

# Translating a Concept Inventory into English – The Case of the CCCI-442

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**Abstract.** Concept inventories are crucial for assessing students' understanding. The Climate Change Concept Inventory (CCCI-422) was developed to meet the need for a reliable assessment-tool in German for assessing the effectiveness of educational interventions and informing policy decisions in addressing this pressing issue. To make it accessible internationally, the CCCI-422 underwent a systematic translation procedure, aligning with Brislin's model. The translation involved software-generated and expert translations, followed by comparison and negotiation of differences. The English version is presented, highlighting translation challenges and seeking collaboration for validation. This translation approach of instruments aims to contribute to the comparability of research in PER.

## Introduction and Problem Focus

Science education research is dependent on psychometrically reliable test instruments. Thereby, concept inventories are an excellent tool to reliably evaluate student's understanding in large scale in order to elicit misconceptions and distinguish them from lack of knowledge [1]. Using the same instrument in different studies does not only save resources for the instrument development but can standardize the conceptualization of the studied phenomenon across diverse studies, allowing for meaningful comparisons of findings (Brislin, 1986). This can finally contribute to the accumulation of a reliable and solid body of knowledge. To make test instruments available for larger audiences beyond country, cultural and language borders, they need to be translated. However, the translation of instruments goes beyond a simple word translation, as challenges arise from cultural and linguistic differences between the source and target language. Errors in translation may distort the original intent of the instrument, jeopardizing the validity and reliability of the resulting tool [3]. The aim of this contribution is to report the translation procedure of our recently developed CCCI-422 [2], a psychometrically reliable climate change concept inventory.

## The Climate Change Concept Inventory (CCCI-422)

The CCCI-422 [2] is a concept inventory developed to assess students' understanding of the scientific principles underpinning climate change [4]. This instrument was developed to address the need for a current, psychometrically and content valid climate change concept inventory available in German, essential for assessing the effectiveness of educational interventions and informing policy decisions in addressing this pressing global issue.

Aligning with AERA's standards, the development of the CCCI-422 draws on literature and experts interviews for identifying core content areas, creating open-ended tasks, and deriving distractors and attractors from over 50 interviews, ensuring a robust foundation for assessing climate change understanding. It comprises 36 multiple-choice single-select items categorized into five concepts: Earth's atmosphere, climate as a system, the carbon cycle, climate and weather, and the greenhouse effect. The Concept Inventory underwent piloting and validation studies with nearly 800 individuals of varying ages and knowledge levels, demonstrating external validity, instructional sensitivity, and construct validity [2]. The focus of this contribution is the portrayal and outcome of the systematic translation procedure of the German CCCI-422 into English.

## Methods

The translation procedure of the CCCI-442 was inspired by Brislin's model of translation [5]. Brislin's model suggests an iterative approach involving several cycles of independent translation and blind back-translation until the back-translation shows equivalence of meaning between the source and the target version of the instrument to be translated. In our case the original version (V0G) of the CCCI-422 was translated by a translation software (Deep L) into the target language English (V1E<sub>DeepL</sub>). Simultaneously, an independent translation (V1E<sub>Expert</sub>) of V0G was made by a bilingual professional translator (with science background). Then, the two English versions V1E<sub>DeepL</sub> and V1E<sub>Expert</sub> were compared. Differences in the English translations were identified by using the text comparison function of Microsoft word resulting in the English comparison version V1E<sub>comp</sub>. The version V1E<sub>Expert</sub> was back-translated into German with the help of DeepL resulting in version V1G. After that, the two German versions V0G (original version) and V1G (back-translation) were compared with help of the text comparison function resulting in the German comparison version V1G<sub>comp</sub>. Then the authors (native German and experts in the field) analysed and categorized the differences into linguistic differences and differences in meaning. Based on this, an English version (V3E<sub>comp</sub>) of the test was compiled that included all passages that exhibited differences in at least one of the comparison versions V1G<sub>comp</sub> or V1E<sub>comp</sub> in both distinct variants. V3E<sub>comp</sub> of the English test instrument, featuring partially duplicated passages in different formulations, served as the basis for interviews with two native English experts in PER. In these interviews, experts were consulted on the linguistically most appropriate wording. In addition, differences in meaning were negotiated.

## Results

At the conference, we will present the translation procedure we used for translating the German CCCI-422 into English and discuss its strengths and weaknesses. We believe that a reliable procedure for the translation of PER test instruments could support the advance of PER in terms of an increasing comparability of research results.

Of course, we will also report the outcome of our translation in terms of the preliminary English version of the CCCI-442 and examples of translation difficulties and errors identified within the process. Finally, we will use the opportunity of the conference to find colleagues of English-speaking countries who would like to support the validation of the English translation of our climate change concept inventory.

## References

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