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Unveiling Turkish students' global competence: a psychometric network analysis of PISA 2018 data

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ABSTRACT

This study aims to examine the interactions between ten scales representing different aspects of the global competence model among students in Turkey, based on PISA 2018 data. The study analyses data from 6,731 students in Turkey who participated in the global competence survey using the psychometric network approach, which is often used to explore relationships between psycho-behavioral structures. The results show that students' global competence in Turkey involves complex and multidimensional relationships. A strong relationship was found between students' awareness of global issues and their ability to discuss complex global issues, as well as between their interest in learning about other cultures and their respect for people from different cultural backgrounds.

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Introduction

In an increasingly interconnected world, the interdependence between nations, cultures, and societies has become more pronounced than ever before. This growing interconnectedness underscores the complexity and interwoven nature of the major challenges facing modern societies. The rising permeability of national borders, driven by economic, technological, and informational exchanges, necessitates a global approach to addressing both local and international challenges. Pressing issues such as climate change, regional conflicts, terrorism, migration and refugee crises, and public health and financial emergencies demand a reevaluation of educational goals. Educators are now tasked with redefining what students need to learn and identifying the most effective strategies to equip them for the demands of an evolving world (Mansilla and Wilson 2020). Reimers (2009) contends that understanding these global challenges is crucial because of the growing interdependence in trade, communication, and migration. However, he criticises educational institutions worldwide for failing to adequately prepare citizens to grasp the complexities of global issues like terrorism, climate change, human-environment interactions, world trade, demographic shifts, and global conflicts. Our age needs global citizens who understand such global problems, see themselves as responsible for them, and strive to solve the global problems they face (Stein 2021). Training global citizens is only possible through a global education. The importance of global education is increasing day by day in terms of providing students with strong competencies (Reimers 2020). Because the need for global connections is increasing day by day, which leads to new searches for intercultural cooperation (Richter and Kjellgren 2024).

Recent research in citizenship education suggests that an ideal curriculum should encompass not only social and political participation but also universal values (such as human dignity, justice, and

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freedom) and skills (including questioning, digital literacy, and problem-solving). These elements are vital for addressing global problems like large-scale immigration, rising societal divisions, ethical issues in digital spaces, hate speech, xenophobia, and intolerance (Kuş 2023). Citizenship education should examine problems in depth and focus on the reasons behind them (Navarro-Medina et al. 2025). The report by Asia Society/OECD (2018) emphasises the importance of developing individuals who can effectively address global challenges while upholding universal values, providing a rationale for the significance of global competencies and their inclusion in education:

> 'Inexorable economic, cultural, technological, environmental, and political forces are affecting every society on earth and making nations and peoples more interdependent than ever before. Responding effectively to these forces, lessening their damage or harnessing them for good, will require creative multinational solutions to be negotiated and carried out by individuals who can and do participate simultaneously in local, national, and global civic life. Put simply, if individuals and their communities are to thrive in the future, schools must prepare today's students to be globally competent.'

In 2015, the United Nations (UN) established the Sustainable Development Goals (SDGs) to address global challenges in a more systematic way. These goals offer a comprehensive strategy to eradicate poverty, reduce inequalities, and safeguard the planet. Achieving these objectives requires contributions from governments, civil society organisations, the private sector, and individuals alike. Educational institutions are pivotal in realising these goals. Organisations such as the Organization for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) emphasise the importance of global competence (OECD 2016a, 2016b, 2016c) and global citizenship (UNESCO 2014) highlighting the need for education systems to address global challenges. This focus is also reflected in the content of The Programme for International Student Assessment (PISA hereafter). Since 2000, PISA has been administered every three years to 15-year-olds who are nearing the completion of compulsory education. PISA focuses on evaluating students' abilities to apply their knowledge practically rather than merely testing their knowledge. The assessments aim to measure whether students can use their knowledge in real-life contexts, make inferences, and apply their understanding to everyday situations (OECD 2016d). These skills are crucial for the effective functioning of democracy, fostering tolerance, and promoting collaboration. Besides assessing mathematics, science, and reading skills, PISA has introduced innovative fields of assessment since 2012. For instance, it evaluated students' creative problem-solving skills in 2012, collaborative problem-solving skills in 2015, and global competences in 2018. The global competence assessment in PISA aims to provide countries with comparable data to build societies that support more sustainable development through education (OECD 2018). The existing literature indicates that global competence is a complex and multifaceted concept, reflecting various interpretations (Chandir 2022). The OECD define global competence as, 'the capacity to examine local, global and intercultural issues, to understand and appreciate the perspectives and world views of others, to engage in open, appropriate and effective interactions with people from different cultures, and to act for collective well-being and sustainable development' (OECD 2018, 7). Global competence education aims to equip young people with the knowledge and skills necessary to research, form opinions on, and address issues of local and global significance. This includes understanding diverse perspectives, fostering cultural awareness, and collaborating creatively to tackle social, political, economic, and environmental challenges. It also involves leading a lifestyle rooted in peace, non-violence, sustainable development, and respect for human rights (OECD 2018). Global competence is not just about possessing knowledge and skills; it is also about applying them actively in different societies and contributing to a sustainable future. According to the Asia Society/OECD (2018) there are four main reasons for integrating global competence into education. First, as global employment opportunities increase, equipping individuals with the skills to compete in the global market is crucial for maintaining economic success. Second, effective communication and collaboration in multicultural communities foster social cohesion and peace. Third, developing the ability to navigate and analyze information in both traditional and digital media ensures responsible digital citizenship. Finally, global competence is

essential for achieving the United Nations Sustainable Development Goals, as it empowers individuals to contribute to a more sustainable and equitable world. Tichnor- Wagner and Manise (2019) identify three key areas that a student should develop to be prepared for global education: cognitive characteristics, social-emotional characteristics, and behaviours. Cognitive traits include critical thinking, problem-solving, and understanding global conditions, events, cultures, and interconnectedness. Social-emotional characteristics encompass empathy, valuing diverse perspectives, awareness of one's own identity and culture, openness, and adaptability. Behaviours involve cooperation, intercultural communication, and proactive engagement with local and global issues. Students who are ready for global education approach events from a broader perspective and give importance to cooperation (Navarro-Medina et al. 2025). Global education offers a humanistic perspective to students from different geographies and cultures by providing them with values such as empathy, respect for differences and diversity (Gibson, Rimmington, and Landwehr-Brown 2008).

Turkey context

In the Turkish context, while literature on global citizenship, democratic citizenship, and global education has developed over the past two decades (Açıkalın 2010a, 2010b; Bozkurt 2013; Öztürk and Günel 2016; Tünkler 2020) the concept of 'global competence' remains under-theorized. Despite this, there is a broad consensus in Turkey that a comprehensive understanding of global issues is essential for enhancing economic competitiveness, fostering leadership in innovation and creativity, and advancing social justice and democratic values. As a result, policies and initiatives in this domain have gained increasing importance. Reflecting global trends, Turkey seems to have embraced the concept of global competence by incorporating elements from various global education frameworks, including intercultural education and democratic citizenship education (Council of Europe 2016; UNESCO 2014). There are different approaches to global competence. Neoliberal approaches view education as an investment, emphasising individual success and promoting global competencies for enhanced global competitiveness and employment. Global consciousness approaches consider global education a moral imperative, focusing on collective goals like social justice and peace. Advocacy approaches prioritise active citizenship to address social injustices, poverty, or environmental issues. Critical approaches, on the other hand, argue that mainstream views risk perpetuating existing economic, social, and political inequalities without challenging underlying assumptions (Conolly, Lehtomäki, and Scheunpflug 2019). Like many Asian countries, Turkey leans towards a neoliberal approach that emphasises work-related skills, reflecting a focus on global competitiveness. Recent education reforms and policies aimed at international competitiveness illustrate the impact of this approach. Conversely, European and Canadian frameworks have traditionally adopted a global consciousness approach in response to migration challenges, emphasising inclusive citizenship and promoting social cohesion and acceptance of minorities (Conolly, Lehtomäki, and Scheunpflug 2019). Given the recent demographic changes in Turkey due to increased migration, a more inclusive citizenship model is needed. According to the Directorate of Migration Management (GİB), the number of foreigners in Turkey has surpassed 5 million (GİB 2024) with opposition parties claiming the figure exceeds 10 million. This situation has significantly impacted the social fabric of the country and reinforced the dynamics of multiculturalism.

Until the early 2000s, globalisation and global citizenship did not feature prominently in Turkish educational objectives, due to concerns about the erosion of national culture and values. However, social and political changes have strongly influenced the meaning and role of 'responsible citizenship', leading to a remarkable transformation in citizenship education. As elsewhere in the world, Turkey has increasingly worked to integrate global competence into school curricula. Initially, the education system aimed to produce obedient individuals loyal to the national state. Over time, the focus has shifted to political and social participation through citizenship education, which is seen as a solution to societal problems (Kuş 2023). Many countries have implemented global citizenship

programmes to prepare students for global realities. In Turkey, democratic citizenship education now emphasises peace and human rights, while striving to balance national identity with global understanding. Over the past two decades, social studies and citizenship education curriculums in Turkey have increasingly addressed global issues, especially environmental ones. The 2005 reform emphasised universal values, skills and global issues, aiming to balance local, regional, national and universal perspectives. This period emphasised the development of global thinking skills and awareness of global changes. More recently, the addition of a 'global connections learning area' to the social studies curriculum in 2018 encouraged students to engage more with different countries, cultures and global issues (Kuş 2022). These changes indicate a growing presence of global perspectives in the Turkish education system.

The current study

PISA identifies the characteristics of education systems in high-performing countries and provides a framework for other countries to shape their education policies (OECD, 2016a). It provides a transformative opportunity for policymakers to reflect on and adjust their education strategies (Lingard and Sellar 2016). A key concern for policymakers is to ensure that young people make full use of their skills and apply their knowledge effectively. Despite numerous criticisms, international assessments such as PISA are among the few tools that allow countries to evaluate their education policies from an external perspective (Lingard and Sellar 2016). These assessments have a direct impact on the education systems of participating countries, motivating changes in curricula and technological infrastructure. For example, Germany's 21st place ranking out of 32 countries in 2001 led to extensive discussions among education stakeholders and resulted in educational reforms (Faas 2013).

In Turkey, PISA results play a crucial role in reviewing education policies, emphasising teacher training, improving resource allocation, enhancing measurement and evaluation systems, and aligning with international standards. These factors are helping to make Turkey's education system more competitive and innovative. The frequent comparison of Turkey's PISA results with those of other countries in public discourse underlines their importance. The discussion of PISA results by journalists, educators and politicians is often used to justify changes in education policy (Gür, Çelik, and Özoğlu 2012, 2). However, studies focusing on PISA in Turkey have mainly examined differences in achievement scores between countries (Aydın, Selvitopu, and Kaya 2018; Coşkun 2020; Çalcalı 2019; Eraslan 2009; Ertürk 2020; Kahraman 2016; Yıldız-Durak and Seferoğlu 2016) leaving limited evidence on students' global competence models. This study, based on PISA 2018 data, aims to uncover the complex interactions among ten scales representing different aspects of students' global competence in Turkey through network analysis. The study will analyse in detail the relationships among the factors that determine students' global competence and explore how these factors interact with each other. Network analysis will visualise the links and relationships between variables and help to identify which factors are more central or interconnected.

Method

Contexts and participants

Contexts and participants PISA 2018 introduced the assessment of students' global competence as a new dimension alongside science and mathematics literacy, with a focus on reading. To achieve this, questionnaires were administered to students, families, teachers and principals to capture the affective characteristics of stakeholders related to global competence. The assessment of global competence uses two instruments: 1) a cognitive test that focuses on knowledge and cognitive skills, and 2) a set of survey items that collect self-reported data from students, parents, teachers and school leaders (OECD 2018). Countries participating in PISA have varying levels of participation

in the assessment of global competence. While 22 EU countries participated in the student survey, only 7 EU countries completed both the cognitive test and the student survey. Turkey participated only in the global competence survey, which collected self-reported information from students. Of the 6,890 students from Turkey who participated, 155 did not respond to the global competence scales and were excluded from the data set. Thus, the final study group consisted of 6,735 students (49.9% female, 50.1% male). According to the Immigration Background Index (IMMIG) defined by PISA – based on the countries of birth of students and their parents – 97.3% of the students (n = 6,552) were classified as native (i.e. at least one parent was born in Turkey), 0.5% (n = 36) as second-generation immigrants (students born in Turkey to parents born abroad), and 0.2% (n = 16) as first-generation immigrants (both students and their parents born outside of Turkey). For 1.9% of the students (n = 131), immigration background data were not reported. In terms of the language spoken at home, 92.7% of the students (n = 6,243) reported speaking the same language as the test language, whereas 7.2% (n = 486) reported speaking a different language at home. Students were also asked whether they interacted with individuals from different countries within their social circles. Of the participants, 49.4% (n = 3,327) reported such interactions, while 47.3% (n = 3,187) stated that they did not. This information was missing for 3.3% of the students (n = 221).

Instruments

The PISA 2018 survey assessed students' global competence using ten scales, each addressing different aspects of this competency. The datasets for these scales are publicly accessible and were downloaded from https://www.oecd.org/pisa/data/. The scales, as reported in the student questionnaire, are detailed below:

1. *Self-efficacy Regarding Global Issues (GCSELFEFF)*

This scale includes six items measuring students' confidence in explaining or discussing complex global issues. Response categories are: 'I couldn't do this', 'I would struggle to do this on my own', 'I could do this with a bit of effort', and 'I could do this easily'. An example item is: 'Explaining how carbon dioxide emissions affect global climate change'.

2. *Awareness of Global Issues (GCAWARE)*

Consisting of seven items, this scale evaluates students' awareness of global issues. Response categories are: 'I have never heard of this', 'I have heard about this but I would not be able to explain what it is really about', 'I know something about this and could explain the general issue', and 'I am familiar with this and would be able to explain this well'. An example item is: 'Climate change and global warming'.

3. *Attitude Towards Immigrants (ATTIMM)*

Developed by the International Civic and Citizenship Education Study (ICCS) and used by PISA, this scale measures students' attitudes towards equal rights for immigrants. It includes four items with responses: 'Strongly disagree,' 'Disagree,' 'Agree,' and 'Strongly agree'. An example item is: 'Migrant children should have the same opportunities for education that other children in the country have.'

4. *Interest in Learning About Other Cultures (INTCULT)*

This scale contains four items that assess students' interest in learning about other cultures. Response categories are: 'Very much like me', 'Mostly like me', 'Somewhat like me', 'Not much

like me', and 'Not at all like me'. An example item is: ' I want to learn how people live in different countries'.

5. *Perspective Taking (PERSPECT)*

Comprising five items, this scale measures how well students consider, are interested in, or adopt other people's viewpoints. Responses are scored on a five-point scale: '"Very much like me", "Mostly like me", "Somewhat like me", "Not much like me", and "Not at all like me". An example item is: "I try to look at everybody's side of a disagreement before I make a decision"'.

6. *Cognitive Flexibility/Adaptability (COGFLEX)*

This scale assesses students' ability to adapt to challenging or unfamiliar situations in intercultural interactions, with six items. Response categories are: 'Very much like me', 'Mostly like me', 'Somewhat like me', 'Not much like me', and 'Not at all like me'. An example item is: 'I can deal with unusual situations'.

7. *Respect for People from Other Cultures (RESPECT)*

Evaluating students' perception of the innate value and respect for people from other cultures, this five-item Likert scale includes responses: 'Very much like me', 'Mostly like me', 'Somewhat like me', 'Not much like me', and 'Not at all like me'. An example item is: 'I respect people from other cultures as equal human beings'.

8. *Awareness of Intercultural Communication (AWACOM)*

This scale assesses students' ability to observe, manage, and communicate effectively in intercultural settings. It consists of seven items with four-point Likert responses: 'Strongly disagree,' 'Disagree,' 'Agree,' and 'Strongly agree.' An example item is: 'I carefully observe their reactions'.

9. *Global Mindedness (GLOBMIND)*

Measuring students' sense of global citizenship and responsibility, this four-point Likert scale has six items. Responses are: 'Strongly disagree,' 'Disagree,' 'Agree,' and 'Strongly agree.' An example item is: 'I think of myself as a citizen of the World'.

10. *Discriminatory School Climate (DISCRIM)*

This scale assesses whether students perceive that teachers treat students from other cultures with equal respect and any perceived prejudices. It consists of four items with responses: 'To none or almost none of them', 'To some of them', 'To most of them', and 'To all or almost all of them'. An example item is: 'They have misconceptions about the history of some cultural groups'.

Table 1 shows the correlations between scales. The scales complement each other and represent a consistent structure, and students' attitudes and skills related to global competence are interconnected.

When examining the descriptive statistics and model fit indices for the scales used in the study (see Table 2) it was observed that the scales provided a good fit to the data.

Table 1. Correlations between scales.

Scales	GCAWARE	ATTIMM	INTCULT	COGFLEX	RESPECT	AWACOM	GLOBMIND	PERSPECT	DISCRIM
GCSELFEFF	.486**	.116**	.209**	.224**	.186**	.309**	.224**	.152**	-.006
GCAWARE		.192**	.279**	.253**	.253**	.330**	.281**	.174**	-.008
ATTIMM			.163**	.174**	.258**	.249**	.382**	.204**	.009
INTCULT				.309**	.490**	.294**	.234**	.326**	-.063**
COGFLEX					.348**	.243**	.244**	.408**	.028*
RESPECT						.316**	.246**	.391**	-.136**
AWACOM							.360**	.265**	-.085**
GLOBMIND								.217**	.024
PERSPECT									-.073**

Table 2. Mean, cronbach alpha and CFA fit indices of the scales.

	α	Mean	CFI	TLI	SRMR	RMSEA
GCSELFEFF	0.857	2.80	0.996	0.993	0.031	0.039
GCAWARE	0.867	3.05	0.992	0.988	0.041	0.030
ATTIMM	0.831	2.77	0.999	0.996	0.017	0.029
INTCULT	0.861	1.78	0.999	0.998	0.014	0.027
PERSPECT	0.791	2.16	0.985	0.971	0.045	0.086
COGFLEX	0.828	2.17	0.987	0.979	0.047	0.067
RESPECT	0.919	1.66	0.997	0.993	0.034	0.043
AWACOM	0.922	3.05	0.999	0.998	0.025	0.017
GLOBMIND	0.858	2.93	0.996	0.993	0.029	0.030
DISCRIM	0.866	1.91	0.998	0.995	0.022	0.032

Data analysis

The analyses of the study used the psychometric network approach, which has gained popularity in recent years, particularly for uncovering and explaining relationships between psychological constructs. As an alternative to traditional psychometric methods, network analysis can be defined as a statistical technique that facilitates the exploration and understanding of psychobehavioural processes (Epskamp, Borsboom, and Fried 2018). This technique, also referred to in the literature as psychometric network analysis, conceptualises psychological processes as behaviours that emerge from dynamic systems in which psychological, sociological, or biological components directly influence each other (Borsboom et al. 2011; Cramer et al. 2010; Van der Maas et al. 2006). Psychometric networks provide an alternative modelling framework to latent variable modelling. Whereas traditional psychometric approaches model observed variables as causes of latent constructs, psychometric networks are based on the premise that observed variables causally influence each other (Schmittmann et al. 2013). A network is an abstract model consisting of nodes and edges, with the observed variables representing the nodes and the relationships between them representing the edges (Börner, Sanyal, and Vespignani 2007). In this context, the nodes represent different psychological variables, while the edges represent the estimated statistical relationships between these nodes. A node can be a scale, a subscale or a single item. The edges provide information about both the strength and direction of the relationships between nodes. An edge reflects the correlation between two variables after accounting for the influence of other variables in the network (Epskamp, Borsboom, and Fried 2018). Positive relationships between nodes are indicated by blue or green edges, while negative relationships are indicated by red edges. In addition, the thickness of the edges increases with the strength of the relationship.

In this study, the scores from each scale were represented as nodes within the network. The relationships between these nodes were estimated using the graphical least absolute shrinkage and selection operator (GLASSO) through the Gaussian Graphical Model (Friedman, Hastie, and Tibshirani 2008, 2019). This algorithm helped identify and exclude spurious networks where nodes might appear statistically connected without a true underlying relationship. Accuracy

analyses were conducted to assess how sampling variation affected the network structure and centrality indices (Epskamp, Borsboom, and Fried 2018). Permutation-based comparison tests were used to examine whether the network structure related to global competence differed by student gender, implemented through the Network Comparison Test (Van Borkulo et al. 2021) package in R.

Centrality indices provide information about the critical importance of nodes within the network structure. These indices are used to model or predict various network processes, such as the amount of flow through a node or the tolerance of removing a particular node from the network (Borgatti 2005; Crucitti et al. 2004; Jeong et al. 2001; Valente 2012). One of the fundamental centrality indices is the strength index, which is the sum of the weights of the nodes directly connected to a node (Barrat et al. 2004; Newman 2010). This index reflects how strongly a node is connected to other nodes, with a higher strength index indicating that a node can directly influence other nodes in the network. Closeness centrality is defined as the inverse of the total distance from a focal node to all other nodes in the network (Freeman 1978; Sabidussi 1966). In terms of network flow, closeness can be interpreted as the expected rate at which something flowing through the network reaches its destination (Borgatti 2005). A node with high closeness centrality is likely to be quickly affected by changes in other nodes' attributes, either directly or indirectly. Betweenness centrality is calculated based on the number of times a node is used as the shortest path between any two other nodes. A high betweenness centrality indicates that the removal of such a node would increase the distances between other nodes in the network, highlighting its importance in maintaining the network's structure.

The study also analyzed invariance and global strength invariance of network structures across different groups using comparison tests to assess whether network densities were consistent across groups. Significance tests between nodes and edges forming the network were conducted and visualised. Additionally, before analyses, model fit indices of the scales were assessed using the *lavaan* (Rosseel 2012) package in R (R Core Team 2023) with the unweighted least squares method employed to determine these indices (Li 2016).

Limitation of study

While this study provides valuable insights into the relationships between factors influencing students' global competence in Turkey, it is important to recognise its limitations and suggest areas for future research. The OECD's PISA 2018 assessment of global competence includes two main instruments: a cognitive test and a student self-report survey. However, only seven EU countries participated in the cognitive test, so this study relied exclusively on self-reported data from Turkish students. The data used were from students who completed the Global Competence Questionnaire, which consists of ten different scales. This limitation affects the generalizability of the study's findings and limits the analysis to data from Turkey alone. Future research could benefit from more comprehensive and comparative analyses with a larger sample size and the inclusion of cognitive test scores. Such an approach could provide a more thorough assessment of students' global competence and facilitate comparisons across countries.

Findings

Network analysis

To illustrate the global competence network structure, Figure 1 presents a psychometric network where the following constructs are represented as nodes: self-efficacy in global issues, awareness of global problems, attitude towards immigrants, interest in learning about other cultures, perspective taking, cognitive flexibility, respect for people from other cultures, intercultural communication awareness, global mindedness, and discriminatory school climate.

Analysis of Figure 1 reveals a strong relationship between several constructs in the global competence network. Specifically, there is a robust connection between self-efficacy in global issues and awareness of global problems; interest in learning about other cultures and respect for others; cognitive flexibility and perspective taking; and global competence and attitude towards immigrants. On the other hand, negative relationships are evident, such as the impact of discriminatory school climate on students' respect for people from other cultures and a negative correlation between perspective taking and awareness of intercultural communication. The most critical edge in the global competence network is the connection between respect and interest in learning about other cultures. This edge is the most frequently traversed in linking other nodes in the shortest path. This finding underscores that the relationship between respect and interest in other cultures is the strongest in the network, indicating a significant shared variance between these two variables. Following this, global mindedness and attitude towards immigrants also show a notable connection. Conversely, the nodes with the weakest interconnections are discriminatory school climate and self-efficacy and awareness of global issues. This suggests that students' awareness and self-efficacy regarding global issues are relatively independent of the discriminatory school climate.

Figure 2 displays the centrality indices of the global competence network structure. According to the strength index, the node representing respect for people from other cultures emerged as the most influential, with the highest number of direct connections to other nodes. Global mindedness, awareness of global problems, and intercultural communication awareness also demonstrated strong direct connections with other nodes. This highlights respect as the most critical node in terms of its direct relationships within the global competence network. The closeness index indicates that respect for people from other cultures has the most extensive indirect connections with other nodes in the network. Following this, intercultural communication awareness also showed significant indirect connections. The strenght and closeness indices identified discriminatory school climate as the least important node in terms of direct influence and indirect connectivity with other nodes. The betweenness index, which represents the average shortest path between other nodes (Hevey 2018) further confirms that respect is the most crucial node for providing the shortest connections within the network. In contrast, self-efficacy in global issues and discriminatory school climate were found to have lower critical importance in connecting with other nodes.

Overall, the analysis reveals that 'respect for people from other cultures' has a strong influence on other variables in the global competence network, affecting them both directly and indirectly. Discriminatory school climate, on the other hand, showed the weakest direct relationship with other nodes. Changes in the network are likely to impact respect for people from other cultures, which, in turn, will affect other nodes either directly or indirectly.

Accuracy analyses

Since the estimated global competence network is based on a sample, it is important to assess both strength of the relationships between nodes, as well as the accuracy and stability of the sample-based estimates of the population parameters. To address this, accuracy tests were conducted to evaluate how sampling variation influences the global competence network.

The accuracy of the edge weights was assessed by calculating confidence intervals (e.g. 95% CI). In the study, 1000 bootstraps were performed, and the results are illustrated in Figures 2 and 3. The red line represents the edge values estimated from the sample used in the study, while the grey bars surrounding the red line indicate the width of the confidence intervals (bootstrapped CIs) for different sample sizes. The results show that the estimated values (red line) fall within the 95% confidence intervals, suggesting that the predictions are accurate and reliable.

The slope of the lines in Figure 4 illustrates the change in average correlation as sample size decreases. Smaller changes in correlation with decreasing sample size indicate greater stability in the centrality indices. In the accuracy analysis of the centrality indices, the CS coefficient was calculated for each index. A CS coefficient value of 0.5 or higher is considered to indicate sufficient stability.

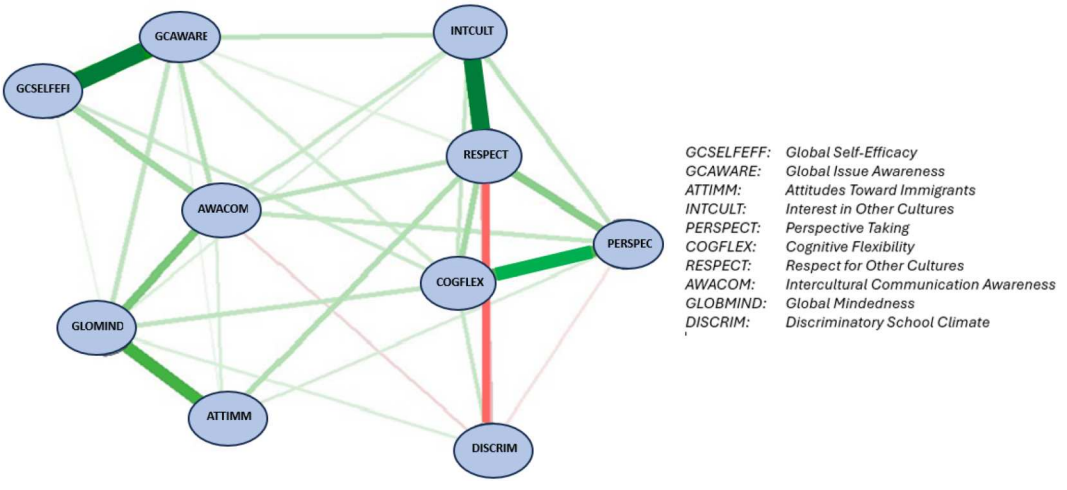

Figure 1. Network representation of the relationships between global competence.

In the study, CS coefficients were 0.517 for betweenness, 0.75 for closeness, and 0.75 for strength, suggesting that the stability of the betweenness, closeness, and strength centrality indices is reliable. Figures 5 and 6 display the nodes and edges in the global competence network that exhibit significant differences. Greater differences between nodes and edges imply that the network captures diverse aspects, suggesting that the global competence network effectively addresses various points of interest.

In Figure 5, the grey boxes represent edges and nodes that are not significantly different from each other, while the black boxes indicate nodes and edges that are significantly different. The figure shows that there are numerous edges and nodes in the global competence network with significant differences, highlighting the complexity and variability within the network.

Separate analyses were conducted to map global competence for male and female students and explore any differences, with the results presented below. The analysis of the network structures revealed that the 'distinctive school principle' was more strongly related to other variables in the global competence network for boys than for girls. Furthermore, negative relationships between attitudes and interest, as well as between perspective taking and awareness of global issues, were weaker in female students.

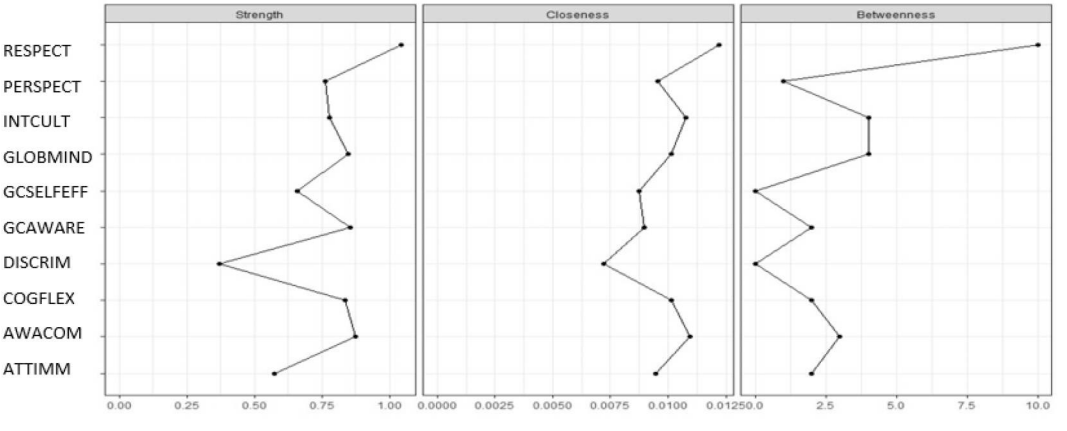

Figure 2. Standardised centrality indices.

When examining the invariance of global competence networks by gender, it was found that the overall network structure was consistent ($p = 0.3$) but global strength invariance was not achieved ($p = 0.00$). This suggests that, while the network structures for male and female students are similar, the strength of specific connections between nodes varies.

An analysis of the centrality indices for both groups showed that, overall, the indices were aligned. However, the strength of connections in the global competence network of male students was higher, and the betweenness indices exhibited more variation compared to other indices (Figure 7).

For instance, in the global competence network of boys, the node representing awareness of global issues plays a mediating role, along with respect for people from other cultures. In contrast, in the global competence network of girls, respect stands out as the most important variable. Additionally, for boys, the edges between self-efficacy in global issues and awareness of global issues, attitudes towards migrants and global mindedness, as well as interest in learning about other cultures and respect, were the most frequently traversed paths to connect the nodes. On the other hand, for girls, the edges between respect and discriminatory school climate, attitudes towards migrants and global mindedness, and perspective taking and cognitive flexibility were more critical.

Results and discussion

In this study, we use PISA 2018 data to explore the complex interactions between ten scales representing different dimensions of global competence among students in Turkey. The accuracy analysis of the estimated global competence network indicates that the predicted values derived from the sample provide reliable predictions. Similarly, the stability of the centrality indices within the model is confirmed to be robust. Furthermore, the significant differences between some edges and nodes within the network indicate the high stability of the network (Conolly, Lehtomäki, and Scheunpflug 2019).

Psychometric network analysis proves to be an effective tool for uncovering the intricate relationships between variables. The first key finding from this analysis is the strong connection between students' awareness of global issues and their ability to discuss complex global problems. Their understanding of global issues enables them to be more sensitive to these challenges and

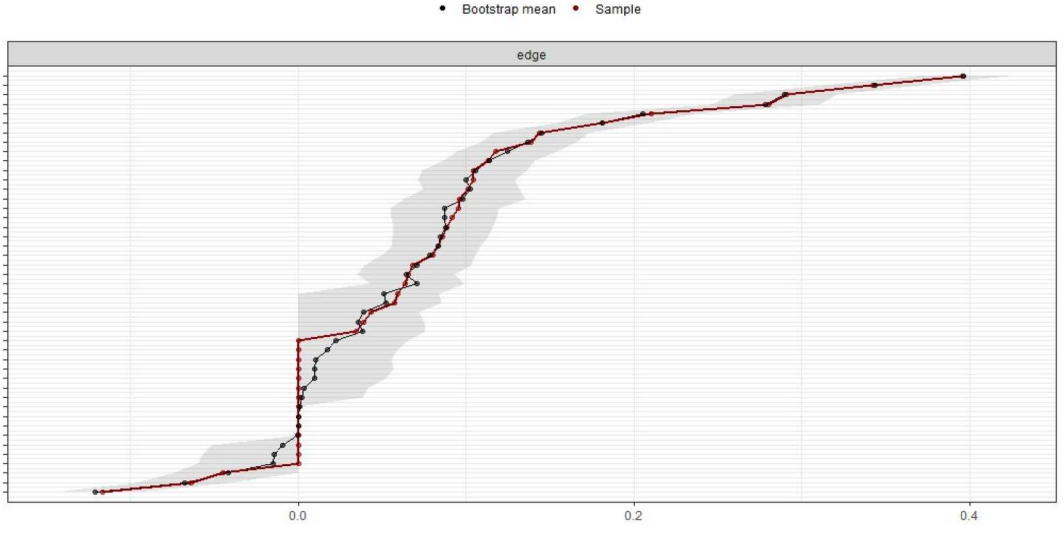

Figure 3. Results of the accuracy of edge weights.

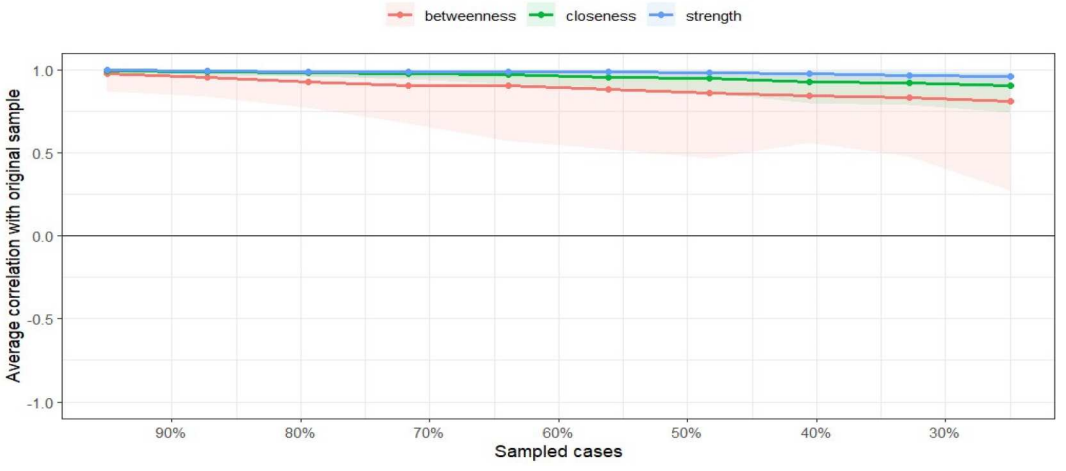

Figure 4. Case-dropping bootstrap test of strength centrality.

address them more effectively. Research also supports this conclusion of the study. Young people's awareness of global problems improves their understanding of these problems, their ability to discuss them from multiple perspectives, and their ability to explain issues (Divéki and Harangozó 2024; Kulturel-Konak, Konak, and D'Allegro 2017; Mthombeni et al. 2024). Schools play a pivotal role in cultivating global competence in young people by offering opportunities to critically engage with global developments, both globally and locally (Mansilla and Jackson 2012; OECD 2018; Schleicher 2019; UNESCO 2014). Enhancing students' global awareness empowers them to contribute to solutions for global problems at both individual and societal levels. However, for schools to promote globally-focused programmes, educators must be equipped and motivated to teach global competence. Research in Turkey and elsewhere indicates that many educators favour national education models and may lack the readiness or willingness to incorporate global competence into their teaching (Carter 2020; Rapoport 2010). In Turkey, the emphasis on global competence within teacher education programmes remains limited.

Another notable finding is the strong link between students' interest in learning about other cultures and their respect for people from these cultures. A curiosity about other cultures often leads to

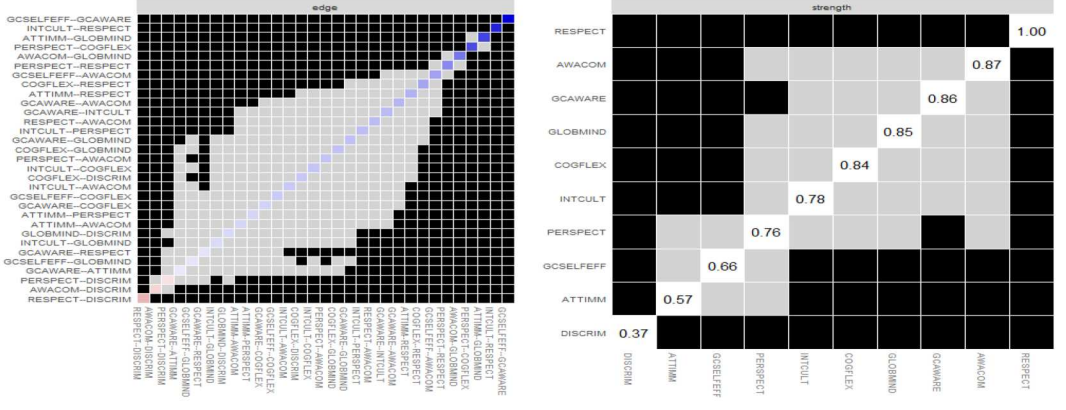

Figure 5. Differences in centrality of nodes.

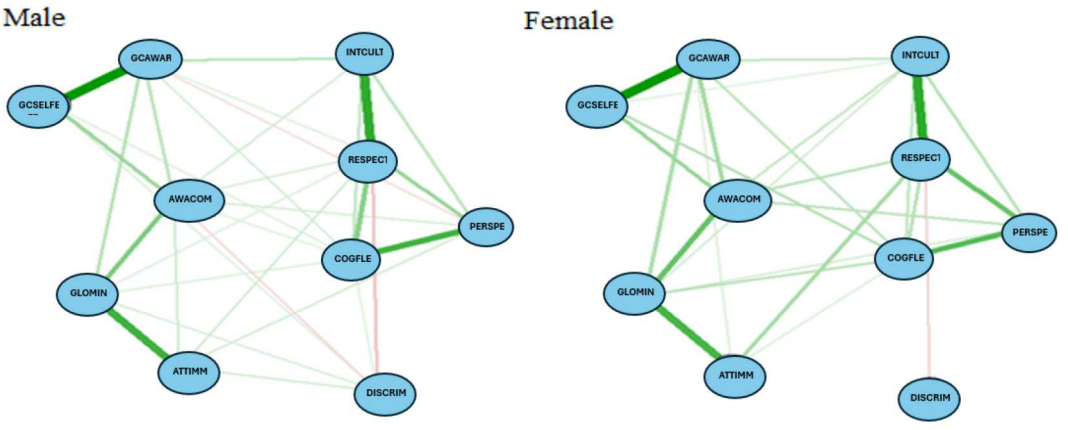

Figure 6. Networks representation of the relationship between global competence dimensions for the (a) Female and (b) Male Students.

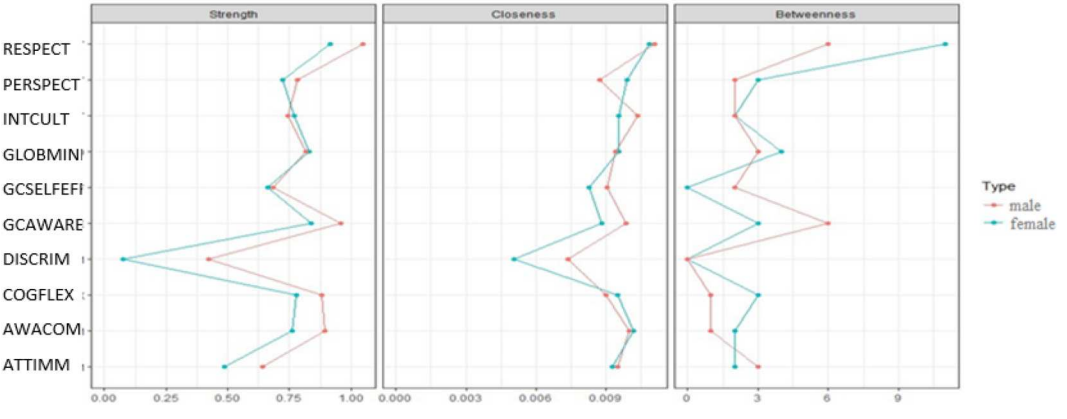

Figure 7. Standardised centrality indices for the (a) Female and (b) Male Students.

a more understanding and respectful attitude toward those from different cultural backgrounds. Schools can foster intercultural sensitivity by exposing students to experiences that encourage them to appreciate cultural diversity (Lyu 2023; Sinicrope, Norris, and Watanabe 2007; Weda, Rahman, and Sakti 2022). Such understanding supports students in broadening their perspectives and promotes social cohesion. By fostering an ability to relate to diverse perspectives, students are less likely to tolerate injustice. Individuals who understand and value cultural differences are typically more resistant to prejudice, while those unable to internalise these values may harbour discriminatory attitudes (OECD 2018).

The analysis also highlights the strong relationship between cognitive flexibility and perspective taking. Cognitive flexibility helps students to cope with difficult or challenging intercultural interactions, while perspective-taking allows them to consider and adopt other points of view. This link suggests that students who develop empathy, tolerance and the ability to engage with diversity are more likely to value the perspectives of others. Increasing cognitive flexibility in education thus supports the development of more cooperative and globally minded individuals. In addition, a strong relationship has been observed between students' global awareness and their attitudes towards migrants. A student's ability to think globally and embrace global citizenship often shapes their attitudes towards migrant communities. Those with a sense of global responsibility are more likely to

respect the rights of migrants and support their living conditions. Therefore, integrating global perspectives and cultural diversity into the education system can foster more inclusive and empathetic students. Empathy improves intercultural relations and enables effective communication with people from different cultures (Kaya Meral, Altan Sarıkaya, and Cengizli 2025; Zhang and Noels 2024).

One of the key findings of this study is the negative relationship between a discriminatory school climate and students' respect for people from other cultures, their ability to consider different perspectives, and their awareness of intercultural communication. This suggests that discrimination and prejudice within schools have a detrimental effect on students' cultural understanding and social relationships. By taking steps to eliminate discrimination and promote inclusivity, educational institutions can help deepen students' cultural awareness and foster the development of more empathetic and culturally aware individuals. Preventing discrimination in the school environment positively affects not only social relations but also learning. A unifying school climate environment can be created by preparing programmes to prevent discrimination in schools and training teachers on this issue (Dessel 2010; Steketee et al. 2021). The 2030 Agenda for Sustainable Development underscores the pivotal role of education in meeting sustainability goals. It calls on all nations to provide education that includes sustainable development, human rights, gender equality, peace and non-violence, global citizenship, and recognition of the contribution of cultural diversity to sustainable development (UNESCO 2014). Through education on these subjects, students can enhance their global awareness and adopt more empathetic and inclusive attitudes toward migrants. Therefore, incorporating global perspectives and cultural diversity into the education system can significantly contribute to developing the understanding and competencies necessary for a sustainable world.

This research highlights that the most critical link in the global competence network is the relationship between respect for people from other cultures and interest in learning about other cultures. The strong association and shared variance between these two variables is particularly important. In addition, based on the centrality indices of the global competence network, the variable 'respect for people from other cultures' significantly influences other constructs, both directly and indirectly. This underlines the essential role of respect for cultural diversity in cultivating students' global competence and the need to focus on these values within the educational system. The weakest links in the network were found between discriminatory school climate and self-efficacy, and between discriminatory school climate and awareness of global issues. This suggests that students' self-efficacy and awareness of global issues are somewhat independent of discriminatory school climate. The strength and closeness indices further confirm that discriminatory school climate is the least significant node in the network, with the weakest relationships to other nodes.

When examining the affective construct of global competence by gender, it was found that while the overall network structures were similar, the relationships between variables differed for male and female students. For instance, while respect for people from other cultures was the most important variable for girls, boys exhibited strong relationships between respect and awareness of global issues. The PISA 2018 report also shows that female students generally reported greater respect for people from other cultures than their male counterparts (OECD 2020). The results of a study conducted with university students similarly showed that female students were more respectful of cultural differences than male students (Zhang 2024).

Respect can be shaped by cultural factors, as what constitutes respectful behaviour varies across societies (Haydon 2006). For boys, relationships between self-efficacy in global issues, awareness of global issues, attitudes toward immigrants, global mindedness, and respect for other cultures were especially significant in the network. In contrast, for girls, the edges linking respect and discriminatory school climate, attitudes toward immigrants and global mindedness, and perspective-taking and cognitive flexibility were more critical.

Although some studies find no gender differences in students' awareness of global issues such as environmental pollution (Olufemi, Mji, and Mukhola 2016; Shobeiri, Omidvar, and Prahallada 2007) others suggest that female students tend to be more responsible (Huang and Yore 2003), female students are more interested in issues such as climate change (Bush and Clayton 2023). While male students are more affected by public misinformation about migrants, female students do not take misinformation into consideration (Kobayashi and Tanaka 2024). Given the complex and uncertain global challenges we face today – such as pandemics, climate crises and rising nationalism – it is increasingly important to develop students' global awareness and foster positive attitudes towards diverse cultures (Gardinier 2021). Schools can equip students with critical global literacy skills that enable them to approach global issues from a broader perspective (Yoon et al. 2018). They can use various methods and techniques to present a critical view of global issues and develop students' global awareness.

Conclusions and implications

This research, which examines the global competence of students in Turkey through network analysis, reveals the multiple and complex relationships within global competence skills. It makes a significant contribution to the scientific understanding of the intricate relationships between personal, social and contextual factors. The findings highlight a strong relationship between students' awareness of global issues and their ability to discuss complex global issues, as well as between interest in learning about other cultures and respect for people from different cultures. In terms of education policy in Turkey, the study emphasises the importance of schools supporting global education programmes, enhancing teachers' capacity to teach global competences, providing students with intercultural experiences, and supporting efforts to combat discrimination while creating an inclusive school climate. Comprehensive training programmes should be developed to increase teachers' capacity to teach and model global competence, which will raise teachers' awareness of global issues and enable them to address these issues more effectively in the classroom. Students should be provided with a variety of intercultural experiences and activities to help them learn about and develop respect for other cultures. This will equip students with global perspectives and help them to internalise values such as empathy and tolerance. In addition, educational institutions need to step up their efforts to combat discrimination and create an inclusive school environment. These steps will deepen students' cultural understanding and contribute to their development as more empathetic individuals. By enhancing students' global competence and cultural awareness, they will grow into more empathetic and cooperative individuals.

Disclosure statement

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