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Global competence behavior: exploring the relevance of students' scientific literacy, related attitudes, and values - evidence from PISA 2018 across 52 countries

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Abstract

Global competence behavior is increasingly recognized as a key prerequisite for navigating cultural diversity, engaging constructively with multiple perspectives, and contributing responsibly to global sustainability and collective well-being. Despite its acknowledged importance, findings from recent international large-scale assessments, such as PISA 2018, indicate that students do not consistently demonstrate global competence behaviors. Against this backdrop, the present study investigates the factors associated with global competence behavior using data from the PISA 2018 assessment of $N=399,321$ students across $N=52$ countries. Guided by the theory of planned behavior and employing a meta-analytic approach, we examine the roles of students' attitudes, values, perceived behavioral control, and scientific literacy in shaping global competence behavior. The results highlight the central importance of attitudes toward global competence behavior and perceived behavioral control as consistent predictors across countries. In addition, the findings point to the relevance of behavioral intentions for understanding students' global competence behaviors. Taken together, the results underscore the potential benefits of explicitly prioritizing global competence behavior within educational systems. Future research should focus on identifying and evaluating concrete strategies for effectively integrating global competence into educational practice, thereby better preparing students to meet the challenges of an increasingly interconnected world.

Introduction

Global competence encompasses the attitudes and values of students towards a range of global issues, including environmental protection, poverty, hunger, gender equality, and access to education (OECD, 2019) and has become a prominent topic in politics and educational sciences due to the challenges faced on a global scale (e.g., Gräsel et al., 2013; Gräsel, 2018; Mun et al., 2016; OECD, 2019; Scheunpflug, 2021; Wiek et al., 2011). As a result, schools are expected to increasingly implement aspects of global competence in school education, whereby few national schools have implemented aspects of

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global competence in curricula such as sustainable development (OECD, 2019). Moreover, global competence has been recognized as an innovative domain in the *Programme for International Student Assessment* (PISA) in the cycle of 2018 (OECD, 2019). PISA is a large-scale international assessment study that evaluates fifteen-year-olds competencies in core subjects such as reading, mathematics, and science, as well as innovative domains that align with current educational policy developments, such as global competence.

There is a widespread understanding in educational policy that global competence is essential for successful participation in society (UN, 2015), whereby the aim is primarily to empower students through their education to demonstrate global competence behavior in their everyday lives. However, current reports show that internationally, students struggle to demonstrate global competent behavior (Lee & Stankov, 2023).

Scholars agree that students' knowledge, attitudes, and values towards global issues are crucial to demonstrating behavior that aligns with global competence (Zareie & Navimipour, 2016; Zsóka et al., 2013). However, the research literature often shows ambiguous findings, and weakly positive correlations are often found regarding the impact of knowledge components, attitudes, and values on global competence behavior (e.g., Geiger et al., 2019). This might be due in part to the fact that research tends to focus on single aspects of global competence, such as energy-saving behavior (e.g., Wang et al., 2014), which can diminish the relationship with the broad concept of global competence. Further, there is a lack of comprehensive theoretical models that fully explain why individuals exhibit global competence behavior (e.g., Gräsel, 2018).

The theory of planned behavior (Ajzen, 1991) is a vital concept in social psychology that provides general insights into human behavior. Per this theory, the *intention* to perform a particular behavior is a powerful indicator of actual behavioral execution. Its holistic approach to identifying the factors influencing behavior has made the theory of planned behavior widely recognized in the research community. Therefore, the theory of planned behavior has gained widespread acceptance and application in recent research, including studies focused on various facets of global competence behaviors (e.g., Ates, 2020; Diedrich et al., 2022; Tamar et al., 2021).

While the theory of planned behavior pertains to the attitudes and values of individuals, the extent to which students' knowledge influences their behavior remains an open question. While global competence encompasses a wide range of issues, science education seems particularly effective in promoting global competence among students due to theoretical overlaps, which have often been identified as socio-scientific issues, particularly relevant in science education (e.g., Keller et al., 2025; Zeidler et al., 2019). Scientific literacy, considered the knowledge component in this study, is evaluated, besides reading and mathematics as part of the cognitive domain in PISA (OECD, 2017). In summary, the study seeks to investigate the role of knowledge, attitude, and value components in student behavior concerning global competence, using path-analysis and a meta-analytic approach with PISA 2018 data from $N=52$ countries. Our study aims to provide valuable insights into the complex interplay between students' values, attitudes, knowledge, and global competence behavior.

Theoretical background

Global competence

Relevant aspects of global competence have long been integrated into research within the educational sciences (Gräsel, 2018; Gräsel et al., 2013; Lee & Stankov, 2023; Majewska, 2023). A comprehensive view of global competence emerged from the agenda of the United Nations *Millennium Development Goals and Beyond 2015* (UN, 2000). This agenda outlined eight objectives to foster holistic sustainable environments for all global citizens within the following 15 years. These objectives emphasize the importance of environmental preservation and resource-friendly management and call for action on pressing global issues such as poverty, gender equality, education, and health security. The Agenda 2015 was replaced by the Agenda 2030 (UN, 2015), which now encompasses an even broader and more integrative approach with 17 goals, covering diverse topics revolving around issues such as poverty, education, gender equality, health, sustainable cities, peace, and justice. Furthermore, Wiek et al. (2011) formulated an established framework in educational sciences for a wide range of key concepts regarding global competence that students should acquire throughout their education, which also gained significant traction in educational policy (e.g., see Scheunpflug, 2021). Given the importance of global competencies in educational sciences and curricula, the PISA 2018 study internationally implemented global competence as an innovative domain, with the OECD global competence framework (2019) as the theoretical foundation.

According to the OECD (2018) framework, global competence encompasses students' knowledge and understanding of topics at local and global levels, such as climate change, poverty, and pandemics. This entails demonstrating environmentally sustainable behaviors and promoting respectful interactions with individuals from diverse nationalities, ethnicities, religions, or cultural backgrounds. Within the OECD framework (2019, see p.169 for further details), global competence has four dimensions (see Fig. 1): (1) examining local, global, and intercultural issues; (2) understanding the perspectives of others; (3) taking action for sustainable development and (4) engage in interactions across cultures. The four dimensions rely on interconnected factors: knowledge, skills, attitudes, and values. For instance, addressing a global issue (dimension 1) entails understanding the topic, transforming awareness into insight, and possessing attitudes and values for reflective consideration from diverse cultural viewpoints. Hence, effective global competence education enables students to synergize their knowledge, skills, attitudes, and values during discussions on global issues within or outside of school, engaging with people from diverse cultural backgrounds through debates, questioning perspectives, seeking explanations, and charting paths for further exploration and action.

Therefore, the assessment of global competence in PISA 2018 aims to evaluate education systems' efforts to cultivate awareness and understanding of international environments and challenges, promote respectful interactions, and encourage active participation in building sustainable communities (OECD, 2019). Despite the call to integrate global competence into international curricula, only a few schools have done so thus far (OECD, 2019). However, science-related subjects are highly relevant due to significant thematic overlaps with global competence, often identified in the literature as socio-scientific issues (Sadler & Zeidler, 2009). For instance, global and environmental issues, intercultural relationships, and globalization are integral components of science-related curricula in countries like Germany (Gräsel, 2018; KMK, 2016). Thus, scientific

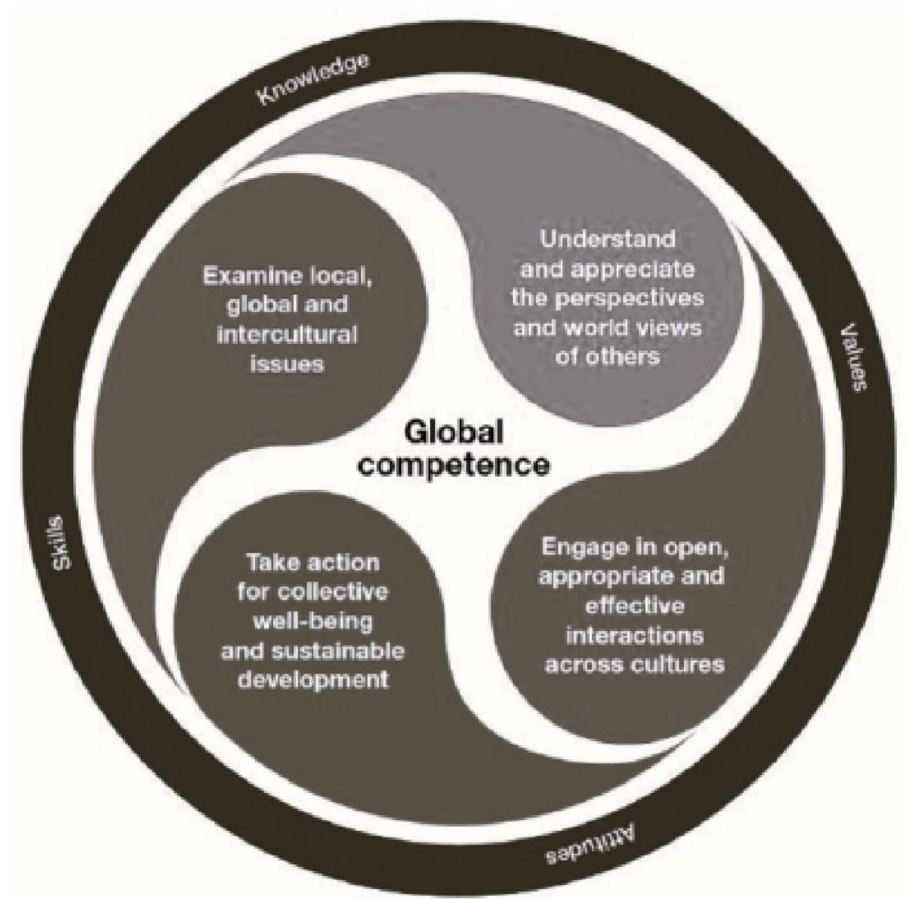


Fig. 1 Global competence according to the OECD-Framework (2018) p. 11

literacy, as enhanced by science-related domains, might play a prominent part in the development of global competence.

In addition to the integration of global competence within the PISA framework, several other frameworks emphasize the relevance of global competence in educational sciences. These frameworks often employ related terms that convey conceptually similar meanings, such as *intercultural competence* or *global citizenship* (Zhang et al., 2024). For instance, UNESCO (2015) defines *global citizenship* as the qualities of being “informed and critically literate, socially connected and respectful of diversity, and ethically responsible and engaged” (p. 23). Zhang et al. (2024) identified in their review three core dimensions that are essential for global competence, despite variations in terminology across frameworks such as those proposed by the OECD and UNESCO (2015): cognitive aspects, socio-emotional aspects, and skills. These dimensions illustrate that global competence is a multifaceted construct integrating knowledge, attitudes, and practical abilities.

Scientific literacy

Since the beginning of PISA surveys, starting with the first assessment in 2000, scientific literacy has consistently been one of the three internationally assessed student competencies domains (OECD, 2017). While scientific education has been constantly reformed during the PISA surveys in response to developments in science education,

current reforms aim to impart robust scientific literacy to students by primarily focusing on real-world phenomena. These reforms emphasize applying evidence-based scientific literacy to address and comprehend real-world occurrences (Forbes et al., 2020). Hence, scientific literacy involves utilizing scientific knowledge to conduct research and formulate inquiries, acquire new understanding, elucidate scientific phenomena, and draw evidence-based conclusions about science-related topics. To be more precise, scientific literacy, as defined by the current OECD framework (2017), comprises a multifaceted concept, covering aspects of : (1) the scientific explanation of phenomena, (2) the assessment and design of scientific inquiries, and (3) the interpretation of data and evidence through scientific lens. Consequently, scientific literacy encompasses a broad spectrum of skills vital for resolving problems in science and technology that may arise in daily life and society. Furthermore, according to the OECD framework (2017), various knowledge domains, including declarative, procedural, and epistemic knowledge, are influenced by the subdomains of competencies within scientific literacy. Generally, with regard to scientific literacy and the OECD framework (2017), students proficient in scientific concepts must not only grasp factual information, but also adeptly integrate information through practical application and comprehend the methods for acquiring reliable knowledge. While scientific literacy is primarily concerned with cognitive aspects, according to the OECD framework (2017), motivation, interest, and attitudes toward science play a central role in achieving scientific literacy. Taken together, to be scientifically literate, competencies and knowledge components play an essential role, as do motivational factors, interests, and attitudes toward science. In promoting scientific literacy, considerable attention has been directed towards understanding the determinants of achievement in science literacy. This body of literature encompasses investigations into various factors at the school level, such as instructional quality (e.g., Aditomo & Klieme, 2020) and personal factors, including gender differences (e.g., Reilly et al., 2019). However, in light of societal progressions and contemporary global challenges, it is imperative to adopt a dynamic perspective toward concepts related to scientific literacy (Valladares, 2021; van Eijck, 2010). For instance, environmental preservation and poverty issues undergo rapid transformations, necessitating a nuanced understanding of data interpretation and scientific processes. Consequently, there emerges a pressing need for a systematic investigation of the relationship between scientific literacy and those factors addressing global issues, encompassing broader concerns such as poverty and economic dynamics, which are linked to the challenges faced on a global scale.

The relationship between scientific literacy and global competence against the background of the theory of planned behavior

For several decades, researchers have been investigating the factors that influence various aspects of global competence; for example, the works of Maloney and Ward (1973) have played a significant pioneering role in identifying predictors of environmentally friendly behavior, which is one relevant aspect of global competence. While it may seem plausible that individuals with positive attitudes towards environmental issues also exhibit environmentally friendly behavior, many studies have shown a weak positive correlation between attitudes towards environmental issues and actual environmentally conscious actions (e.g., Lehmann, 1999 as cited in Gräsel, 2018; Tamar et al., 2021). This has led to the conclusion that, so far, theoretical explanatory models often do

not entirely capture the complexity of environmentally friendly behavior. Consequently, research on environmentally friendly behavior has often been criticized due to the lack of explanatory approaches and theoretical embedding (Gräsel, 2018).

The theory of planned behavior (Ajzen, 1991) is a psychological framework elucidating general aspects of human behavior, particularly concerning intentions and predictability of individuals' actual behavior. The theory has been foundational in studying human behavior and is further established in domains of global competence (e.g., Ates, 2020; Diedrich et al., 2022; Wang et al., 2014; Yazdanpanah & Forouzani, 2015). For instance, the theory of planned behavior has been employed to analyze behaviors related to energy conservation or the preference for purchasing environmentally friendly products (Wang et al., 2014; Yazdanpanah & Forouzani, 2015). Applying the theory of planned behavior has been noted in investigating individual engagement in environmental conservation alongside broader facets of global competence. However, current research has yet to extensively leverage this theory for assessing readiness to act across the comprehensive spectrum of global competence, wherein a variety of theoretical frameworks covering aspects of global competence behavior is evident (Steeh et al., 2019). Nevertheless, the theory of planned behavior holds significant promise owing to its adaptability about global competence, suggesting its potential utility in addressing this gap (see also Kaiser et al., 2005).

In the theory of planned behavior, *intention* is a central component, serving as the immediate precursor to actual behavior. An individual's intention to engage in a specific behavior is further influenced by their *attitude towards that behavior*, *subjective norms*, and *perceived behavioral control*. In other words, a person's intention to act directly results from their attitude towards it, social expectations, and their perception of their ability to enact the behavior. According to Ajzen (1991), attitude toward behavior generally encompasses a positive or negative disposition toward the behavior. Thus, if an individual holds a favorable attitude toward a behavior, it is more likely to be enacted. Subjective norm pertains to the social pressure or support experienced by an individual in the execution or omission of a particular behavior. Significant reference persons like family, friends, or peers may influence these subjective norms. Evidence suggests that internalized norms can be influenced and shaped by a person's integration into a 'suitable' peer group. This involves the degree of identification with the ingroup and the adoption of its norms and goals (e.g., Fritsche et al., 2018). Perceived behavioral control refers to an individual's assessment of the ease or difficulty in executing the intended behavior. This component considers individual factors, resources, and external obstacles that may impact behavior. Therefore, a person may be more willing to enact the behavior if it appears feasible or manageable for them. The research literature has also established the central role of attitudes and values concerning global competence behavior (e.g., Acquadro Maran et al., 2023). While the theory of planned behavior addresses already relevant individual factors, norms, attitudes, and values and further considers the intention regarding whether someone shows a specific behavior, the question remains open as to the extent to which an individual's *knowledge* plays a pivotal role in whether the behavior is carried out or not (e.g. Geiger et al., 2019; Wiek et al., 2011). Earlier, researchers have frequently identified a "gap" between "knowledge and action," particularly in the context of factors related to global competence, which suggests that knowledge does not automatically lead to corresponding action (e.g., Kaiser & Furher, 2003; Geiger et

al., 2019; Tamar, 2020). Various factors may contribute to this phenomenon, but a common notion suggests that declarative knowledge alone is often deemed necessary but insufficient for engaging in corresponding behaviors (e.g., Kaiser & Furher, 2003). The authors argue that while knowledge is a necessary yet distant determinant of behavior, closer behavioral proximal predictors warrant exploring the association between knowledge and behavior. This suggests a potential necessity for incorporating more procedural knowledge elements about processes rather than solely relying on declarative knowledge, which may be crucial for actual behavior. Nonetheless, knowledge remains a vital aspect of behavior in a broader context (Geiger et al., 2019), as it is essential, for example, to interpret information or identify misinformation (Sharon & Tsabari, 2020), which is particularly relevant to global competence behavior.

For instance, research has demonstrated that solid scientific literacy – serving as a comprehensive measure for different knowledge components – is fundamental for identifying misinformation during events such as the COVID-19 pandemic, which can significantly influence behavior (Sailer et al., 2022), as well as for undertaking preventive actions to maintain environmental sustainability (Zareie & Navimipour, 2016). Consequently, it can be summarized that holistic knowledge components, often described in the literature as a “literacy concept,” constitute a highly relevant additional aspect that can impact individuals’ behavior. Hence, it is plausible to assume that scientific literacy, as regularly assessed in PISA, might have an important impact on global competence behavior, which is investigated in the context of this study. In the theory of planned behavior (Ajzen, 1991), alongside attitudes and values, intention is highlighted as pivotal in determining whether a behavior is performed. Numerous studies have affirmed the significance of intention in behavioral enactment (e.g., Connor & Neumann, 2022), demonstrating its central role in behavior enactment.

In summary, the theory of planned behavior (Ajzen, 1991) holds the substantial potential to continue serving as a theoretical foundation, elucidating the extent to which students manifest such global competence behavior in light of their scientific literacy, attitudes, and values. Moving forward, the theory of planned behavior could play a pivotal role in exploring and explaining how students genuinely exhibit relevant behaviors in the context of global competence. For example, Diedrich et al. (2022) utilized the PISA 2018 data of specific OECD states to examine the interrelation between global competence and students’ scientific literacy, pointing to the theoretic foundations of the theory of planned behavior (Ajzen, 1991). The investigation by Diedrich et al. (2022) provided some initial insights into the complex relationships between adolescents’ environmental knowledge, skills, self-efficacy, motivation, and climate protection activities. However, the authors put a specific focus on single specific climate protection activities based and limited their analysis and investigation to only five countries from the group of western European states only.

The present study aims to further explore this complex relationship between students’ global competence behavior, attitudes, values, and scientific literacy by following a more complex path analytical model (see Fig. 2 below). Second, this model is applied to $n = 52$ datasets from countries participating in the PISA 2018 assessment. The single results are summarized using a meta-analytic approach which increasingly represents a new quasi-standard of integrative data analysis (see Brunner et al., 2023; Scherer et al., 2024) based

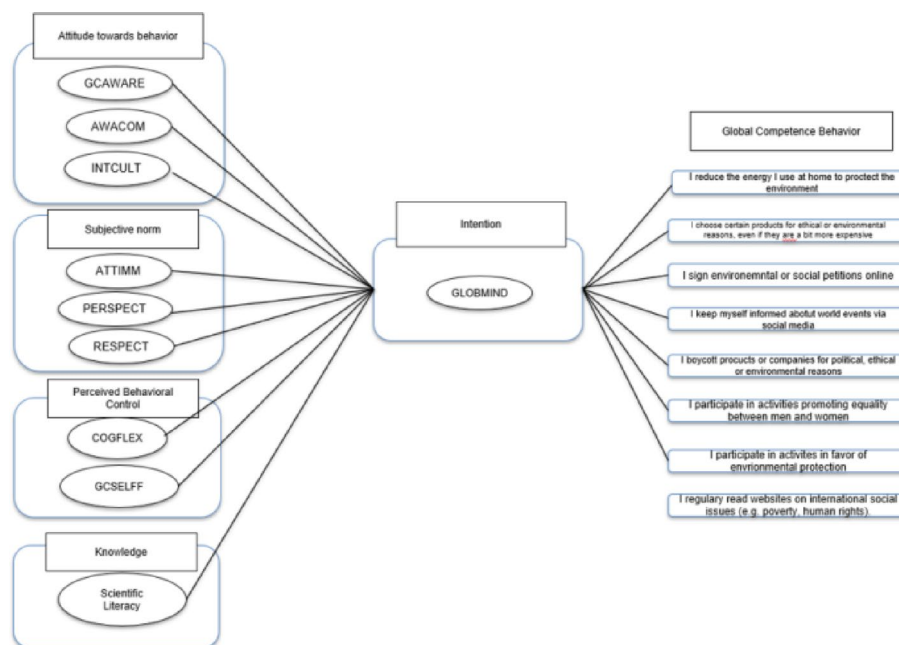


Fig. 2 Hypothesized model, attitudes, beliefs, and interests regarding their Global Competence. Note: The eight global competence (GC) behavior items were analyzed as individual observed variables; no grouping or parceling into latent factors was performed. The allocation of items to components of the Theory of Planned Behavior (attitude toward behavior, subjective norm, perceived behavioral control) serves only as a theoretical framework to guide interpretation and visualization. Each latent construct (e.g., global mindedness, global competence behavior) is measured by its respective set of indicators. For simplicity, the measurement models are not displayed in this figure. For the description of the scales see Table 1

on independently drawn country data samples in the context of large-scale assessments (see, e.g., Hofer et al. 2024; Keller et al., 2022).

The present study

This research delves into how students' scientific literacy, attitudes, and values impact their global competence behavior through the lens of the theory of planned behavior (see Fig. 2). In addition, the study at hand also examines the extent to which scientific literacy among students contributes to global competence behavior. The hypothesized model was adapted following the theory of planned behavior, wherein the attitudes and values regarding global competence among students were attributed to aspects such as social norms, perceived behavioral control, attitudes towards behavior, and the intention to perform behavior (refer to the method section for further elaboration). Furthermore, based on theoretical considerations, the model was augmented with scientific literacy as a knowledge component, given the pivotal role scientific literacy can play, especially concerning global competence behavior as often highlighted in the concept of socio-scientific issues (Sadler & Zeidler, 2009).

Our research focuses on studying global competence behavior and its influencing factors, which is of utmost importance internationally. Using the PISA dataset, we can provide standardized data from diverse educational systems to identify how different countries' socio-economic and cultural conditions and contexts shape global competence behavior. Therefore, to answer the research questions, a meta-analytical approach was employed (Brunner et al., 2023; Scherer et al., 2024) using PISA 2018 data from 52 countries:

RQ 1a *To what extent can students' attitudes and values predict behavioral intention regarding global competence across 52 countries?*

It can be assumed that students who hold positive attitudes and values towards global competence are more likely to show globally competent behavior, such as advocating for educational equity and environmental conservation. However, previous research has shown only minimal positive correlations between attitudes, values, and actual behavior in specific thematic areas related to global competence (see Gräsel, 2018). Hence, there is a need for a meta-analytical examination within the international large-scale assessment using the broader construct of global competence to potentially reassess previous research findings. Furthermore, it is particularly interesting to analyze the extent to which knowledge plays a role in global competence behavior, as studies have highlighted the relevance, for example, of science education and its impact on behavior (e.g., Sailer et al., 2022; Zareie & Navimipour, 2016). For this study, scientific literacy, as assessed in PISA, has been identified as suitable, given that in some countries, global competence is intended to be conveyed through science education (Sadler & Zeidler, 2009; OECD, 2019). Consequently, the second and third research questions in this study investigate the relevance of scientific literacy for global competence behavior:

RQ 1b *To what extent can students' scientific literacy predict behavioral intention regarding global competence across 52 countries?*

Finally, according to the theory of planned behavior, central to this study, the assumption posits that global competence behavior is preceded by intention. Thus, the third research question in this study is:

RQ 2 *To what extent does behavioral intention predict global competence behavior across 52 countries?*

The OECD frameworks provide comprehensive and globally applicable guidelines for the PISA study. Nevertheless, it is important to recognize that the interpretation and manifestation of global competence may vary across countries due to differences in curricular mandates, cultural values, and contextual conditions (e.g., Geiger et al., 2018). Such country-specific factors, including educational policies, socio-economic circumstances, and cultural norms, may influence individuals' perceptions and behaviors related to global issues. To account for these potential cross-national variations, the present study synthesized associations across countries using a meta-analytic path modeling approach. This method also enabled the quantification of heterogeneity across countries, thereby providing insights into the consistency and variability of associations while acknowledging that some degree of contextual diversity is expected. Considering these aspects, it becomes essential to incorporate country-level indicators in moderator analyses to better capture and interpret the contextual influences shaping the relationship between global competence and scientific literacy:

RQ 3 *Which country-specific characteristics (e.g., the environmental performance index (EPI) and the human development index (HDI) explain the possible variation in the tested model? (Moderation by EPI, HDI)*

Method

Participants and design

Data were drawn from the PISA 2018 study, which assesses and collects cross-sectional data every three years on competencies from fifteen-year-olds at the end of their compulsory schooling worldwide in mathematics, science, and reading. Additionally, students answered questionnaires on background information and, among others, items regarding global competence. The assessment and questionnaire administered by PISA measure science, reading, and mathematics and take approximately three hours to complete. Although 79 countries participated in the PISA 2018 assessment, the present study utilized data from 52 countries ($N=399,321$ participants). This selection was necessitated by the optional nature of certain components of the PISA study, specifically, sections of the background questionnaire, resulting in incomplete data availability across all participating countries. Consequently, only countries with accessible and relevant data for the variables under investigation were included in the analyses. Within these 52 countries, the distribution of boys and girls was approximately equal.

Measures and procedure

Global Competence and global competence Behavior. With the additional survey of Global Competence in PISA 2018, students were asked via questionnaires about various factors such as their self-efficacy, attitudes, beliefs, and interests regarding their Global Competence. Global competence consisted of a total of ten subscales relevant to this study. The subscales of Global Competence included *student's self-efficacy regarding global issues* (GCSELFEEF; Schultz et al., 2011), *student's awareness of global issues* (GCAWARE; Müller et al., 2016), *Perspective-Taking* (PERSPECT; Davis, 1983), *cognitive flexibility* (COGFLEX; Dennis & Vander Wal, 2010), *awareness of intercultural communication* (AWACOM; OECD, 2018), *student's interest in learning about other cultures* (INTCULT; OECD, 2018), *respect for people from other cultures* (RESPECT; OECD, 2018), *global-mindedness* (GLOBMIND, OECD, 2018), and *students attitudes towards immigrants* (ATTIMM, OECD, 2018).

Global competence behavior. Global competence behavior was assessed with individual items in PISA 2018, with students reporting the extent to which they engage in global and intercultural issues, measured using 8 items. The corresponding variables are labelled in the international PISA dataset as ST222Q01 – ST222Q10. All datasets relevant for this study can be drawn from here. Descriptive statistics, example items and reliability indicators about students' answers on global competence and scientific literacy can be drawn from Table 1 (for further details see OECD, 2019).

Scientific literacy. Scientific literacy is assessed through a competency test in PISA, based on “real-world” problems that can relate to global, national, or personal contexts, as defined by the OECD in 2017. These real-world scenarios are presented in “units,” where a broad theme is introduced, and students are asked simple or complex multiple-choice questions as well as open-ended questions (example items can be found here). In total, the scientific literacy test in PISA 2018 consisted of 115 items, which were represented in 34 units.

Allocation of the factors to the hypothesized model. This study is based on the theory of planned behavior (Ajzen, 1991), which posits that actual behavior is influenced by attitudes, perceived social norms, and perceived behavioral control, all contributing to

Table 1 Descriptive statistics and example items

Scale	M*	SD	Example item and response scale	α
Student's self-efficacy regarding global issues (GCSELEFF)	−0.06	1.04	<i>How easy do you think it would be for you to explain how carbon-dioxide emissions affect global climate change?</i> (1 = "I couldn't do this" – 4 "I could do this easily")	0.87
Student's awareness of global issues (GCAWARE)	−0.03	1.07	<i>How informed are you about... Climate change and global warming?</i> (1 = "I have never heard of this" – 4 "I am familiar with this and I would be able to explain this well")	0.88
Perspective-taking (PERSPECT)	0.62	1.02	<i>How well does... I try to look at everybody's side of a disagreement before I make a decision ... describe you?</i> (5 = "Not at all like me" – 1 "Very much like me"). Items were reversed coded before scaling	0.81
Cognitive flexibility (COGFLEX)	0.01	1.03	<i>How well does... I can change my behavior to meet the needs of new situations describe you?</i> (1 = "Not at all like me" – 5 "Very much like me")	0.84
Awareness of inter-cultural communication (AWACOM)	−0.01	1.00	<i>I choose my words carefully...</i> When talking to someone who has a different native language than me (1 = "Strongly disagree" – 4 "Strongly agree")	0.90
Respect for people from other cultures (RESPECT)	−0.02	0.99	<i>How well does... I respect people from other cultures as equal human beings describe you?</i> (5 = "Not at all like me" – 1 "Very much like me"). Items were reversed coded before scaling	0.91
Global-mindedness (GLOBMIND)	0.05	1.00	<i>To what extent do you agree with... I think my behavior can impact people in other countries</i> (1 = "Strongly disagree" – 4 "Strongly agree")	0.82
Students' attitudes towards immigrants (ATTIMM)	0.01	0.96	<i>How much do you agree with... Immigrants should have the opportunity to continue their own customs and lifestyle?</i> (1 = "Not at all like me" – 5 "Very much like me")	0.85
Student's interest in learning about other cultures (INTCULT)	0.10	0.98	<i>How well does... I want to learn how people live in different countries, describe you?</i> (1 = "Not at all like me" – 5 "Very much like me")	0.86
Global competence behavior (ST222Q01 – ST222Q10)	–	–	e.g. I choose certain products for ethical or environmental reasons, even if they are a bit more expensive e.g. I participate in activities promoting equality between men and women (1 = No, 2 = yes, recoded for this study, see supplementary material)	–
Scientific literacy	–	–	Example items can be found here: https://www.oecd.org/pisa/aboutpisa/PISA%20for%20Schools%20sample%20test%20items.pdf	–

All constructs were represented by IRT-generated scale scores provided by the OECD (2019) based on the PISA 2018 data. Each scale is derived from multiple items analyzed using item response theory (IRT)

For details on the scaling procedures and psychometric properties, see the PISA 2018 Technical Report. Cronbachs Alpha was calculated based on the mean of all participating countries ($N=52$)

behavioral intention. To align the nine subscales of the global competence framework with these theoretical components, each subscale was allocated according to the conceptual meaning of its items. Subscales reflecting evaluative beliefs and values related to global issues were assigned to attitudes; those addressing social expectations, respect, or openness toward others were mapped to subjective norms; and subscales capturing confidence, self-efficacy, or perceived ability to act were linked to perceived behavioral control and behavioral intention. The allocation was guided by content-based criteria and refined through several rounds of discussion among the authors—all of whom hold at least a PhD—to ensure theoretical consistency and conceptual validity. The subscales GCAWARE (Müller et al., 2016) and AWACOM (OECD, 2018), and INTCULT (OECD, 2019) were assigned to the construct *attitude towards behavior*, as they encompass aspects of interest in and familiarity with global issues. The subscale PERSPECT (Davis, 1983), RESPECT (OECD, 2018), and ATTIMM (OECD, 2018) were assigned to the *subjective norm*. For instance, one of the items ("I choose my words carefully when talking to someone who has a different native language than me") (see Table 1, p. 22)

reflects perceived social expectations to act respectfully and appropriately in intercultural interactions, aligning with the conceptual definition of subjective norms. COGFLEX (Dennis & Vander Wal, 2010) and GCSELFEFF (Schultz et al., 2011) were assigned to *perceived behavioral control*. GLOBMIND (OECD, 2018) was allocated to *intention towards the behavior* based on content-based criteria following the theory of planned behavior (Ajzen, 1991). The global competence behavior was aligned to the items estimate where students estimate their own global competence behavior via questionnaire (Variables ST222Q01 – Q10), as due to the nature of the PISA design, objective measures are not possible. These items describe concrete actions, such as boycotting companies and reducing energy consumption at home. Based on theoretical considerations, scientific literacy was incorporated into the study as an additional component, serving as the additive knowledge component within the hypothesized model (Fig. 2). This decision was grounded in recognizing the pivotal role that scientific literacy plays in shaping individuals' understanding and engagement with global competence.

Indicators for moderator analyses

To ensure accurate interpretation of results, country-specific factors must be considered due to the international heterogeneity of countries. In this regard, two factors that can represent country-specific characteristics related to global competence are the Environmental Performance Index (EPI) and the Human Development Index (HDI). These two indices are publicly available, making them suitable for the study. The Environmental Performance Index (EPI, see Wolf et al. (2022), or Milfont & Sibley, 2012) is a metric used to evaluate and compare countries' environmental performance worldwide. EPI assesses a country's environmental achievements and challenges across various policy categories, such as air quality, water resources, biodiversity and habitat, climate change, and environmental health, and ranges from 0 to 100, whereby higher indices indicate higher environmental performance. On the other hand, the Human Development Index (HDI, <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI>) is a composite statistic used to measure a country's overall level of human development and ranges from 0 to 1 whereby higher indices indicate higher human development. It considers three key dimensions: health (measured by life expectancy at birth), education (measured by mean years of schooling and expected years of schooling), and standard of living (measured by gross national income per capita). For better alignment of the indices with the PISA data from 2018, the indices from 2018 were utilized.

Statistical analysis

The hypothesized model for this study (Fig. 2) was analyzed using a path model estimated separately for each country, where each path represents a direct regression relationship among the constructs. A approach to integrative meta-analytic large-scale assessment was employed to incorporate the standardized β -coefficients of the regressions for all $N=52$ countries into the analyses (see Brunner et al., 2023). Accordingly, the individual standardized β -coefficients of the path model were meta-analytically analyzed. To account for the complex two-stage sampling design of PISA, both sampling and replicate weights were applied following OECD guidelines (Asparouhov, 2004; OECD, 2019). All analyses were conducted in R Version 4.2.3 using the *BIFIEsurvey*

package (Robitzsch & Oberwimmer, 2024) and the *metafor* package (Viechtbauer, 2010). Students' scientific literacy was evaluated using item 10 plausible values. This study utilized all ten plausible values to analyze scientific literacy, accounting for measurement inaccuracy. The relevant data and analysis scripts are available at: https://osf.io/73q2y/overview?view_only=6726b28499e647c19a4fb7137a475e1e.

Results

RQ1a: Attitudes and values of students and the relationship with Intention regarding global competence – attitudes towards behavior.

The first research question examines to what extent the factors related to attitudes and values regarding global competence, categorized into attitudes towards behavior, subjective norm, and perceived behavioral control, predict behavioral intention (see Figs. 2, 3, 4 and 5). The results, estimated using a random-effects model, indicate that factors associated with *attitudes towards behavior* significantly and positively predict the *intention* to perform the behavior. The summary effect for the $N=52$ countries, attributed to factors related to attitudes towards behavior, is as follows: $\beta_{\text{awareness of global issues}} = 0.07$ (95% CI [0.07, 0.08]), $\beta_{\text{awareness of intercultural communication}} = 0.15$ (95% CI [0.14, 0.16]), and $\beta_{\text{interest in learning about other cultures}} = 0.11$ (95% CI [0.10, 0.13]). While the effects for *awareness*

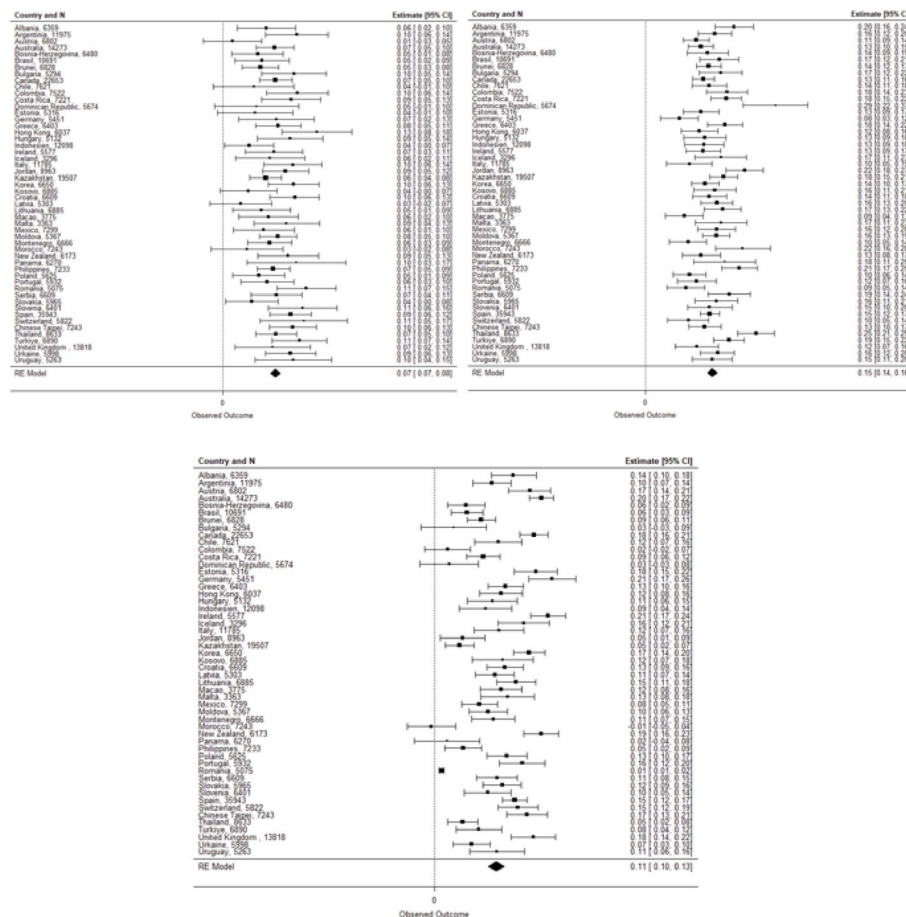


Fig. 3 Forest plots of the standardized β -coefficients for the variables of global competence related to *attitudes towards behavior*, ranging from awareness of global issues (left), awareness of intercultural communication (right), and interest in learning about other cultures (bottom). Note. The weighted average effect sizes were based on random-effects (RE) models

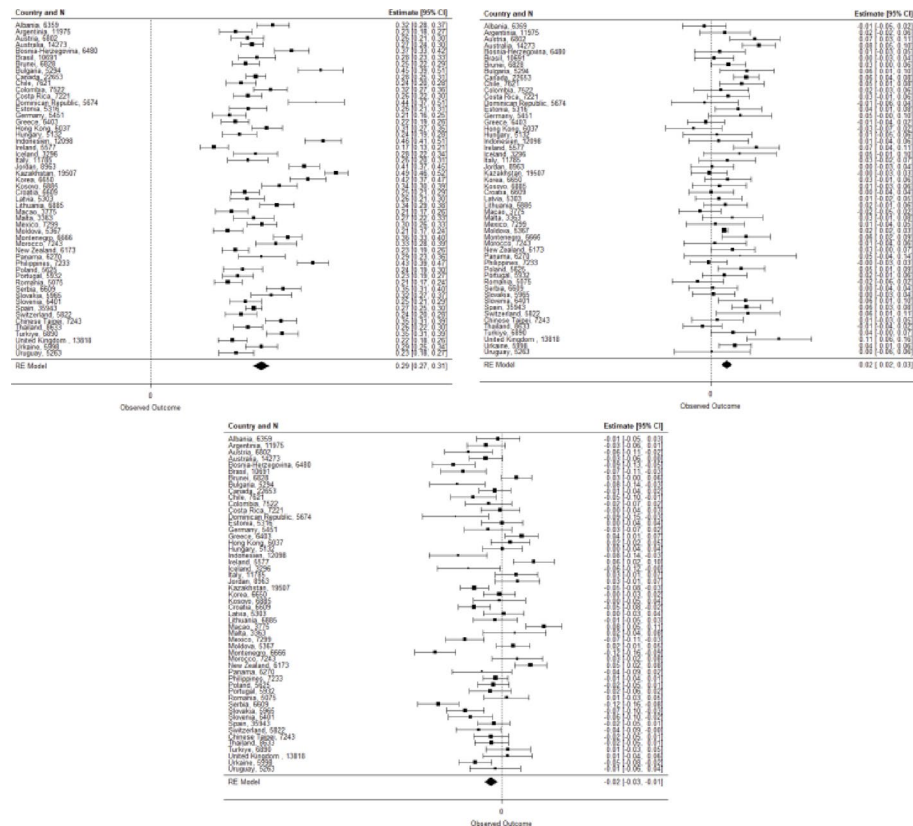


Fig. 4 Forest plots of the standardized β -coefficients for the variables of global competence related to *the subjective norm*, ranging from attitudes towards immigrants (left), perspective-taking (right), and respect for people of other cultures (bottom) Note. The weighted average effect sizes were based on random-effects (RE) models

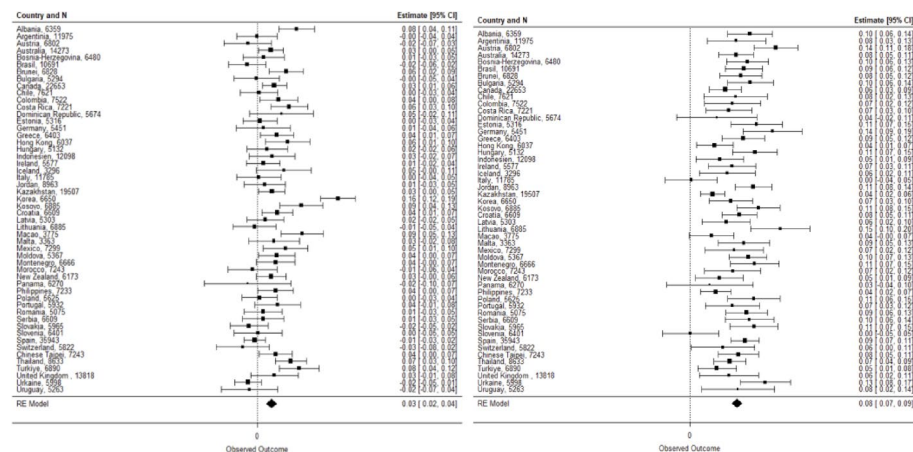


Fig. 5 Forest plots of the standardized β -coefficients for the variables of global competence related to *perceived behavioral control*, ranging from cognitive flexibility (left) to self-efficacy regarding global issues (right). Note. The weighted average effect sizes were based on random-effects (RE) models

of global issues ($I^2 = 34.10\%$, $\tau^2 = 0.0002$) and awareness of intercultural communication ($I^2 = 71.62\%$, $\tau^2 = 0.0010$) were distributed with low to moderate heterogeneity across the $N = 52$ countries, a significantly greater heterogeneity between states was observed concerning interest in learning about other cultures, where 92% of the total variability is attributed to heterogeneity between the countries ($I^2 = 92.43\%$, $\tau^2 = 0.0026$). In summary,

the variables of global competence, associated with attitudes towards behavior, significantly preceded the intention to perform the behavior (specified as global-mindedness, see Fig. 3), with varying levels of heterogeneity observed across different factors related to global competence.

Attitudes and values of students and the relationship with Intention regarding global competence – subjective norm

Furthermore, *subjective norms* play a central role within the theory of planned behavior regarding the intention to perform a behavior. Within the scope of this study, the factors of *attitudes towards immigrants*, *perspective-taking*, and *respect for other people and cultures*, identified as relevant to subjective norms, were examined within the constructs of global competence (see Fig. 4). The summary effect for the $N=52$ countries, attributed to factors related to subjective norm, is as follows: $\beta_{\text{attitudes towards immigrants}} = 0.29$ (95% CI [0.27, 0.31]), $\tau^2 = 0.005$, $I^2 = 92.12\%$; $\beta_{\text{perspective-taking}} = 0.02$ (95% CI [0.02, 0.03]), $\tau^2 = 0.0004$, $I^2 = 65.95\%$; and $\beta_{\text{respect for other people and cultures}} = -0.02$ (95% CI [-0.32, -0.008]), $\tau^2 = 0.001$, $I^2 = 81.48\%$, respectively. Accordingly, both *attitudes towards immigrants* and *perspective-taking* show a significant positive effect on the intention to perform a behavior. In contrast, the summary effect of *respect for other people and cultures* negatively affects the intention. This effect is attributed to 81% of the heterogeneity among the $N=52$ states. Consequently, *attitudes towards immigrants* and *perspective-taking* positively shape behavioral intentions, while *respect for other people and cultures* negatively impacts intention, explaining 81% of the observed heterogeneity across the $N=52$ countries.

Attitudes and values of students and the relationship with Intention regarding global competence – perceived behavioral control

The theory of planned behavior also proposes that *perceived behavioral control* impacts the intention to enact a behavior. In this study, the global competence variables *cognitive flexibility* and *self-efficacy regarding global issues* were conceptually associated with perceived behavioral control. The summary effect for cognitive flexibility ($\beta_{\text{cognitive flexibility}} = 0.03$, 95% CI [0.02, 0.04], $\tau^2 = 0.0008$, $I^2 = 70.63\%$) and for $\beta_{\text{self-efficacy regarding global issues}} = 0.08$, 95% CI [0.07, 0.09], $\tau^2 = 0.0005$, $I^2 = 60.52\%$) are both statistically significant (see Fig. 5). However, while moderate, the heterogeneity observed may suggest some variability in the effects across studies.

RQ 1b: Scientific literacy and the relationship with intention regarding global competence.

Moreover, an extension of this study examined the extent to which students' scientific literacy, regularly assessed in PISA studies, influences behavioral intention. However, no significant summary effect was found for scientific literacy ($\beta_{\text{Scientific literacy}} = -0.0009$, 95% CI [-0.0021, 0.0001]). In summary, all factors of global competence significantly predict behavioral intention across 52 countries. Conversely, contrary to the hypothesis, scientific literacy did not significantly predict behavioral intention (see Fig. 6).

RQ 2: Behavioural intention in relationship with global competence behavior

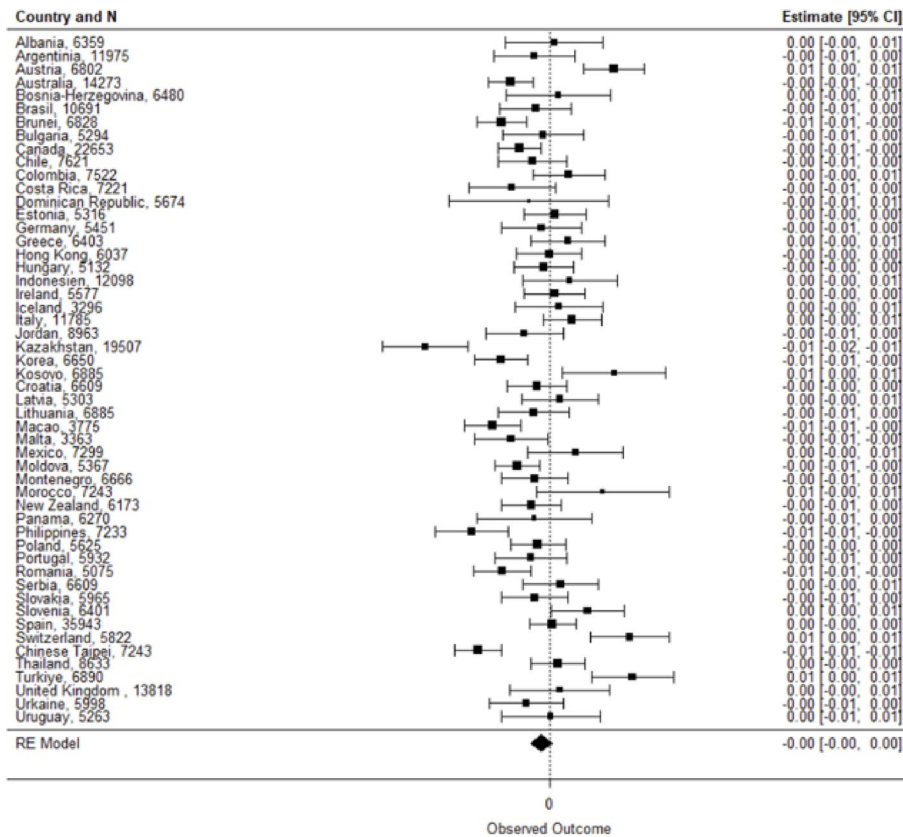


Fig. 6 Forest plots of the standardized β -coefficient of scientific literacy Note. The weighted average effect sizes were based random-effects (RE) models

According to the theory of planned behavior, intention is a significant predictor of whether a behavior is enacted. Hence, within RQ2, the examination focused on how global mindedness (“intention”; see Fig. 2) predicts global competence behavior across 52 countries. The results are depicted in Fig. 7. In total, eight variables were utilized to assess the global competence behavior of students. For clarity, the variables are thematically categorized for the results of this study. Three variables pertain to concrete environmental behavior by students, with the summary effects for $N=52$ countries significantly positive: $\beta_{\text{reduce energy at home to protect the environment}} = 0.06$, 95% CI [0.05, 0.06], $\tau^2 = 0.0006$, $I^2 = 93.44\%$, $\beta_{\text{I choose certain products for ethical or environmental reasons}} = 0.07$, 95% CI [0.07, 0.08], $\tau^2 = 0.0009$, $I^2 = 94.42\%$, and $\beta_{\text{I participate in activities in favourof environmental protection}} = 0.08$, 95% CI [0.09, 0.08], $\tau^2 = 0.0007$, $I^2 = 92.91\%$, respectively. Furthermore, the results indicate that over 90% of the variance in the observed effect sizes for all three summary effects is attributed to between-study heterogeneity. Two variables specifically inquired about how students stay informed about world events and social issues. For both variables, a significant positive summary effect of global mindedness on $\beta_{\text{I keep myself informed about world events via social media}} = 0.04$, 95% CI [0.04, 0.05], $\tau^2 = 0.0004$, $I^2 = 87.92\%$, and $\beta_{\text{I regularly read websites on international social issues}} = 0.09$, 95% CI [0.08, 0.10], $\tau^2 = 0.0007$, $I^2 = 94.49\%$. Lastly, the students answered three items regarding their participation in petitions or activities related to current global issues. The summary effect of this is as follows: $\beta_{\text{I sign environmental or social petitions online}} = 0.05$, 95% CI [0.04, 0.05], $\tau^2 = 0.0005$, $I^2 = 90.55\%$, $\beta_{\text{I participate in activities promoting equality between men and women}} = 0.07$, 95% CI [0.06, 0.07],

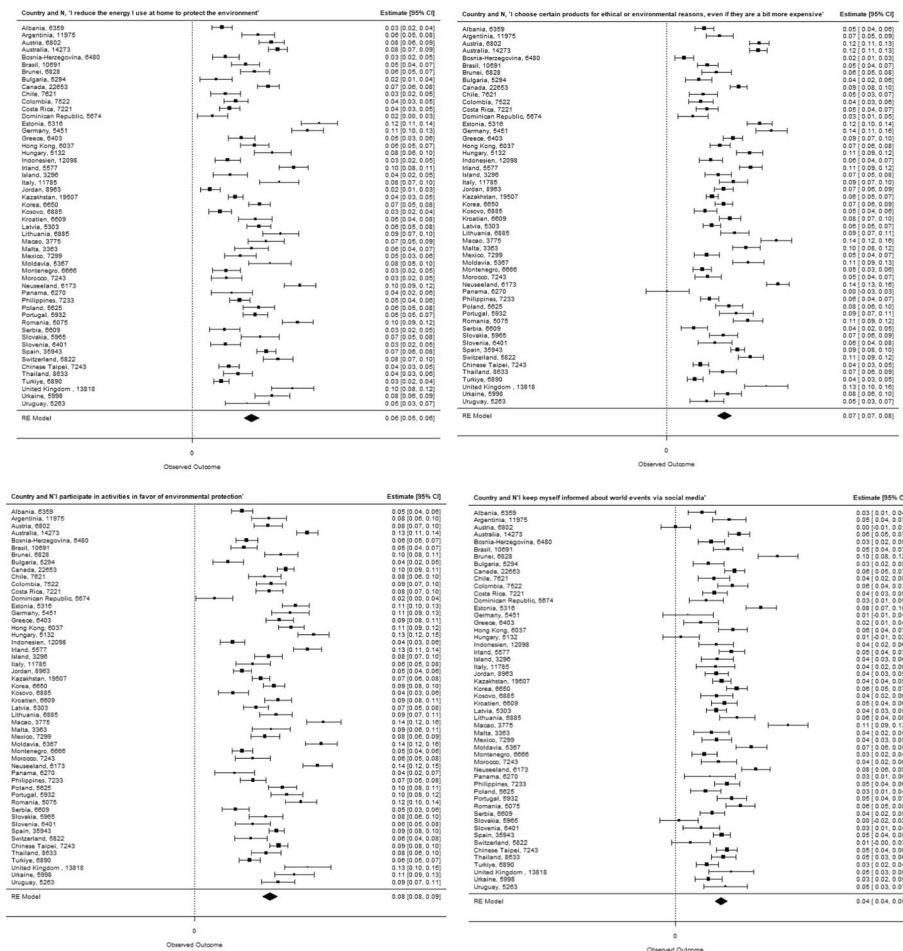


Fig. 7 Forest plots of the standardized β -coefficients for the variables of global competence behavior. Note. The weighted average effect sizes were based on random-effects (RE) models. Descriptions of the items are within the forest plots

$\tau^2 = 0.0005$, $I^2 = 88.62\%$, and β_1 boycott products or companies for political, ethical or environmental reasons = 0.05, 95% CI [0.04, 0.06], $\tau^2 = 0.0007$, $I^2 = 92.68\%$, respectively. Overall, a significant summary effect of global mindedness on all variables of global competence behavior is observed, ranging from $\beta = 0.04$ to 0.09 across the $N = 52$ countries. All relevant path coefficients can be found in Fig. 8.

RQ 3: Moderator analysis based on the Environmental Performance Index (EPI) and Human-Development Index (HDI).

To account for the heterogeneity among the $N = 52$ countries, it is essential to incorporate country-specific indicators into the analyses and test whether this variation can be predicted within the model. Consequently, moderator analyses based on country-specific indices were conducted, considering environmental and developmental aspects relevant to global competence. Table 2 presents the moderator analyses based on the Environmental Performance Index (EPI) and the Human Development Index (HDI) for the tested model (Fig. 2). The results indicate significant moderator effects for most variables related to global competence behavior based on the HDI and EPI indices. The findings show that the higher a country scores on the EPI and HDI, the stronger the relationship between intention and global competence behavior. Similar findings were

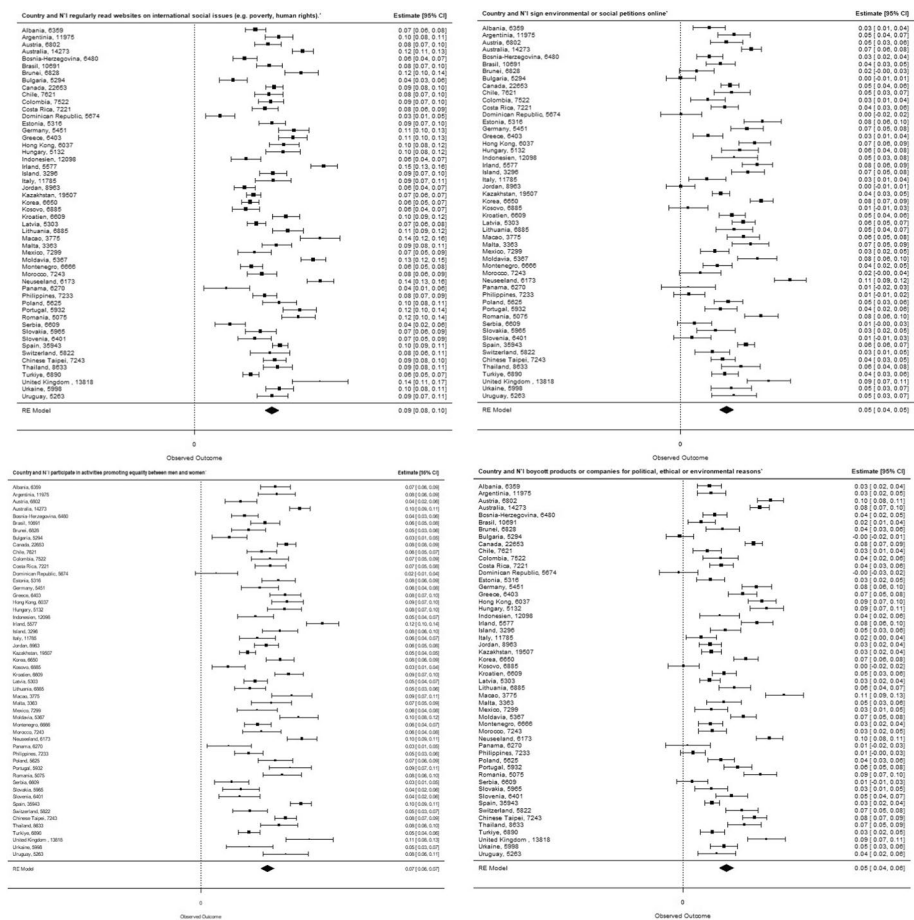


Fig. 7 (continued)

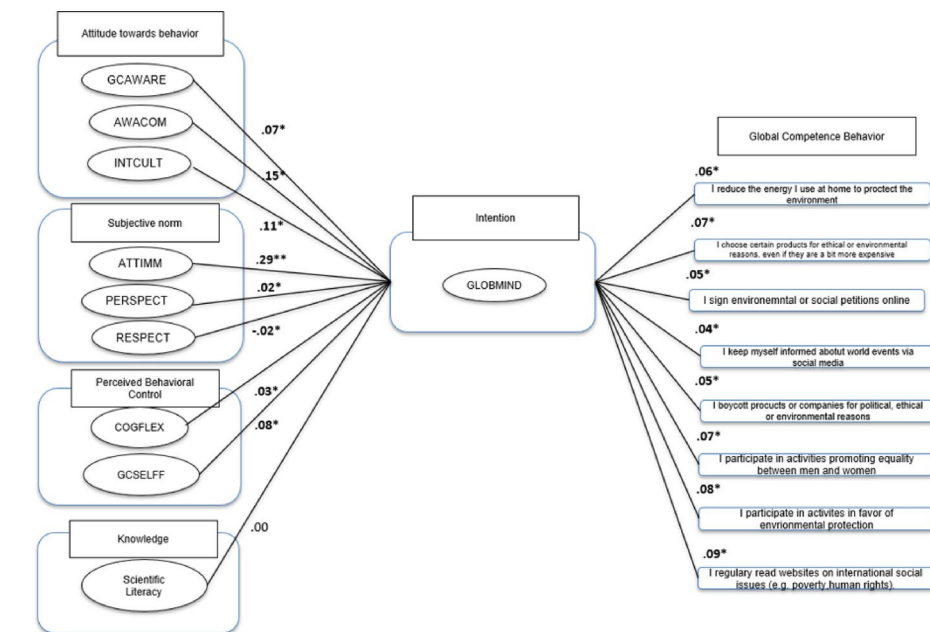


Fig. 8 Hypothesized model with estimated path coefficients. Note: The eight global competence (GC) behavior items were analyzed as individual observed variables; no grouping or parceling into latent factors was performed

Table 2 Moderator analysis (Meta-regression) predicting paths in the hypothesized model (Fig. 1) by Human-Development-Index (HDI) and environmental performance index (EPI)

	HDI		EPI	
	Estimate	SE	Estimate	SE
Attitudes and Values ~ Intention				
Awareness of global issues (GCAWARE)	0.04	0.046	0.003	0.000
Awareness of intercultural communication (AWACOM)	−0.33***	0.061	−0.0016	0.001
Interest in learning about other cultures (INTCULT)	0.61***	0.066	0.0034	0.000
Attitudes towards immigrants (ATTIMM)	−0.48***	0.13	−0.0036**	0.001
Perspective-taking (PERSPECT)	0.20***	0.05	0.0014***	0.000
Respect for people of other cultures (RESPECT)	0.12	0.08	0.0014*	0.001
Cognitive flexibility (COGFLEX)	−0.002	0.07	−0.0006	0.001
Self-efficacy regarding global issues (GCSELFEEF)	−0.006	0.06	0.0001	0.001
Scientific literacy	0.0007	0.0008	0.000	0.000
Intention (GLOBMIND) ~ behavior				
I reduce the energy I use at home to protect the environment	0.20***	0.04	0.0012**	0.0004
I choose certain products for ethical or environmental reasons, even if they are a bit more expensive.	0.25***	0.05	0.0019***	0.0004
I sign environmental or social petitions online.	0.16 ***	0.04	0.0006	0.0004
I keep myself informed about world events via social media.	0.003	0.05	−0.0002	0.0003
I boycott products or companies for political, ethical or environmental reasons.	0.20***	0.04	0.0011**	0.0004
I participate in activities promoting equality between men and women.	0.12**	0.04	0.0007*	0.0003
I participate in activities in favor of environmental protection.	0.17**	0.05	0.0008	0.0004
I regularly read websites on international social issues (e.g. poverty, human rights).	0.16**	0.05	0.0011**	0.0004

*** $p < .001$, ** $p < .01$, * $p < .05$

observed in the first part of the measurement model (Fig. 2), which analyzed the extent to which attitudes and values predict intention (GLOBMIND). The results reveal a significantly positive moderator effect based on the EPI and HDI indices on *perspective-taking* (PERSPECT) and *interest in learning about other cultures* (INTCULT). However, there is also a significantly negative moderator effect for *awareness of intercultural communication* (AWACOM) and *attitudes towards immigrants* (ATTIMM), indicating that countries with higher HDI and EPI indices exhibit lower scores on these scales.

Discussion

Previous international studies such as PISA have shown that there is considerable room for improvement in students' behavior with regard to global competencies. In order to foster global competence behavior, it is imperative to identify factors that influence global competence behavior, which was the main focus of our study. Many studies have focused on attitudes and values, often related to specific actions, such as environmental behavior (Wang et al., 2014; Yazdanpanah & Forouzani, 2015). However, the knowledge aspect has frequently been overlooked despite evidence suggesting that an individual's knowledge can significantly impact their behavior (Sailer et al., 2022; Sharon & Tsabari, 2020). Additionally, research on the determinants of global competence behavior has often been conducted without a coherent theoretical framework, which has been highlighted in the literature (Steeh et al., 2019). We have taken up this criticism with our study and have examined how attitudes, values, and knowledge, conceptualized as scientific literacy, influence students' global competence behaviour within the widely established theory of planned behaviour (Ajzen, 1991). According to the theory of planned

behavior, a specific behavior is preceded by an intention, which is influenced by attitudes toward the behavior, subjective norms, and perceived behavioral control.

In line with this theoretical model, our results across 52 countries show that a positive *attitude towards behavior*, namely, toward global competence topics, is consistently associated with positive behavioral intention. Hence, awareness of global issues, intercultural communication, and interest in learning about other cultures is positively associated with behavioral intention. Previous studies have reported similar findings (Li et al., 2019). As a consequence of such findings, in the future, it would be worthwhile to consider and foster more holistic educational goals internationally, which also encompass attitudes toward socially relevant topics and promote positive attitudes. Several countries, e.g. Germany, have already implemented such approaches. An example is *Education for Sustainable Development* (German Federal Ministry of Education and Research, 2024), which fosters positive attitudes towards global issues such as environmental protection, social justice, and global responsibility. Education for Sustainable Development aims to empower learners to make sustainable and responsible decisions and act accordingly, promoting a comprehensive understanding and a more vital willingness to actively participate in the global community.

The study's results indicate that *social norms* have a varied impact on behavioral intention. Namely, students who believe that immigrants should have the same rights as themselves showed a strong positive influence on behavioral intention. However, the other aspects related to social norms, such as the effect of considering others' perspectives, were minimal and differed across different countries. Additionally, there was a negative effect regarding respect for individuals from different cultures, which is important for successful intercultural relationships and global competence (OECD, 2019). Previous research has shown that intercultural communication is influenced by various complex factors, such as personality traits and language proficiency (e.g., Chen & Gabrenya, 2021). Moreover, these studies often focus on tertiary education, emphasizing the need for further investigation into intercultural relationships among adolescents. Future research could identify the factors that influence intercultural relationships among students and examine them within the students' social environment (e.g. see Fritzsche et al., 2018). This might help clarify the significance of peer groups and parents in understanding the observed minimal effects and their impact on global competent behavior and intention to engage in intercultural relationships.

With regard to perceived behavioral control, students' cognitive flexibility in dealing with challenging or difficult situations, as assigned to perceived behavioral control, presents a heterogeneous picture regarding behavioral intention. However, self-efficacy related to global issues consistently emerges as a significantly positive predictor of behavioral intention internationally. This finding aligns with previous research indicating that individuals who perceive high self-efficacy in a specific domain are likelier to form corresponding behavior (e.g., Tabernero & Hernandez, 2011). The results suggest that individuals who find it easy to engage with global issues are more inclined to develop a behavioral intention. This underscores the importance of self-efficacy in promoting global competence behavior. Therefore, it would be beneficial to focus on enhancing self-efficacy concerning global issues to strengthen students' willingness to actively engage with global challenges and act accordingly.

Furthermore, an international uniformity emerges: positive behavioral intentions predict actual behavior concerning all global competence behaviour items assessed in this study. Moderator analyses related to the *Human-Development-Index* (HDI) and *Environmental index* (EPI) indicate that countries with higher development indices generally exhibit more global competent behavior. Consequently, these findings underscore that promoting behavioral intentions in the future remains worthwhile, as they can lead to actual behavior, consistent with previous research (Armitage & Connor, 2001; Webb et al., 2006).

The study's findings suggest that scientific literacy is generally not a significant predictor of behavioral intention across 52 countries. This finding is noteworthy, considering previous research indicates that knowledge can be crucial in guiding actions (e.g. Kaiser & Fuhrer, 2003; Sailer et al., 2022). Hence, it was expected that students' scientific literacy would positively impact their behavioral intentions. However, the research landscape often presents a heterogeneous picture regarding how much knowledge translates into action. For instance, Geiger et al. (2019) identified similar findings wherein the knowledge component exhibited minimal effects on actual behavior concerning global competence behaviors. Nonetheless, the authors explicitly emphasize that this outcome should not be interpreted to mean that knowledge plays no relevant role; rather, the constituents of knowledge should be more precisely delineated to analyze their potential impacts on behavioral intention.

It is crucial for interpreting the results to consider that scientific literacy, as measured by the PISA assessments, has evolved significantly over the years. PISA's reforms emphasize the application of evidence-based scientific literacy in understanding and addressing real-world problems (Forbes et al., 2020). In contrast, Global Competence was introduced as an innovative domain in PISA 2018 for the first time, so there has been no longitudinal development of its items. Furthermore, Global Competence has often been criticized for being too broad, thus failing to encompass all relevant areas within its construct (Sälzer & Roczen, 2018). Consequently, while there is a theoretical overlap between scientific literacy and Global Competence, this study's model could not empirically demonstrate this overlap. This is because the specific behaviors associated with global competence might not have been adequately defined.

It has been argued (Duschl & Osborne, 2002) that science education should evolve to emphasize the development of scientific thinking rather than merely the acquisition of factual knowledge. This critique aligns with the broader educational goals of fostering skills essential for Global Competence. For instance, behaviors associated with Global Competence require a foundation in scientific thinking—skills that could be cultivated effectively within the science classroom.

However, it remains an open question to what extent this shift towards emphasizing scientific thinking has been successfully implemented across different international education systems. This question is particularly pertinent when considering the non-significant effects of scientific literacy on behavioral intentions observed in our study. The lack of significant findings may suggest that despite the theoretical overlap, scientific literacy, as currently taught, may not sufficiently incorporate the scientific thinking necessary to influence behavioral intentions tied to global competence behavior.

In summary, future research could delve into specific topics of scientific education, such as knowledge regarding the development of climate change, and examine this as a

precursor to specific facets of global competence behavior, such as individuals actively making environmentally responsible decisions (see also Kaiser et al., 2008).

Limitations and outlook.

In the present study, some limitations warrant consideration. Firstly, focusing on students' global competence behavior is central; however, its assessment relied solely on self-report questionnaires. Future investigations could complement these with observational or laboratory-based approaches to mitigate potential biases such as social desirability effects. Additionally, the measurement of global competence behavior was based on a limited set of eight individual items. Future research endeavors could aim to develop comprehensive measurement tools that accurately capture the multidimensional nature of global competence behavior. Furthermore, it is important to note that global competence is a very broad and complex construct that should be elaborated on in the future (Sälzer & Roczen, 2018).

Moreover, it is essential to note that the data utilized in this study were derived from PISA, a cross-sectional survey. While this provides a robust dataset for identifying associations, caution must be exercised when drawing causal inferences. Despite these constraints, the present study offers valuable insights into the role of attitudes, values, and scientific literacy in shaping global competence behavior.

Future investigations could expand their scope to incorporate additional relevant factors influencing attitudes, values, and scientific literacy. Furthermore, including school and social-related variables could enrich our understanding by providing additional context and insight into the determinants of global competence behavior. Another limitation of the present study concerns the operationalization of *global competence behavior* in the PISA 2018 assessment. This construct was measured through self-reported items, which may not fully capture actual behavioral engagement and are potentially subject to biases such as social desirability and self-perception effects. Moreover, some items, such as those referring to following world events via social media, reflect the media landscape at the time of data collection rather than current modes of global engagement. While these items were relevant in 2018 as dominant platforms for accessing global information, they may now limit the generalizability of the findings. Future assessments should therefore consider more behaviorally grounded and context-independent measures to better reflect real-world manifestations of global competence. Furthermore, path coefficients were synthesized separately across countries. This univariate approach does not model within-country dependencies between coefficients and should be interpreted with caution. However, by incorporating all participating countries and contextual indicators such as the Human Development Index (HDI) and the Environmental Performance Index (EPI), our study sheds light on how socio-economic and environmental conditions shape the self-reported global competence behaviors. This cross-national perspective underlines the importance of context-sensitive analyses when interpreting global competence data, what should be integrated into future research.

Conclusion

Understanding why people engage in behaviors related to global competence is complex and multifaceted. This study, covering 52 countries in a large-scale international assessment, aimed to untangle some of the complexities surrounding this issue based on the widely implemented theory of planned behavior. Our findings underscore the

significance of attitudes towards behavior and self-efficacy regarding global issues as influential predictors of behavioral intention, highlighting their pivotal role in shaping individuals' readiness to act. Moreover, we observed that intention to enact a behavior emerges as a robust determinant of actual behavioral implementation. However, it is important to acknowledge the inherent complexity of this issue, and further research is warranted to explore additional factors that may contribute to individuals' actions in the realm of global competence. Nonetheless, our study is crucial in elucidating the mechanisms underlying behavioral engagement in this critical domain.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40536-025-00278-3>.

Supplementary Material 1

Acknowledgements

Not applicable.

Authors' contributions

Tamara Kastorff: Conceptualization, Formal Analysis, Data Curation, Resources, Writing – Original Draft, Writing- Review & Editing, Stephanie Moser: Conceptualization, Investigation, Resources, Writing – Original Draft, Writing- Review & Editing, Jörg Henrik Heine: Conceptualization, Methodology, Formal analysis, Data Curation, Writing – Review & Editing, Alexander Kauertz: Conceptualization, Investigation, Resources, Writing – Original Draft, Writing- Review & Editing.

Funding

The study was conducted without external funding.

Data availability

The study represents a secondary data analysis of the public use PISA 2018 file provided by the OECD. The PISA 2018 international data have been made publicly available by the OECD and can be accessed at: <https://www.oecd.org/pisa/data>.

Declarations

Ethics approval and consent to participate

The data used in this research was obtained from publicly available PISA data, which was provided in an anonymized format. Therefore, individual consent was not required for this study.

Consent for publication

Based on international regulations, individuals participating in the PISA study are informed and agreed upon that data will be used for scientific interest.

Competing interests

The authors have no competing interest in declare.

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Received: 27 June 2024 / Accepted: 10 December 2025

Published online: 12 January 2026

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