD-EF has proven to be a reliable and valid instrument to use with Mexican high school students.

Introduction

School violence is one of the most worrying social problems in adolescents, and it leads to behaviors such as physical and verbal abuse among students, with disrespect for the teacher's authority, constant disorder in the classroom being among the most common [1]. In addition to this, classroom violence increases the probability of school failure, which, together with the dissatisfaction of adolescents, is even related to a higher suicide rate [2], which increases concern about this problem [3]. In fact, interpersonal violence is the fourth leading cause of adolescent and youth mortality worldwide, although its weight varies substantially from one region of the world to another, according to the World Health Organization [WHO] [4]. In the low- and middle-income countries of the Region of the Americas, it is the cause of almost one third of all adolescent male deaths. According to data from the Global School Health Survey, 42% of adolescent boys and 37% of girls were exposed to bullying [4], with low school engagement and school failure being a major risk factor [5]. Different studies, have highlighted the importance of studying the disruptive behaviors of young people at school since they spend most of their time there [6].

These matters are of even greater concern in the Mexican context, as it continues to rank first internationally among Organization for Economic Cooperation and Development [OECD] countries in cases of bullying and school violence, a phenomenon that affects more than 18 million primary and secondary students in public and private schools in the country [7]. Furthermore, Mexico is one of the three OECD member countries where suicide rates rose between 1990 and 2015 for young people aged 15 to 19 years [8].

Disruptive behaviors are defined as those that disrupt school activities, particularly behaviors that disturb teachers and/or students in class [9]. For teachers, this set of inappropriate student behaviors hinders the normal development of classroom activities during the sessions, causing a great loss of time due to constant calls for attention that cause interruption of school planning and low academic performance [10]. Regarding the typification of disruption, school regulations and teachers' perceptions classify it under misconduct as: misbehavior, aggressiveness, repeated annoyance, indiscipline, rudeness, transgression of the truth, attention deficit and distancing [10].

The subject of Physical Education (PE) has been labeled as a conflictive curricular area due to the frequent interactions that occur in it because of its eminently practical and competitive nature [11]. These conflicts in
the PE classroom are usually more prone to occur in sessions where students have to demonstrate that they are more skilled than their peers [12], when students find PE classes monotonous and boring [13], and when they experience feelings of dissatisfaction with the subject [14]. By contrast, when the adolescent experiences feelings of fun and satisfaction with PE the probability of negative behaviors in the classroom is reduced. Thus, boredom is a determining factor in the increase of inappropriate behaviors in PE [15], with the teacher being an important element in reducing it [16].

There are certain behaviors that are identified more frequently in PE, such as aggressive, low engagement or irresponsibility, fails to follow directions, distract or disturbs others, and poor self-management [17, 18]. Among the students' explanations for their inappropriate behaviors in the PE classroom the boredom they experience in their classes stands out as they find them to be monotonous, and dissatisfaction with the teacher is also significant. It is common to find these behaviors reiterative in the same subjects [17]. Along these lines, disruptive behaviors in the PE class can reduce learning and the opportunity for classroom activities [19]. As some studies highlight, adolescents often show some problematic behaviors in classrooms, such as idleness, disrespect, irresponsibility, disobedience of rules, talking out of turn, and/or skipping class, which generates a negative impact on the learning environment [18, 20]. The learning environment that the teacher is able to create in PE classes can influence inappropriate behaviors, motivation, and student learning [15].

In this vein, questionnaires have been designed and validated to measure disruptive behaviors in the PE classroom from the students' [21, 22] and the teachers' perspectives [18, 22]. Focusing on students, first Kulínna, Cothran and Regualos [23] and Cothran and Kulínna [17] designed the 59 item Physical Education Classroom Instrument (PECI) to measure both the frequency of indiscipline and the severity of students’ disruptive behavior. This scale began with six factors: aggressive, low engagement or irresponsibility, fails to follow directions, distract or disturbs others, poor self-management, and disruptive and illegal behaviors [23]. However, none of these studies presented validity analyses of the instrument and also did not provide values related to goodness-of-fit indices. Later, the PECI evolved to a short version of 20 items from which the dimension of harmful and illegal behaviors was eliminated, and which did present acceptable validity and reliability values [22]. Subsequently, the PECI was adapted and validated for PE in the Spanish context by Granero-Gallegos and Baena-Extremera [21] receiving the name Questionnaire for Disruptive Behavior in Physical Education (CCD-EF). This adaptation obtained acceptable validity and reliability values. However, in Mexico there are no adapted and validated questionnaires available that assess disruptive behaviors in PE classrooms and that could contribute to evaluating the origin of the very high rates of violence among Mexican adolescents. Likewise, it is worth mentioning that none of the previously mentioned versions of this instrument have analyzed it as a higher-order model [24] in which negative behaviors are evaluated from a global perspective, in addition to evaluating their variables in a correlated manner. Given that previous research presented a high correlation between the different factors [21, 22], it would be interesting to analyze the psychometric properties of the CCD-EF as a higher-order model in which it would function as a single latent variable.

It should be noted that of all the studies mentioned above, the only one that reported results of factorial invariance as a function of academic level was the study by Krech et al. [22], who studied factorial invariance
as a function of academic level (primary vs. secondary) and as a function of student and teacher perception. However, in the adaptation and validation of the instrument to the Spanish context [21] the factorial invariance of the instrument was not reported, although recently Martínez-Molina, Granero-Gallegos, Baena-Extremera, and Baños [25] obtained valid results in the factorial invariance analysis of the CCD-EF as a function of gender with another Spanish sample. However, it is necessary to continue studying the validity of the instrument in different samples.

In view of the above, adapting and validating this instrument to the Mexican context may be of great interest, as it could contribute to the analysis of violence among school adolescents with such worrying figures as discussed in the previous paragraphs. In this way, PE teachers could establish general strategies to address disruptive environments and maintain discipline in the classroom. Therefore, the objectives of the present study are: (i) to analyze the psychometric properties of the CCD-EF scale in the Mexican context; (ii) to analyze a higher order model from the subscales included in the CCD-EF; (iii) to analyze the factorial invariance of the CCD-EF scale as a function of gender; and (iv) to analyze the predictive relationship of satisfaction with PE on disruptive behaviors. Based on all the literature reviewed, the following hypotheses are proposed based on the objectives of the present study: Hypothesis 1 (H1), the CCD-EF will obtain adequate validity and reliability in the Mexican context; H2, the higher order model will obtain adequate validity and reliability values; H3, the CCD-EF will be gender invariant; H4, satisfaction with PE will negatively and significantly predict disruptive behaviors in the classroom; H5, boredom with PE will positively and significantly predict disruptive classroom behaviors. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative was used to description of the research [26].

**Methods**

**Design**

The present study has a non-experimental, cross-sectional, and correlational-causal design [27]. The sample design was probabilistic by centers, stratified, multistage by proportional allocation, and was made up of students in the third year of secondary education in the state of Nuevo León (Mexico). The secondary schools that participated in the study were randomly selected. To do this, all schools were listed and selected using a random number table. The number of students in the third year of secondary school in the State of Nuevo León in 2019 was 13396 girls and 13831 boys. These data were provided by the Secretary of Public Education of the State of Nuevo León.

**Eligibility Criteria**

Any secondary school in the State of Nuevo León could be selected to participate in the study. The main condition is that only public secondary schools would participate in the randomization process. Once all centers had been enumerated, they were randomly selected using a numerical randomization table. The criteria for excluding the schools from the present study were that they were private schools or that they received a negative response from the director of the secondary education center to participate in the study. In addition, the subjects who did not present the informed consent signed by the father/mother/guardian to participate in the research were excluded.
Adaptation to the Mexican context

The CCD-EF items from Granero-Gallegos and Baena-Extremera [21] were adapted to the Mexican context. Two native speakers adapted the 20 items to the Mexican context. To judge the goodness of the adaptation, the degree of coincidence with the original version was considered. Following Lynn [28], four experts in secondary education analyzed the final version to ensure the adequate design of the items for the measurement of the construct it was intended to measure and that it maintained the original meaning. The experts evaluated the relevance and comprehension of each item on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). If the mean item scores were <2.5, the items were revised. If an item was not rated by at least three of the four experts within the theoretical dimensions of the scale, it was further revised. The overall agreement of four experts on relevance and comprehension was measured by the Intraclass Correlation Coefficient (ICC); the values obtained were: ICC=.83 for relevance and ICC=.85 for comprehension. The Mexican version was administered to 45 high school students between 12 and 14 years of age and they showed full comprehension of the items. The final Mexican version of the CCD-EF was thus arrived at.

Instruments

Questionnaire for Disruptive Behavior in PE (CCD-EF). The CCD-EF validated to the Spanish context by Granero-Gallegos and Baena-Extremera [21] was adapted to the Mexican context from the original Physical Education Classroom Instrument by Krech et al. [22]. This instrument presents 20 items that measure negative behaviors in the PE classroom. It is composed of five dimensions with four items each: a) aggressive, b) low engagement or irresponsibility, c) fails to follow directions, d) distract or disturbs others, and e) poor self-management. The scale was preceded by the statement, "Tell us your degree of agreement or disagreement regarding PE classes." Responses were collected on a 5-point Likert type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Satisfaction with PE (SSI-EF). The version adapted to the Mexican context by Baños, Baena-Extremera, and Granero-Gallegos [29] of the Sport Satisfaction Instrument (SSI) by Castillo, Balaguer, and Duda [30] was used. This scale is composed of eight items and measures levels of satisfaction/fun with PE (five items) and boredom with PE (three items). The scale was preceded by the statement: "Tell us your degree of agreement or disagreement with regard to the PE classes" The responses were collected using a Likert type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Procedure

This research was conducted in accordance with the Declaration of Helsinki [31] Approval was obtained by the Secretaría de Educación Pública of México and Universidad Autónoma of Baja California, México (identification number: 431/569/E). In order to carry out this research, a research proposal was submitted to the Secretaría de Educación Pública de México entitled: "Programme for International Student Assessment: relationship of school performance in secondary school students with psychological, family and physical activity variables", which was approved and subsidized by the aforementioned organization. Subsequently, permission was requested from the management of the secondary schools, and the parents/guardians of the students gave informed consent after the objectives and purpose of the study were stated to them. Once the
aforementioned permissions had been obtained, data collection proceeded by informing the participants of the objective of the study, the anonymous and voluntary nature of their participation, the confidential treatment of their responses, that there were no right or wrong answers and requesting that they answer with the utmost sincerity. The questionnaires were completed in the classroom, with the principal investigator always present to resolve any doubts during the process, which lasted 15-20 minutes.

Risk of bias

Regarding bias control, it should be noted that there was randomization of the educational centers but not of the participants. There was blinding between the participants and the investigators responsible for the treatment and data analysis. Regarding selection bias, participation in the study was voluntary and communication with the students was in person in the classroom.

Sample Size

Regarding the sample size, the requirement stipulated by Carretero-Dios and Pérez [32] were met; namely, that there were 10 participants for each item to carry out a Confirmatory Factor Analysis (CFA). In addition, the Free Statistics Calculator v.4.0 [33] software was used, which calculated that a minimum of 717 subjects would be sufficient to detect effect sizes ($f^2 = 0.19$) with a statistical power of .95 and a significance level of $\alpha = .05$ in a structural equation model (SEM) with eight latent variables and 28 observed variables. A total of 755 students participated in the research.

Statistical Analysis

For the achievement of the objective of this study, statistical analyses of homogeneity of each item and Cronbach's alpha ($\alpha$) were carried out in the first instance.

The evaluation of the factorial structure of the instrument analyzed was carried out through confirmatory factor analysis (CFA) Several fit indices were calculated for the evaluation of the different proposed models, combining absolute and relative fit indexes [34, 35]. Among the absolute ones: the $p$-value, associated with the Chi-square statistic ($\chi^2$), the ratio between and degrees of freedom (gl; $\chi^2$/gl) and GFI (goodness-of-fit index). Among the relative indexes: TLI (Tucker-Lewis index) and CFI (comparative fit index). Also, RMSEA (root mean square error of approximation) and SRMR (standardized root mean square), were used as incremental indexes [36]. In the case of $\chi^2$/gl model fit values <5.0 were considered acceptable, and ratios <2.0 considered as indicators of excellent model fit [37]. Values of CFI and TLI >.95, RMSEA <.06 and SRMR <.05, were considered as indices of excellent model goodness-of-fit [37, 38]. Values of CFI and TLI >.90 and RMSEA and SRMR <.08 were considered acceptable indices of model goodness-of-fit [38, 40]. The reliability of each dimension was assessed with $\alpha$, and composite reliability (CR) and average variance were extracted (AVE) to measure convergent validity. Reliability values >.70 and AVE >.50 were considered acceptable as were values >.50 [41].

Attending to the high correlations that often occur between lower-order factors, researchers follow their initial CFA with a post-hoc test of a higher-order (e.g., second order) model [42]. In a higher-order model, each item is specified as loading on its target first-order subscale and each first-order factor is allowed to load on one or
more higher-order factors [43]. Thus, alternative models were tested to find the best factor structure approach of the CCD-EF, including a higher-order model (H-CFA) as an alternative to the first-order model (CFA).

The invariance according to the sex variable (multigroup invariance) of the CCD-EF was tested following the methodological proposal advanced by Milfont and Fisher [44], of testing four successively more constrained models. Following Chen [45], these nested models were compared considering the change (Δ) in goodness-of-fit indexes (i.e., increase in RMSEA of at least .015 or decrease in CFI and TLI of at least .01, indicate lack of invariance).

Finally, to test the nomological validity of the scale, a regression model with latent variables was performed to test the predictive relationship of the SSI-EF (satisfaction/enjoyment and boredom with PE). For a better interpretation of the results, $R^2$ was used as effect size (ES), having calculated the CI (95%) to confirm that no value was below the minimum required for interpretation ($R^2=.02$) [46]. The cut-off points established to score it are: .02, .13 and .26, for small, medium, and large, respectively [47].

**Results**

**Participants**

The representative sample was calculated according to sex, for a finite population with a confidence level of 95% and a margin of error of +5%, 378 being girls ($M_{age}=13.99; SD=.30$) and 375 boys ($M_{age}=14.02; SD=.33$).

**Item Descriptive Analysis**

The item statistics for each of the dimensions are presented in Table 1. In the aggressive dimension, it should be noted that the SD of item 1 was <1 and the skewness and kurtosis values presented values <2. In addition to this, the internal consistency of the dimension with the four items was inadequate ($\alpha=.56$) and does not improve if any of the items are eliminated. These results should be considered for the evaluation of model fit in confirmatory analyses. The items of the dimensions of low engagement or irresponsibility, fails to follow directions and distract or disturbs others, obtained adequate values in SD, CCIT-c, skewness, kurtosis, and reliability. The irresponsibility and low commitment factor obtained values slightly below those accepted in reliability; however, according to Taylor, Ntoumanis, and Standage [48], when a factor is composed of a small number of items (in this case by four items) an internal consistency index < .70 can be considered acceptable. Regarding the items of the poor self-management factor, the deletion of item 19 improved the internal consistency to .75 and item 20 obtained skewness and kurtosis values >2. These results should be considered for the evaluation of model fit in confirmatory analyses.

**Table 1.** Descriptive, internal consistency and homogeneity statistics ($n = 315$).
<table>
<thead>
<tr>
<th>Dimensions:</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Q1</th>
<th>Q2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1: Aggressive (α = .56)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Amenazo a los demás compañeros/as de clase. [Threatens others]</td>
<td>1.47</td>
<td>.95</td>
<td>.35</td>
<td>.48</td>
<td>2.23</td>
<td>4.39</td>
</tr>
<tr>
<td>2. Hablo correctamente a mis compañeros/as de clase. [Smart mouth toward students]</td>
<td>2.27</td>
<td>1.15</td>
<td>.38</td>
<td>.45</td>
<td>0.65</td>
<td>-0.32</td>
</tr>
<tr>
<td>3. Hablo de los demás a sus espaldas. [Talking back]</td>
<td>1.81</td>
<td>1.10</td>
<td>.32</td>
<td>.49</td>
<td>1.36</td>
<td>1.05</td>
</tr>
<tr>
<td>4. Hablo de forma correcta al profesor/a. [Smart mouth toward teacher]</td>
<td>1.90</td>
<td>1.17</td>
<td>.32</td>
<td>.50</td>
<td>1.34</td>
<td>0.91</td>
</tr>
<tr>
<td>Factor 2: Low Engagement or Irresponsibility (α = .69).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Me quejo habitualmente. [Whining]</td>
<td>2.57</td>
<td>1.33</td>
<td>.42</td>
<td>.61</td>
<td>0.41</td>
<td>-0.96</td>
</tr>
<tr>
<td>6. Soy perezoso en clase. [Lazy]</td>
<td>2.47</td>
<td>1.37</td>
<td>.42</td>
<td>.62</td>
<td>0.46</td>
<td>-1.01</td>
</tr>
<tr>
<td>7. Busco llamar la atención. [Attention seeking]</td>
<td>1.73</td>
<td>1.09</td>
<td>.45</td>
<td>.59</td>
<td>1.43</td>
<td>1.08</td>
</tr>
<tr>
<td>8. Me muevo lentamente a propósito. [Moves slowly on purpose]</td>
<td>1.89</td>
<td>1.22</td>
<td>.50</td>
<td>.56</td>
<td>1.23</td>
<td>0.37</td>
</tr>
<tr>
<td>Factor 3: Fails to Follow Directions (α = .71).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Interrumpo las clases. [Interruptions]</td>
<td>1.72</td>
<td>1.12</td>
<td>.53</td>
<td>.70</td>
<td>1.55</td>
<td>1.43</td>
</tr>
<tr>
<td>10. Me siento inseguro en clase de EF. [Unsafe actions]</td>
<td>1.96</td>
<td>1.29</td>
<td>.45</td>
<td>.74</td>
<td>1.10</td>
<td>-0.06</td>
</tr>
<tr>
<td>11. No presto atención en clase de EF. [Doesn't pay attention]</td>
<td>2.07</td>
<td>1.37</td>
<td>.57</td>
<td>.67</td>
<td>1.02</td>
<td>-0.30</td>
</tr>
<tr>
<td>12. No sigo las instrucciones. [Not following directions]</td>
<td>1.86</td>
<td>1.17</td>
<td>.64</td>
<td>.64</td>
<td>1.23</td>
<td>0.41</td>
</tr>
<tr>
<td>Factor 4: Distract or Disturbs Others (α = .85).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Tengo mal genio y me enojo. [Temper tantrums]</td>
<td>2.08</td>
<td>1.26</td>
<td>.48</td>
<td>.83</td>
<td>0.92</td>
<td>-0.30</td>
</tr>
<tr>
<td>14. Abandono el grupo durante una actividad. [Leaving the group during an activity]</td>
<td>1.69</td>
<td>1.11</td>
<td>.69</td>
<td>.72</td>
<td>1.68</td>
<td>1.90</td>
</tr>
<tr>
<td>15. Miento en clase. [Lying]</td>
<td>1.71</td>
<td>1.11</td>
<td>.68</td>
<td>.73</td>
<td>1.58</td>
<td>1.54</td>
</tr>
<tr>
<td>16. Me salto las clases de EF. [Sneaks out of class]</td>
<td>1.51</td>
<td>1.00</td>
<td>.67</td>
<td>.74</td>
<td>2.10</td>
<td>3.62</td>
</tr>
<tr>
<td>Factor 5: Poor Self-Management (α = .70)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Soy peleónero/a. [Quarrelsome]</td>
<td>1.82</td>
<td>1.16</td>
<td>.58</td>
<td>.58</td>
<td>1.31</td>
<td>0.70</td>
</tr>
<tr>
<td>18. Me burlo de otros/as compañeros/as de clase. [Makes fun of other students]</td>
<td>1.89</td>
<td>1.18</td>
<td>.58</td>
<td>.57</td>
<td>1.22</td>
<td>0.45</td>
</tr>
<tr>
<td>19. Argumento mis actos. [Arguing]</td>
<td>2.76</td>
<td>1.39</td>
<td>.32</td>
<td>.75</td>
<td>0.17</td>
<td>-1.19</td>
</tr>
</tbody>
</table>
20. Acoso a algunos/as compañeros/as de clase.  
[Bullying]

Confirmatory Factor Analysis and Reliability

Next, the original dimensionality theoretically proposed by Krech et al. [22] was analyzed with CFA and, following authors such as Markland [35], several models were formulated and analyzed, given that the data so recommended, and the most relevant results were reported. Considering the above in the analysis of scale items, it was appropriate to perform and compare several structural regression models to check the best fit. Several models were hypothesized (see Table 2). The first of the models included the 20 items and the five factors of the original scale [22] that presented some unacceptable fits (TLI=.87; CFI=.89), and two of the items of the aggressive dimension presented low regression weights <.33 [41] and high values (>2.58) in their standardized residuals [49]. Considering the above, as well as the unacceptable internal consistency of the aggressive factor (α=.56) this factor was eliminated and a model with the other four factors was evaluated, it presented acceptable goodness-of-fit indices. However, taking into account the index modification values of the statistical program, the errors of items 11 and 12 of the fails to follow directions factor and items 14 and 16 of the distract or disturbs others factor were correlated and the model presented acceptable (TLI=.94; CFI=.95) and excellent (SRMR=.036; RMSEA=.058) goodness-of-fit indices. Thus, H1 is fulfilled. Despite the good fits of this model, it was considered that the high correlations (.94) between some of the factors (i.e., distract or disturbs others with poor self-management and fails to follow directions with low poor self-management) could limit the discriminant validity of the scale, as values <.85 are considered adequate [50], although some authors consider values < .90 to be [51], so a higher-order model [24] was evaluated, which also presented acceptable (TLI=.94; CFI=.95) and excellent (SRMR=.038; RMSEA=.060) goodness-of-fit indices. To examine the model comparison, the AIC (Akaike Information Criteria) and BIC (Bayesian Information Criterion) were also taken into account, in which, although they do not describe the model fit, lower values are considered to reflect a better fit.

Table 2  Fit indices for each model.

<table>
<thead>
<tr>
<th>Models</th>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$</th>
<th>$\chi^2/gl$</th>
<th>TLI</th>
<th>CFI</th>
<th>SRMR</th>
<th>RMSEA(90%IC)</th>
<th>AIC</th>
<th>BIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 5 factors</td>
<td>765.80</td>
<td>160</td>
<td>.000</td>
<td>4.79</td>
<td>.87</td>
<td>.89</td>
<td>.049</td>
<td>.071(.066;076)</td>
<td>865.80</td>
<td>1097.00</td>
</tr>
<tr>
<td>Models 4 factors</td>
<td>456.10</td>
<td>98</td>
<td>.000</td>
<td>4.65</td>
<td>.91</td>
<td>.92</td>
<td>.042</td>
<td>.070(.063;076)</td>
<td>532.10</td>
<td>707.81</td>
</tr>
<tr>
<td>Models 4 factors*</td>
<td>339.49</td>
<td>96</td>
<td>.000</td>
<td>3.54</td>
<td>.94</td>
<td>.95</td>
<td>.036</td>
<td>.058(.051;065)</td>
<td>419.49</td>
<td>604.45</td>
</tr>
<tr>
<td>Higher order model*</td>
<td>361.22</td>
<td>.98</td>
<td>.000</td>
<td>3.69</td>
<td>.94</td>
<td>.95</td>
<td>.038</td>
<td>.060(.053;066)</td>
<td>437.22</td>
<td>612.94</td>
</tr>
</tbody>
</table>

Note.  $\chi^2$ = chi-square; df = degrees of freedom; TLI = Tucker Lewis index; CFI = comparative fit index; SRMR = Standardized Root Mean-Square; RMSEA = root-mean squared approximation; IC = confidence interval; AIC =
Akaike Information Criteria; BIC = Bayesian Information Criterion; *model with correlation of the errors of items 11 with 12 and 14 with 16.

In Table 3, we can see the standardized factor loadings for first-order CFA and higher order CFA of the CCD-EF with model four factors. To evaluate the reliability and validity of the scale, $\alpha$, composite reliability and average variance extracted, and AVE were measured for each factor. The results can be seen in Table 4. The $\alpha$ values are acceptable and only the low engagement or irresponsibility dimension presented values <.70, although considering the stipulations of Taylor et al. [47], given the low number of items, this value can be accepted. All factors present acceptable composite reliability values [41]. In relation to the AVE, these same authors indicate that convergent validity values are considered acceptable when all the values of the standardized regression weights in a latent variable are significant and >.50, even if its AVE is <.50. This is the case for low engagement or irresponsibility and fails to follow directions. H2 is, thus, satisfied.

**Table 3** Standardized factor loadings for first-order CFA and H-CFA of the CCD-EF.
<table>
<thead>
<tr>
<th>Item</th>
<th>LEI</th>
<th>FFD</th>
<th>DDO</th>
<th>PSM</th>
<th>LEI</th>
<th>FFD</th>
<th>DDO</th>
<th>PSM</th>
<th>DB</th>
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</table>
Nota. CFA = first order confirmatory factorial analysis; H-CFA = higher order CFA; DB = disruptive behaviors; **\( p < 0.01 \).

**Table 4.** Reliability and validity of the CCD-EF factors.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Composite Reliability</th>
<th>AVE</th>
<th>Cronbach´s Alpha</th>
</tr>
</thead>
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<tr>
<td>Low engagement or irresponsibility</td>
<td>.72</td>
<td>.38</td>
<td>.69</td>
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<tr>
<td>Fails to follow directions</td>
<td>.71</td>
<td>.39</td>
<td>.75</td>
</tr>
<tr>
<td>Distract or disturbs others</td>
<td>.81</td>
<td>.52</td>
<td>.81</td>
</tr>
<tr>
<td>Poor self-management</td>
<td>.72</td>
<td>.41</td>
<td>.70</td>
</tr>
</tbody>
</table>

Note. AVE = average variance extracted.

**Factorial Invariance Across Gender**

The invariance of the CCD-EF was evaluated across gender (i.e., male=375, female=378) based on the first order CFA model and the higher order (H-CFA) model, the results of which are shown in Tables 5. Starting with a configural invariance model, invariance constraints were progressively added to the factor loadings (i.e., weak invariance, intercepts (i.e., strong invariance), and residual variances (i.e., strict invariance), weak invariance), intercepts (i.e., strong invariance), and residual variances (i.e., strict invariance). The values of these restrictive models were acceptable, except for the strict invariance of the H-CFA, as the CFI results were outside the cut-off values. The values of these restrictive models of the H-CFA did not exceed the cut-off points for RMSEA (\( \Delta > .015 \)), CFI (\( \Delta > .01 \)), and TLI (\( \Delta > .01 \)) so it can be considered fully invariant. In the case of the first-order model, it can be considered partially invariant, since the strict invariance model showed a decrease that slightly exceeded the limits of the recommended values (\( \Delta \text{CFI} = -.013 \)). H3 is, thus, fulfilled.

**Table 5.** Invariance test across gender for the CCD-EF.
A regression analysis with latent variables was performed to test the extent to which the dimensions of the SSI-EF (independent variable) predict disruptive behaviors (dependent variable). Firstly, to indicate that the SSI-EF showed excellent goodness-of-fit indices in CFA: $\chi^2$=34.30; gl=19; $p$=.01; $\chi^2$/gl=1.80; GFI=.99; CFI=.97; RMSEA=.04; SRMR=.05, as well as adequate reliability: satisfaction/fun, CR = .84; AVE=.52; $\alpha$=.78; boredom, CR=.71; AVE=.45; $\alpha$=.65. Next, the measure of invariance of the linear regression model was tested according to the sex variable (girls, $n$=378; boys, $n$=375). The regression model was found to be invariant by sex, as the restrictive increase/decrease of the models for RMSEA was <.015, CFI<.01, and TLI<.01, the results are shown in Figure 1. In both boys and girls, the prediction of satisfaction/fun with PE on disruptive behaviors was not significant (H4 is not satisfied), but it was significant for boredom with PE (H5 is satisfied). When males are bored in PE classes, the predictive relationship for disruptive behaviors is .51 ($p$<.0001), with 23% of variance explained; while among female students the predictive relationship of boredom with PE for disruptive behaviors in class is .36 ($p$<.0001), with 15% of variance explained.
Discussion

The objectives of the present study were: (i) to analyze the psychometric properties of the CCD-EF scale in the Mexican context; (ii) to analyze a higher-order model based on the subscales that make up the CCD-EF; (iii) to analyze the factorial invariance of the CCD-EF scale as a function of sex; and (iv) to analyze the predictive relationship of satisfaction with PE on disruptive behaviors. The main results show that both the model with four correlated factors (first order) and the higher-order factor have adequate goodness-of-fit indices. In addition, the scale is invariant according to sex, and boredom with PE is a significant and positive predictor, stronger in males, of disruptive behaviors in the school context of secondary education in Mexico.

Concerning H1, the analysis of the data shows that the internal consistency obtained by the CCD-EF is adequate in all its dimensions, except for aggressive, which does not reach the minimum score to be accepted [52]. This same problem with the aggressive factor was already found in the validation of the instrument with Spanish adolescents [21], it not being possible to make a comparison with the original English version, since it did not report internal consistency values. This result obtained in the aggressive dimension should be considered for the elimination of the factor. It is worth noting that the rest of the indicators suggest maintaining all the items of the scale [52].

Regarding the data obtained from the goodness-of-fit index, the present study analyzed several models following the indications of authors such as Markland [34]. The five-factor model did not reach the minimum acceptable values set by authors such as Hooper et al. [38] to consider the CCD-EF as a valid instrument applicable in the Mexican context, so it was decided to eliminate the aggressive factor from the instrument since it presented problems in both reliability and validity analyses. Similar results were previously obtained by Granero-Gallegos and Baena-Extremera [21] in their validation with a Spanish sample, in which they also proposed the elimination of the aggressive dimension. By contrast, in the original version, this factor was maintained since the results obtained in the validity of the instrument were acceptable. Subsequently, the instrument was analyzed with only four factors (i.e., low engagement or irresponsibility, fails to follow directions, distract or disturbs others and poor self-management), in which an excellent fit was obtained if two errors were correlated, one between items 11–12 and the other between items 14–16. Also, in the Spanish version [21] an excellent fit was obtained in the four-factor model proposed. Thus, we can state that the four-dimensional CCD-EF is a valid and reliable instrument, as it has been used in different countries, and in the adaptation to the Mexican context, good results for reliability, validity and goodness-of-fit indexes have been obtained. In addition to this, it is worth highlighting the important contribution that the present study makes to the Mexican educational system and society, since it provides an instrument that evaluates the negative behaviors of adolescents in the PE classroom, in the country with the highest rate of violence among its elementary and high school students [7]. Therefore, H1 is fulfilled.

Regarding H2, the present work showed a higher-order factor of a reflective type [24] from the four subscales, obtaining adequate goodness-of-fit values. This means that the same student can have irresponsible behaviors, disobey the rules, be disruptive in class, and/or have no control over it, but, in addition, the CCD-EF can be used as a single latent variable that measures disruptive behaviors in general. This makes a contribution to the scientific literature that had not previously been made either in the original validation of
the PECI [22, 23] or in the adaptation and validation to the Spanish context carried out by Granero-Gallegos and Baena-Extremera [21]. Therefore, H2 is fulfilled.

In relation to H3, the present study has obtained that the Mexican version of the instrument is invariant according to sex, both for the four-factor model and for the higher order factor model. Thus, the factorial invariance of the CCD-EF is confirmed, and the CCD-EF can be considered to be valid and invariant instrument in the Mexican context for comparison studies based on the sex variable. Given its strength in the known psychometric properties of the CCD-EF [21, 25], and the use in other languages [22], the data obtained have the potential to confirm construct validity. Thus, this study represents a contribution to the consistency of the psychometric properties of the CCD-EF, so that it can be used in future research regardless of gender. Therefore, H3 is confirmed.

In relation to H4 and H5, the prediction model proposed in this study showed that boredom with PE classes is a positive and statistically significant predictor of disruptive behaviors, both in girls and boys, although with higher predictive values in boys. This gender difference could be due to the fact that boys engage in negative behaviors more frequently than girls in the PE classroom [12, 17, 18]. This can be explained by boys pretending to show superiority over their peers in order to attract the attention of girls [53]. Similar results were found other studies in which boredom in PE classes or at school predicted CCD-EF dimensions [14, 17, 25]. This could be due to the learning climates created by the teacher since when environments are created where the adolescent has to demonstrate superiority to the rest of his or her peers or avoid not showing incompetence [53] conflicts and disruptive behaviors among students are generated [12, 54]. This highlights the importance of students not experiencing feelings of boredom as they will increase disruptive behaviors of some students in the classroom, who will then try to distract their peers in classes [53]. However, satisfaction and enjoyment with PE do not significantly predict CCD-EF, although it obtained a negative relationship. In this line [12] and Cothran et al. [56], did obtain a statistically significant negative relationship between the dimensions of CCD-EF and satisfaction with PE, with the exception of the dimension of aggressive at work by Baños [12], a factor that has been eliminated in the present study. It is worth mentioning that the scientific literature highlights the importance of students feeling satisfied at school as it reduces disruptive behaviors in both boys and girls [57], increases satisfaction with life [58] and is a relevant factor in the competencies acquired by the teacher for the creation of ideal learning climates for the student body [59]. Therefore, H5 is fulfilled, but not H4.

Limitations and strengths

The present research has a series of strengths that should be mentioned, among them is the sample design, which is probabilistic and randomized by centers, stratified, multistage and with proportional allocation. In this way, the results of the study can be generalized to the State of Nuevo León in Mexico. Another important strength is the subject matter it addresses since it can contribute to generating solutions to the main problems related to adolescent behavior at school, a very worrying problem in Mexican society. It is also necessary to admit a series of limitations. For example, the CCD-EF scale can be applied at the high school level regardless of the subject’s gender; however, it cannot be held that this scale can be used at different educational levels, so the results of the present study cannot be generalized to students of other ages. We consider it important to mention the need to carry out future studies of a longitudinal nature and using a
mixed research methodology (quantitative and qualitative), also classifying the subjects at both socio-demographic and socio-economic levels.

**Conclusion**

To conclude, the findings of this study have demonstrated that the CCD-EF is a reliable and valid instrument for application in the Mexican context and that it can be applied independently of the sex variable. Furthermore, it has been shown that the CCD-EF can be used as a higher order model, so that this scale can measure disruptive behaviors in a unidimensional way and, in turn, low engagement or irresponsibility, fails to follow directions, distract or disturbs others and poor self-management. This is a significant contribution to the existing literature since no scale of negative behaviors in PE had previously been validated with Mexican adolescents. In addition, boredom with PE positively and significantly predicts disruptive behaviors in both girls and boys.

**Abbreviations**

**ARQC-V**: Behavioral Anger Response Questionnaire for Children in Vietnam

**CCDE-EF**: Questionnaire for Disruptive Behavior in Physical Education.

**WHO**: World Health Organization.

**OECD**: Organization for Economic Cooperation and Development.

**PE**: Physical Education.

**PECI**: Physical Education Classroom Instrument.

**SSI-EF**: Satisfaction with Physical Education.

**CFA**: Confirmatory Factor Analysis.

**SEM**: Structural equation model.

**Declarations**

**Availability of data and materials**

The data sets generated and/or analyzed during the current study are not publicly available due to data confidentiality and unpublished research project results, but are available from the corresponding author upon reasonable request.

**Acknowledgements**

We would like to thank all the participants in this study, all the directors of the educational centers who agreed to participate in this research. Also to the Ministry of Public Education of Mexico for the financial
resources provided.

Author contributions

RB, MBR and ABE conceived the hypothesis of this study. RB, ABE, and MBR, participated in data collection. RB and AGG analyzed the data. All authors contributed to data interpretation of statistical analysis. RB, AGG and MBR wrote the paper with the most significant input from RB. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

This research was conducted in accordance with the Declaration of Helsinki [31] Approval was obtained by the Secretaría de Educación Pública de México (Ethics committee) and Universidad Autónoma of Baja California, México (identification number: 431/569/E). In order to carry out this research, a research proposal was submitted to the Secretaría de Educación Pública de México entitled: "Programme for International Student Assessment: relationship of school performance in secondary school students with psychological, family and physical activity variables", which was approved and subsidized by the aforementioned organization. Informed consent was obtained from all subjects and/or their legal guardian(s). All experimental protocols were approved by Secretaría de Educación Pública of México.

Consent for publication

Not applicable

Competing interests

The authors declare that no conflict of interest have been identified at the time of publication.

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Figures
Figure 1

Structural regression model of satisfaction/fun and boredom with Physical Education classes and disruptive behaviors (higher order model). Note: girls' values are in parentheses; SAT/FUN=satisfaction/fun; DB=disruptive behaviors; LEI=Low engagement or irresponsibility; FFD=Fails to follow directions; DDO=Distract or disturbs others; PSM=poor self-management. In parentheses are the values corresponding to the girls' model.