InCLASS factorial validity: what it entails for research conducted in Quebec on child engagement

Julie Lachapelle, M.A.
Université du Québec à Montréal

Maude Roy-Vallières, Ph.D.
Université du Québec à Montréal

Nathalie Bigras, Ph.D.
Université du Québec à Montréal

Lise Lemay, Ph.D.
Université du Québec à Montréal

Caroline Bouchard, Ph.D.
Université Laval

Abstract

This study examines the factorial validity of the Individualized Classroom Assessment Scoring System (inCLASS) using data collected from 151 children attending Early Childhood Education and Care (ECEC) in Quebec (Canada). Confirmatory factor analyses showed an inadequate fit of the four-domain model based on problems related to the Teacher Communication dimension. Positive intercorrelations were found between Peer Interactions and Task Orientations. After allowing for the covariance of dimensions belonging to these two domains and setting the residual variance of the Teacher Communication variable to zero, the fit of the model improved, but remained inadequate. These findings suggest the factorial structure of the inCLASS should be reviewed and that interpreting findings from Quebec research using this tool should be done with caution.

Key words: Individualized Classroom Assessment Scoring System; inCLASS; Child Engagement; factorial validity; Confirmatory Factorial Analysis; early childhood education and care

Résumé

Cette étude examine la validité factorielle de l'outil d'observation de l'engagement Individualized Classroom Assessment Scoring System (inCLASS) à l'aide de données recueillies auprès de 151 enfants fréquentant les services de garde éducatifs à l'enfance (SGÉE) au Québec (Canada). Les analyses factorielles confirmatoires ont montré un ajustement inadéquat du modèle à quatre domaines en raison de problèmes liés à la dimension de la communication avec l'adulte. Des corrélations positives ont été trouvées entre les interactions avec les pairs et l'orientation envers la tâche. Après avoir pris en compte la covariance des dimensions appartenant à ces deux domaines et fixé à zéro la variance résiduelle de la variable de la communication avec l'adulte, l'adéquation du modèle s'est améliorée, mais est restée inadéquate. Ces résultats suggèrent que la structure

factorielle de l'inCLASS devrait être révisée et que l'interprétation des résultats de recherches menées au Québec et utilisant cet outil d'observation devrait être effectuée avec prudence.

Mots-clés : Individualized Classroom Assessment Scoring System; inCLASS; engagement de l'enfant; validité factorielle; analyses factorielles confirmatoires; services de gardes éducatifs à l'enfance

1. Objectives

This research aims at validating the four-domain and ten-dimension factorial structure of the *Individualized Classroom Assessment Scoring System* (inCLASS; Bohlmann et al., 2019) in the context of Early Childhood Education and Care (ECEC) in Quebec (Canada). The specific research objectives are to 1) validate the factorial structure of the inCLASS tool when used in ECEC in Quebec and 2) explore modifications that could improve the structure of the initial model.

2. Perspectives and theoretical framework

In ECEC settings, process quality focuses on the interactions between teacher and child and has been mostly studied from an adult perspective. Research has used tools such as the Classroom Assessment Scoring System (CLASS; Pianta et al., 2008) and the Early Childhood Environment Rating Scale-Revised (ECERS-R; Harms et al., 2015), which measure process quality at the classroom or group level. However, within the same group, children may experience differently their interactions with the adults and peers around them. Furthermore, these individual experiences are considered to predict oral and written language development and subsequent school readiness more strongly than the overall quality of group interactions (Bohlmann & Downer, 2016; Williford et al., 2013). As such, more research is warranted to study the quality of interactions at the child level, although such research appears limited at the moment (Lachapelle et al., 2021; Smidt & Embacher, 2021).

Recently, the Individualized Classroom Assessment Scoring System (inCLASS; Downer et al., 2010) was developed in the United States to measure the engagement level of children aged 3 to 5 by observing their individual interactions in educational settings. By going beyond the "average" classroom experience, this direct observational tool provides valuable information on children's interactions during their daily activities in ECEC. According to Bohlmann et al. (2019), the

inCLASS is an appropriate tool to study interactions among a wide range of children from the age of 3 to 5 across demographic subgroups such as gender, poverty status, and ethnicity.

However, the inCLASS has shown some issues regarding the structural validity of its four-domain model which includes Teacher Interactions, Peer Interactions, Task Orientation and Conflict Interactions. Studies that have examined the inCLASS with regard to its structural validity have produced inconsistent results thus far (Bohlmann et al., 2019; Slot & Bleses, 2018; Smidt & Embacher, 2021). These results might be due to contextual specificities such as country of origin or cultural differences, causing some problems when assessing children's engagement in sociocultural contexts other than those for which the tool was originally designed (Slot & Bleses, 2018; Smidt & Embacher, 2021). As such, it remains difficult to determine if findings can be applied to other countries where educational approaches might differ. Considering that studies conducted in other countries (Slot & Bleses, 2018; Smidt & Embacher, 2021) have shown that the inCLASS four-domain structure may not be fully adequate in these settings, the question arises as to whether the inCLASS can assess children's engagement in Quebec, a North American context, but which also presents several sociocultural differences with the United States, notably language. The present study therefore proposes to examine the factorial validity of the inCLASS observation tool in the context of ECEC in Quebec.

3. Method

Individualized Classroom Assessment Scoring System

The inCLASS observation tool (Downer et al., 2010, 2012) was used to assess children's engagement in regular activities provided by the ECEC. The tool was developed to assess children's interactions with their teachers and peers, as well as with activities or tasks (Downer et al., 2012). The revised version of the inCLASS (Bohlmann et al., 2019) includes ten dimensions: 1) Positive Engagement with Teachers, 2) Teacher Communication, 3) Peer Sociability, 4) Peer Communication, 5) Peer Assertiveness, 6) Task Engagement, 7) Self-reliance, 8) Teacher Conflict, 9) Peer Conflict and 10) Behavior Control (reverse coding). The internal consistency ($\alpha = 0,72$) of the four domains (Teacher Interactions, Peer Interactions, Task Orientation and Conflict Interactions) is considered acceptable (Taber, 2018). The inCLASS domains and dimensions, along with a brief description of each dimension, are presented in Table 1.

Each child participating in the study was observed during four cycles of observation (10 minutes observation, 5 minutes coding) in order to assess on a Likert-type scale his or her level of engagement for each of the ten inCLASS dimensions. For every cycle, the certified observer gave each dimension a score between 1 and 7 ([1,3] = low, [3,6] = medium, [6,7] = high) based on observed behavioral indicators. In this study, the observer assessed between 2 and 3 children alternately per group during their usual morning activities, for a total duration of 2.5 hours.

Data analysis

To validate the inCLASS factorial structure, a confirmatory factor analysis was performed. Due to variables for which the symmetry and kurtosis indices suggested a non-normal distribution, the maximum likelihood with robust standard errors (MLR) method was used to extract the variable groupings. The analyses were performed using the *R* programming language (R Core Team, 2021) and the *Lavaan* library (Rosseel, 2012).

In this study, the analysis aimed at validating the inCLASS four-domain model (Bohlmann et al., 2019) based on average scores drawn from children in Quebec ECEC. The fit of the model to the research data was explored using different fit indices (Chi-square, Root Mean Square Error [RMSEA; Steiger, 1990], Comparative Fit Index [CFI; Bentler, 1990], Standardized Root Mean Square Residual [SRMR; Bentler, 1995]). Taking into account modification indices also guided the exact specification of the model. There were no missing data in the database for these analyses.

4. Data sources

The data used in this study is derived from a larger research project aimed at comparing the influence of attending early childcare services in Quebec or France on the development of children aged 3 to 5. For the purposes of the present study, only data collected in Quebec between February and May 2019 from children aged 5 were used. To recruit participants, a random draw was held among the ECEC facilities in the Montreal region included in an administrative directory available on Quebec's Ministry of Family's website.

A letter of invitation was sent to the targeted ECEC directors to inquire about their interest in participating in the study. Subsequently, with the collaboration of the educators working in the ECEC, a letter of consent was sent to the parents of children born between October 2013 and May 2014. Twenty-one out of 41 ECEC participating in the project received an allowance for children

from low socio-economic backgrounds. The sample included 151 children (n = 78 girls) from 41 ECEC facilities in the Montreal area (Quebec, Canada). The mean age of the children was 61.52 months (SD = 2.21, range 56.00-66.00), and the majority (69.3%) had French as their mother tongue.

5. Results and substantiated conclusions

Preliminary analyses using the initial model suggest an inadequate fir of the four-domain structure to the study data. Table 2 shows that only the SRMR index supports a good model fit (0.07), while the Chi-square (p < 0.001), RMSEA (0.15) and CFI (0.85) indices all exceed thresholds for an adequate fit. Preliminary analyses also resulted in negative residual variance and a standardized factor loading of 1 for the Teacher Communication dimension. Otherwise, the standardized factor loadings of the original model ranged from 0.57 to 0.89. A significant positive intercorrelation was found between the Peer Interactions and Task Orientation domains (See Fig. 1).

Modifications to the model were applied due to the impossibility of obtaining convergence of the initial model. The residual variance of the Teacher Communication dimension was constrained to zero, as suggested by Kolenikov and Bollen (2012). Furthermore, the modification indices suggested that allowing covariance of the residual variances of several dimensions would improve the fit of the model, specifically dimensions from the Teacher Interactions domain and Peer Interactions domain, as well as two dimensions in the Conflict Interactions domain. This is coherent with McWilliam and Casey's (2008) levels of engagement model, which suggests that children's social skills are in development at this age, whether they are being used during interactions with the adult or with peers. The model was thus modified to allow these residual variances to covary. In doing so, another residual variance became problematic, that of the Behavior Control. It was therefore constrained to zero.

As presented in Table 2, modification of the analysis parameters resulted in an acceptable model fit (Chi-square < 0.001; RMSEA = 0.09; CFI = 0.95; SRMR = 0.06). The standardized factor loadings of the modified model range from 0.44 to 0.89. A positive and significant intercorrelation was found between the Peer Interactions and Task Orientation domains ($r = 0.38$; see Fig. 2).

The analyses have shown that the four-domain structure of the inCLASS, as conceptualized by Downer et al. (2010) and revised by Bohlmann et al. (2019), does not fit the Quebec data

adequately due, among other things, to Heywood cases for some of the dimensions (factor loading ≥ 1). While modification of the model parameters allowed for a fair fit of the model after a second round of analysis, the fit of the model remains lacking for the Quebec data as it may not represent adequately the reality of children's day to day experiences in ECEC. Results of Quebec studies on child engagement using the inCLASS should therefore be interpreted with caution.

The results of this study add to the growing body of work showing to some regard inadequate fit of the four-domain structure of the inCLASS to social and cultural contexts that diverge from that of the United States. Similar problems have been raised by Bohlmann et al. (2019), Slot & Bleses (2018) and Smidt & Embacher (2021), particularly regarding the Teacher Communication dimension. This suggests a particularly problematic impact of this dimension on the structure of the inCLASS and raises the importance of future studies that would reconceptualize the tool's factorial structure, considering it is used in a variety of countries and cultural contexts. In particular, researchers should reflect on the place of the Teacher Communication dimension in the model and consider other elements that would increase the inCLASS' relevance in a variety of sociocultural contexts.

Findings from the current study may be affected by some limitations. First, the study is limited by the relatively small sample size. Second, the study was confined to a specific urban area. Future research should address this restriction by recruiting a more representative sample from Quebec. Third, since children's behaviors vary greatly from day to day and across classroom settings, observing across several days or weeks may help to stabilize children's scores.

6. Scientific or scholarly significance of the study

As more studies are conducted around the world to evaluate children's engagement (e.g. Bigras et al., 2020; Bouchard et al., 2021; Hanan et al., 2021; Roy-Vallières et al., 2022; Sabol et al., 2018; Slot & Bleses, 2018), representing an important predictor of educational success (Bohlmann et Downer, 2016; Williford et al., 2013), it is essential that any observation tool used for that purpose be adequate in its factorial structure. As of now, the only observational tool specifically conceived to measure 3 to 5 year old children's engagement is the inCLASS, which was created in the specific context of the United States (Downer et al., 2012). While U.S. studies reported good validity of the inCLASS tool (Bohlmann et al., 2019; Downer et al., 2010), other studies have raised problems with the factorial structure of the tool when used in other sociocultural contexts (Slot & Bleses,

2018; Smidt & Embacher, 2021), which suggests that children's engagement outside of the U.S. might not be adequately represented by inCLASS scores. This also raises questions regarding how engagement should be measured, and which part of engagement is more predictive of educational success in the early years.

This study provides further data to support a revision of the inCLASS as a way to be representative of data collected from culturally and socially diverse contexts. It also raises the importance of exercising caution when interpreting inCLASS results originating from international research and their possible links to child development.

Table 1.

Domains and dimensions of the inCLASS (Bohlmann et al., 2019; Downer et al., 2010)

Domains	Dimensions	Description
Teacher Interactions	Positive Engagement	Child's level of emotional engagement with the adult, including seeking and enjoying interactions with the adult
	Teacher Communication	Child to adult verbal communication initiatives, conversation maintenance and functional use of language for a variety of communication purposes
Peer Interactions	Peer Sociability	Evidence of positive emotions and behaviors, including proximity and interaction seeking, social awareness, and positive peer response
	Peer Communication	Child's verbal communication initiatives toward peers, maintaining conversations, and functional use of language for a variety of communication purposes
	Peer Assertiveness	Use of positive strategies to initiate and demonstrate leadership in peer interactions
Task Orientation	Task Engagement	Consistent and active involvement of the child in the activities, including time spent on the activities and level of enthusiasm
	Self-Reliance	Child taking learning into his/her own hands, including his/her sense of initiative
Conflict Interactions	Teacher Conflict	Interactions with teachers characterized by tension, resistance and negativity
	Peer Conflict	Interactions with peers characterized by tension, resistance and negativity
	Behavior Control (rev)	Adherence to situational behavioral expectations, including demonstrations of patience and body awareness in space

Table 2.

Fit indices for the initial four-domain model

Model	χ^2 (ddl)	p	RMSEA (CI)	CFI	SRMR
Initial four-domain model	124.69 (30)	< 0.001	0.15 (0.12 ; 0.17)	0.85	0.07
Modified four-domain model	56.93 (26)	< 0.001	0.09 (0.06 ; 0.12)	0.95	0.06

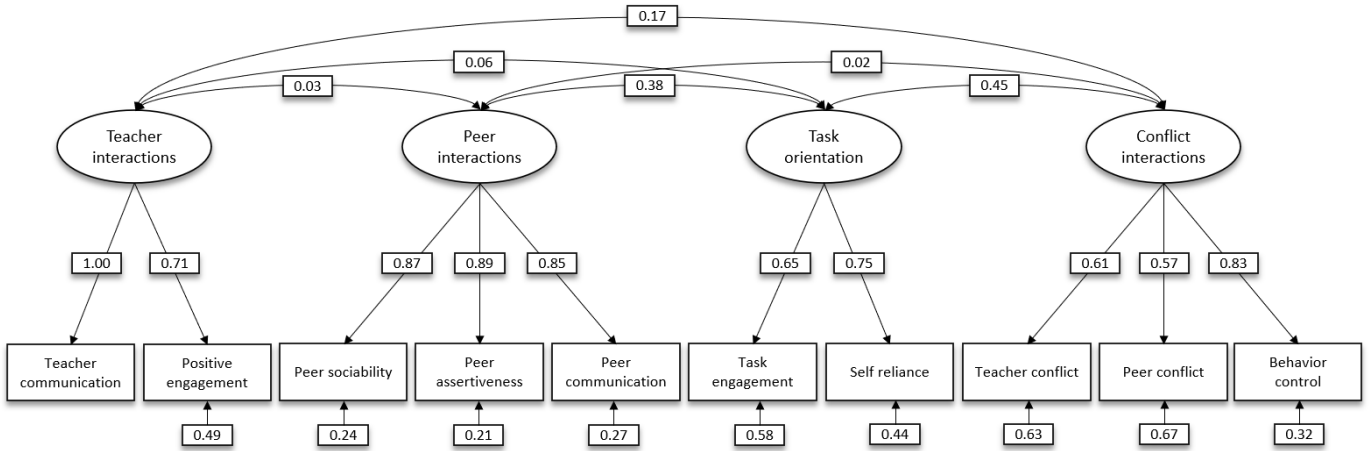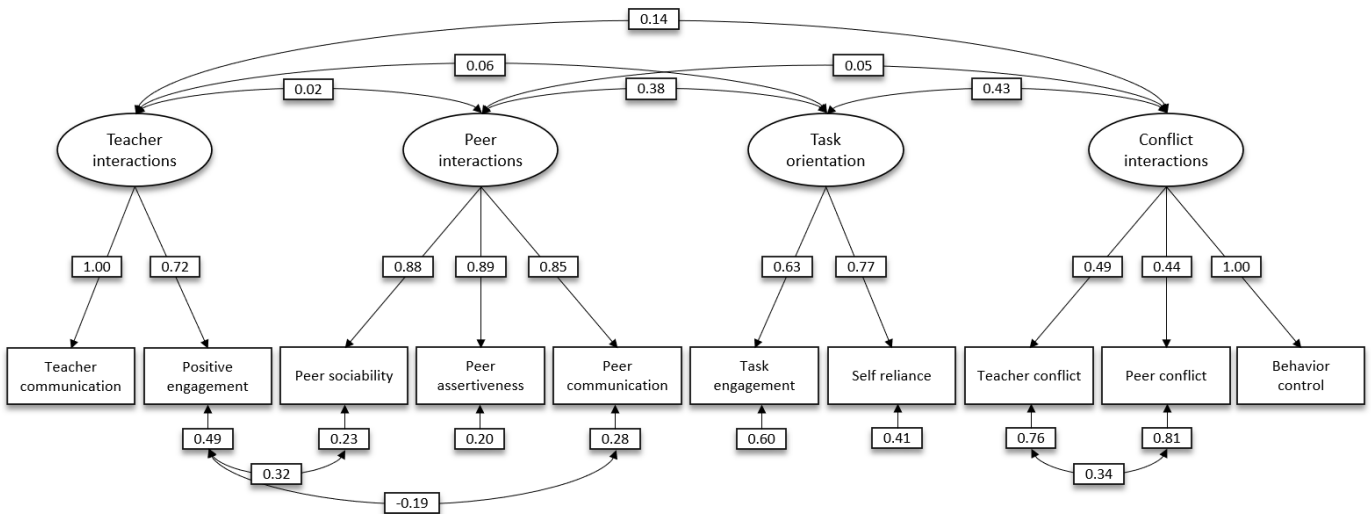**Figure 1. Initial four-domain model**

Figure 2. Modified four-domain model

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